Über dieses Buch

Dies ist ein digitales Exemplar eines Buches, das seit Generationen in den Regalen der Bibliotheken aufbewahrt wurde, bevor es von Google im Rahmen eines Projekts, mit dem die Bücher dieser Welt online verfügbar gemacht werden sollen, sorgfältig gescannt wurde.

Das Buch hat das Urheberrecht überdauert und kann nun öffentlich zugänglich gemacht werden. Ein öffentlich zugängliches Buch ist ein Buch, das niemals Urheberrechten unterlag oder bei dem die Schutzfrist des Urheberrechts abgelaufen ist. Ob ein Buch öffentlich zugänglich ist, kann von Land zu Land unterschiedlich sein. Öffentlich zugängliche Bücher sind unser Tor zur Vergangenheit und stellen ein geschichtliches, kulturelles und wissenschaftliches Vermögen dar, das häufig nur schwierig zu entdecken ist.

Gebrauchsspuren, Anmerkungen und andere Randbemerkungen, die im Originalband enthalten sind, finden sich auch in dieser Datei – eine Erinnerung an die lange Reise, die das Buch vom Verleger zu einer Bibliothek und weiter zu Ihnen hinter sich gebracht hat.

Nutzungsrichtlinien

Google ist stolz, mit Bibliotheken in partnerschaftlicher Zusammenarbeit öffentlich zugängliches Material zu digitalisieren und einer breiten Masse zugänglich zu machen. Öffentlich zugängliche Bücher gehören der Öffentlichkeit, und wir sind nur ihre Hüter. Nichtsdestotrotz ist diese Arbeit kostspielig. Um diese Ressource weiterhin zur Verfügung stellen zu können, haben wir Schritte unternommen, um den Missbrauch durch kommerzielle Parteien zu verhindern. Dazu gehören technische Einschränkungen für automatisierte Abfragen.

Wir bitten Sie um Einhaltung folgender Richtlinien:

+ *Nutzung der Dateien zu nichtkommerziellen Zwecken* Wir haben Google Buchsuche für Endanwender konzipiert und möchten, dass Sie diese Dateien nur für persönliche, nichtkommerzielle Zwecke verwenden.

+ *Keine automatisierten Abfragen* Senden Sie keine automatisierten Abfragen irgendwelcher Art an das Google-System. Wenn Sie Recherchen über maschinelle Übersetzung, optische Zeichenerkennung oder andere Bereiche durchführen, in denen der Zugang zu Text in großen Mengen nützlich ist, wenden Sie sich bitte an uns. Wir fördern die Nutzung des öffentlich zugänglichen Materials für diese Zwecke und können Ihnen unter Umständen helfen.

+ *Beibehaltung von Google-Markenelementen* Das "Wasserzeichen" von Google, das Sie in jeder Datei finden, ist wichtig zur Information über dieses Projekt und hilft den Anwendern weiteres Material über Google Buchsuche zu finden. Bitte entfernen Sie das Wasserzeichen nicht.

+ *Bewegen Sie sich innerhalb der Legalität* Unabhängig von Ihrem Verwendungszweck müssen Sie sich Ihrer Verantwortung bewusst sein, sicherzustellen, dass Ihre Nutzung legal ist. Gehen Sie nicht davon aus, dass ein Buch, das nach unserem Dafürhalten für Nutzer in den USA öffentlich zugänglich ist, auch für Nutzer in anderen Ländern öffentlich zugänglich ist. Ob ein Buch noch dem Urheberrecht unterliegt, ist von Land zu Land verschieden. Wir können keine Beratung leisten, ob eine bestimmte Nutzung eines bestimmten Buches gesetzlich zulässig ist. Gehen Sie nicht davon aus, dass das Erscheinen eines Buchs in Google Buchsuche bedeutet, dass es in jeder Form und überall auf der Welt verwendet werden kann. Eine Urheberrechtsverletzung kann schwerwiegende Folgen haben.

Über Google Buchsuche

Das Ziel von Google besteht darin, die weltweiten Informationen zu organisieren und allgemein nutzbar und zugänglich zu machen. Google Buchsuche hilft Lesern dabei, die Bücher dieser Welt zu entdecken, und unterstützt Autoren und Verleger dabei, neue Zielgruppen zu erreichen. Den gesamten Buchtext können Sie im Internet unter `http://books.google.com` durchsuchen.

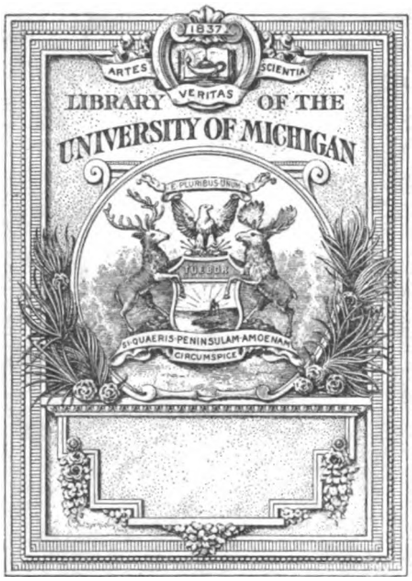
This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google™ books

https://books.google.com

3 9015 00358 648 7
University of Michigan – BUHR

Digitized by Google



Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

8202

INDEX TO VOL. XLIX

Electrical Review

NEW YORK

JULY 7 TO DECEMBER 29, 1906

Digitized by Google

INDEX TO VOLUME XLIX

ELECTRICAL REVIEW

JULY 7 TO DECEMBER 29, 1906

Articles marked * are illustrated; (E) indicates "Editorial"; (P) indicates notes under "Recent Electrical Patents": (R) indicates "Reviews of Current Engineering Literature."

A

Accidents, electrical 223
Accumulator, a new zinc-lead (R)..... 179
Accumulator, the nickel-iron (R)..... 225
Accurate speed, frequency and acceleration measurements (R)..... 556
Adirondack Murray Memorial Association, the 468
Adjuncts to the power-load, by C. J. Russell* 850
Advertising electricity, by Frank B. Rae, Jr. 952, 990, 1028, 1064
Air and electric drills, the comparative merits of (R)..... 334
Alaskan-Yukon-Pacific Exposition of 1909, the 770
Alcohol-engine investigations..... 125
Alfortville central station and the system controlled by the Est-Lumiere Company (near Paris), by C. L. Durand* 170
Allis-Chalmers Company, the electrical works of the*..... 14
Allis-Chalmers hoisting engine for the Chapin mine, an..... 654
Allis-Chalmers steam turbine and generator in New Rochelle station of Westchester Lighting Company.... 1055
All-steel cars adopted for the New York city tunnel of the Pennsylvania Railroad* 256
Alpine tunnel, another..... 162
Alsace, the use of electricity in the mines of 1009
Alternating-current apparatus, testing* 816
Alternating currents for incandescent lighting (E) 918
Alternating-current frequencies, an arrangement for measuring (R)..... 385
Alternating currents, measurement of (R) 108
Alternating-current motor to central station power business, the relation of the, by E. W. Lloyd..... 506
Alternating-current rectifiers (R)..... 731
Alternators, the sudden short-circuiting of (R) 471
Alternator with an auxiliary field for direct compensation for the armature reaction (R)..... 775
Aluminum 258
Aluminum wire, coils of bare (R)..... 510
American Association for the Advancement of Science, the meeting of the 88
American Chemical Society, electrochemical papers before the..... 298
American Electrochemical Society..534, 583
American Electrochemical Society, communication from the secretary of the 819
American Electrochemical Society, the (E) 573
American Institute of Architects..... 926
American Institute of Electrical Engineers' land and building fund..... 954
American Institute of Electrical Engineers, meeting of the..... 469
548, 724, 899, 1025
American navy safety appliances at Milan 219
American Society of Mechanical Engineers, Calvin W. Rice accepts the position of secretary of the..... 6
American Street and Interurban Railway Association, the (E)..... 575
American Street and Interurban Railway Association, the committee on standard rules of the..... 332
American Street and Interurban Railway Manufacturers' Association—the exhibition of appliances*..... 691
American Telephone and Telegraph Company, Edgar C. Bradley joins the staff of the..... 199
Anemometer, an electrical (R)..... 680
Announcement, special 698
Arc, the iron (R)..... 511
Armature reaction in polyphase alternators, by L. A. Herdt*..... 889
Armatures, construction of squirrel-cage (R) 428
Asbestos in 1905, production of..... 76
Asbestos, the importation of..... 77
Athletic sports for operators, by J. E. Peavey* 893
Audion, the; a new receiver for wireless telegraphy, by Dr. Lee De Forest* 724
Australia, electric railways in..... 6
Australia, tantalite in..... 883
Automatic circuit-breaker, an (R)..... 1026
Automatic Electric Company, the growth of the*..... 270
Automatic electric motor-driven pumping plant 909
Automobile Club show, the..... 711
Automobile races, telephone at..... 647

B

Baggage men, electric railways and the (E) 277
Baker Light and Power Company, Baker City, Ore., the hydroelectric plant of the*..... 10
Balancers, by J. W. Shuster*..... 99
Ballistic galvanometers, the theory of "moving-coil" and other kinds of, by Professor Harold A. Wilson.... 633
Ballistic method for magnetic induction, limitations of the (R)..... 428
Baltimore, Md., electrical spectacle at.. 462
Bath Portland Cement Company, Bath, Pa., electrical equipment of the*... 808
Belgian telegraph and telephone service 9
Belgium, the design of blast-furnace gas engines in, by H. Hubert..... 196
Belmont tunnel terminus 304
Berlin street lighting..... 769
Best methods to increase business applied to a village or small city, where the population is not increasing, by Samuel Rust..... 472
Binnacle a cause of error in a compass, the (E) 533
Birmingham (England) power station, the (E) 793
Birmingham (England), new electric generating station at..... 679
Birmingham (England), the new generating station at, by A. H. Bridge* 800
Blast-furnace gas engines in Belgium, the design of, by H. Hubert..... 196
Blow to baggage men..... 258
Blue-print washing machine..... 908
Book Reviews.
A Graphic Treatment of the Induction Motor. Heyland..... 410
Alternating-Current Windings. Kinzbruner 169
American Street Railway Investments 66
Brazing and Soldering. Hobart... 645
Complete Examination Questions and Answers for Marine and Stationary Engineers. Swingle.... 467
Continuous-Current Armatures. Kinzbruner 169
Continuous-Current Dynamo Design. Hobart 1009
Designs for Small Dynamos and Motors. Poole 410
Electric Machine Design. Parshall and Hobart 106
Electrical Engineering in Theory and Practice. Parr..... 9
Electricity as Applied to Mining. Lupton, Parr and Perkin..... 984
Electricity Meters. Gerhardi..... 105
Elementary Experimental Magnetism and Electricity. Allanach... 984
Elements of Gas-Engine Design. Moss 901
Fowler's Electrical Engineers' Handbook 957
Handbook of Mathematics. Claudel 410
Illustrated Technical Dictionary in Six Languages. Deinhardt and Schlomann 410
Industrial Furnaces and Methods of Control. Damour 66
Modern Polyphase Machinery. Stewart 9
Outlines of the Evolution of Weights and Measures and the Metric System. Hallock and Wade 468
Practical Lettering. Meinhardt... 957
Steam Turbines and Turbo-Compressors—Their Design and Construction. Foster 467
Steam-Turbine Engineering. Stevens and Hobart 66
Stray Currents from Electric Railways. Michalke 410

Digitized by Google

BOOK REVIEWS—*Continued.*
The American Steel Worker. Markham 410
The Copper Handbook. Stevens... 1009
The Design of Steel Mill Buildings and the Calculation of Stresses in Framed Structures. Ketchum.... 957
The Elements of Electrical Engineering. Franklin and Esty..... 468
The Grouping of Electric Cells. Dunton 984
The Management of Electrical Machinery. Crocker and Wheeler.. 467
The Phantom of the Poles. Reed.. 105
The Practical Engineer Electrical Pocketbook and Diary..... 984
The Practical Telephone Handbook. Poole 9
The Practical Testing of Dynamos and Motors. Smith..... 66
The Principles of Electric-Wave Telegraphy. Fleming 9
The Wire Tappers. Stringer..... 223
Things That Are Usually Wrong. Sweet 9
Turbines. Garnett 106
Turning and Boring Tapers. Colvin 1009
Wiring a House. Pratt 468
Boston & New York Electric Railroad Company 554
Boston Edison Company, monthly dinner of the..... 697
Boston Elevated Railway Company, a good year for the..... 853
Boston grants independent telephone franchise 1024
Boston Rejuvenation of the Sons of Jove, the 549, 992
Bradley, Edgar C., joins the staff of the American Telephone and Telegraph Company 199
Bragg, Charles A., death of..... 161
Brake shoes, standardization of..... 165
Brakes for city railways, mechanical (E) 531
Brilliant Electric Company to build new factory 984
British Association for the Advancement of Science, annual meeting of the 204
British Association, the York (England) meeting of the, by John B. C. Kershaw 280
British Association committee on practical standards for electrical measurements, report of the..... 375
Brooklyn Edison Electric Illuminating Company, a visit to the powerhouses of the*..... 326
Buckeye Electric Company, meeting of the sales managers and representatives of the..... 389
Bunsen Society meeting at Dresden, the, by John B. C. Kershaw..... 94
Bust of Volta presented to the Institution of Electrical Engineers of Great Britain 88

C

Cable-laying apparatus, novel..... 97
Cables for high-voltage transmission, underground (E)..... 836
Candle-power, an investigation of auxiliary apparatus for determining the mean spherical and mean hemispherical (R)..... 334
Cadmium cell, the (E)..... 405
Calculation of star resistances, the (R). 903
Camden-Atlantic City line of the West Jersey & Seashore Railroad, the opening of the..... 509
Calvin W. Rice accepts the position of secretary of the American Society of Mechanical Engineers..... 6
Canadian Niagara Power Company, the electrical plant of the, by H. W. Buck* 53
Canal bank, two cities left in darkness because of the breaking of a..... 586
Canton, Ohio, a combined heating and lighting system at, by R. W. Hutchinson, Jr.*..... 756
Capacity of a battery of accumulators operating at variable output..... 937
Carbon brushes *versus* copper (R).... 470
Car brake, an electric*..... 773
Car brakes, by Henry Mozley*..... 676
Car heater, electric (P)*..... 143
Cassier's Magazine..... 932
Chapin mine, an Allis-Chalmers hoisting engine for the..... 654
Charging storage batteries when employed as a reservoir of energy (R) 384
Chemical and electrical changes induced by light (R)..... 680
Chicago, another new telephone company for..... 981
Chicago electrical trades exposition. 898, 1019
Chicago, Lake Shore & South Bend Railway 126
Chicago, second annual electric show at 751
Chicago, the telephone situation in..381, 982
Chicago traction situation, the..... 1025
Cincinnati Fall Festival, the..... 427
Circuit-breaker, automatic magnetic (P)* 263
Cities of evil smells, our (E)..... 491
Close works of Ernest Scott & Mountain, Limited, the new (R)..... 225
Coal as affecting performance with steam boilers, some characteristics of, by W. L. Abbott*..... 411
Coal supply, the world's..... 98
Coal, the testing of, by A. Bement.... 597
Coal values (E)..... 405
Collieries, some notes on the mechanical equipment of, by E. M. Hann.. 296
Collisions at sea, wireless apparatus to prevent 209
Colloids in technical processes, the use of (E)..... 123
Colloids, notes on, by Alfred Lottermoser 555
Columbia University, electrical engineering department of..... 698
Columbia University, evening technical courses at..... 869
Combined heating and lighting system at Canton, Ohio, a, by R. W. Hutchinson, Jr.*..... 756
Commercialism, an uplifting of (E).. 795
Comparative cost of cooking with various fuels, by Charlotte D. Seaver 1024
Concord, N. C., extension of Southern Power Company's system to..... 295
Condenser, a new type of industrial (R) 902
Conductivity and magnetism (E)..... 1004
Conductivity of air in an intense electric field, and the Siemens ozone generator, the (R)..... 821
Connellsville, Pa., an electrical spectacle at*..... 426
Contractor, an interesting suggestion for the electrical..... 343
CONVENTIONS.
American Street and Interurban Railway Accountants' Association 722
American Street and Interurban Railway Association. 328, 587, 642, 687
American Street and Interurban Railway Claim Agents' Association 722
American Street and Interurban Railway Engineering Association 682
Association of Edison Illuminating Companies 327, 516
Colorado Electric Light, Power and Railway Association.....427, 509
Electrical Trades Association of Chicago 901
Electrical Trades Society of New York 1021
Illinois Electrical Association..... 509
International Association of Municipal Electricians..... 331
National Electrical Contractors' Association 18, 48, 88, 124
National Interstate Telephone Association 19
Northwestern Electrical Association 817
Northwestern Telephone Exchange Company 930
Ohio Electric Light Association... 125
254, 282, 382
Railway Signal Association, the. 547, 695
Street Railway Association of the State of New York..... 43
The Street Railway..... 587
West Virginia Independent Telephone Association 1055
Conveyers, adaptations of electrically driven, by Day Allen Willey*.... 752
Cooperative Electrical Development Association 760
Copper exports, increased value of.... 987
Copper production, increase in the United States..... 479
Correction, a..... 698
Cosmopolitanism of science, the..... 297
Cost table wanted..... 363
Cost of suction gas power (A)..... 950
Costs of, and results from, soliciting and advertising, by H. K. Mohr.... 513
Council Bluffs, Iowa, telephone crossing at (R)..... 864
Creplet system of hoisting for mines, the (R)..... 109
Crookes tubes, phenomena observed in (R) 605
Cryolite, importation of..... 96
Curtis steam turbine, test of a 5,000-kilowatt* 4

D

Dam of the bear-trap type in the country, the largest movable, by W. C. Weeks 711
Death of Arthur Vaughn Abbott..... 932
Dedication of the new building for the engineering departments of the University of Pennsylvania..... 597
Denver "Welcome" arch, the*..... 61

17179
Digitized by Google

Determination of the point of transformation of certain steels by means of the electrical resistance (R) 680
Detroit River tunnel contract awarded. 429
Diagrams, simple (E)..... 967
Diesel engines for interurban railway service, by Norman McCarthy.... 907
Direct-current electric stations, a method of compounding (R)..... 24
Distribution system, electrical (P)*. 333
Domestic electricity (E).....159, 745
Double compounding (E)..... 621
Dresden, the Bunsen Society meeting at, by John B. C. Kershaw..... 94
Drill, a condemnation of the electric rock (E)..... 315
Duluth, forty thousand horse-power in hydraulic turbines for..... 306
Duration of the after-glow produced by the electrodeless ring discharge, the (R)..... 731
Dynamo, a large steam-turbine-driven, continuous-current (R)..... 651
Dynamoelectric machinery, Thompson. 957
Dynamoelectric machines, design coefficients for (R)..... 864
Dynamometer for small motors, a.... 799
Dynamos, high-speed and high-voltage continuous-current (R)..... 108
Dynamos with auxiliary poles, continuous-current (R)..... 604
Dynamo, the fire-proof (E)..... 489
Dynamo, the voltage regulation of a continuous-current (R)..... 511

E

Earthquakes, possible prediction of (C) 879
Economical importance of gas engines in generating stations (R)..... 774
Economy in central station operation, by George Wilkinson..... 855
Educating the public to a better knowledge of illumination..... 1030
Education, the liberal..... 383
Efficiency of steam plant, by Walter A. Vignoles*..... 259
Efficiency of steam plant, the..... 89
Elastic limit of a metal, an electrical method of measuring the (E).... 193
Election of directors of the Westinghouse Electric and Manufacturing Company 161
Electrical and mechanical equipment of the new clubhouse of the Engineers' Club, New York city, the*. 7
Electrical apparatus and supplies, advancing market in..... 819
Electrical cutting of steel I-beams and girders (R)..... 384
Electrical Development Company, of Ontario, the power plant of the, by F. O. Blackwell..... 138
Electrical discharge in air and its commercial application, the..... 364
Electrical Engineering Company, new. 518
Electrical engineering, the influence of (E)..... 121
Electrical equipment of a Newcastle (England) railway warehouse (R) 1027
Electrical equipment of the Bath Portland Cement Company, Bath, Pa.* 808
Electrical equipment of the Erie railroad shops at Hornell (Hornellsville), N. Y.*..... 894
Electrical insulator (P)*..... 223
Electrical machinery breakdowns..... 768
Electrical manufacture of steel..... 716
Electrical measurements of very short time intervals (R)..... 68
Electrical mining notes, by Sydney F. Walker 135, 176, 1016
Electrical night at the Coliseum, Chicago 422
Electrical notes from Europe, by C. L. Durand*.....59, 220, 638, 848
Electrical notes from Great Britain, by A. H. Bridge.....601, 754, 946
Electrical resistances of alloys..... 1044
Electrical spectacle at Connellsville, Pa., an*..... 426
Electrical Trades Association of Chicago 799
Electrical Trades Association of Philadelphia, dinner of the..... 847
Electrical Trades Exposition Company, the 516
Electrical Trades Society of New York, the 930
Electrical works of the Allis-Chalmers Company, the*..... 14
Electric arc destructively applied, the (E) 449
Electric car equipment of the Long Island Railroad, the, by W. N. Smith* 210
Electric cooker (P)*..... 177
Electric drive in the envelope factory, the (E)..... 159
Electric drive, the (E)..... 1043
"Electrician" electrical trades directory and handbook..... 883
Electricity (E)..... 919
Electricity, applications of..... 420
Electricity in medicine (E)..... 879
Electricity in mines..... 251
Electricity in the treatment of disease, by John V. Shoemaker..... 841
Electricity on steam railroads..... 5
Electricity, popularizing (E)..... 531
Electricity: the power behind the South, by W. S. Lee, Jr..... 62
Electricity the safest of all powers (E). 965
Electricity was served to consumers and street-car lines by the San Francisco Gas and Electric Company after the fire, how, by L. E. Reynolds 584
Electric lighting by wind power..... 753
Electric lighting in a zoo (E)..... 707
Electric lighting plant for Ridgefield, Ct.* 1059
Electric motors in competition with gas engines..... 458
Electric phenomena at very high tensions (R)..... 865
Electric power in the South (E)..... 37
Electric power on the Great Western Railway, England (R)..... 68
Electric power to rid London of smoke. 325
Electric pumping at collieries, by Gerald H. J. Hooghwinkel..... 100
Electric railway development (E).... 622
Electric railway development at Niagara Falls (E)..... 123
Electric railway engineering preliminaries, by Sydney W. Ashe*..... 579
Electric railways in sparsely settled communities, by E. P. Roberts*.728, 766
Electric railway statistics for Greater New York 255
Electric smelting of iron and steel (E). 3
Electric tool (P)*..... 107
Electrification of the New York zone of the New York Central & Hudson River Railroad, the present status of the, by W. J. Wilgus*..... 354
Electrification, progress in (E).....2, 351
Electrification of West Jersey & Seashore Railroad*..... 761
Electrifying, economy in..... 712
Electrochemical papers before the American Chemical Society..... 298
Electrolysis, double trolley system not a sure cure for..... 600
Electrolysis, phase displacement in alternating-current (E)..... 573
Electrolytic rectifier, an..... 554
Electrolytic resistances (E)..... 967
Electromagnetic control of governors. 667
Electromotive force (E)..... 193
Elevator service, electricity in..... 47
Emergency application of electricity, an interesting* 516
Engineer and nature, the (E)..... 1041
Engineering activity, an apprenticeship course as a preparation for..... 437
Engineering building of the State University of Iowa, the new, by William G. Raymond..... 292
Engineering building of the University of Pennsylvania*..... 671
Engineering education, progress in (E) 663
Engineering education, society for the promotion of..... 98
Engineering experiment station of the University of Illinois, the*..... 103
Engineering experiment stations (E). 122
Engineers and their work, by Sir Alexander B. W. Kennedy..... 1020
Engineers' Club, New York city, the electrical and mechanical equipment of the new clubhouse of the* 7
England, underground telegraph wires in 69
English experiment of shipping by electric wagons 760
English overhead transmission lines and distribution mains..... 554
English pumping station, an (R).... 902
Enquiry into the operation, efficiency and construction of a typical modern industrial producer gas power plant, by J. R. Bibbins*..... 1013
Entraygues (France) hydroelectric plant, the, by C. L. Durand*..... 933
Envelope factory, the electric drive in the (E)..... 159
Erie electrification..... 930
Ernest Scott & Mountain, Limited, the new Close works of (R)..... 225
Erratum 232
Europe, electrical notes from, by C. L. Durand*.....59, 220, 638, 848
Exhausting our supplies (E)..... 242
Exposition of safety devices..... 773

F

Faraday, a memorial to..... 1018
Faraday Society, the.....57, 164, 948
Fire-proof insulated magnet wire, by W. H. Easton*..... 908
Fires not caused by electricity in Germany 654
Flour bleaching with the aid of electricity 18
Fogs by electricity, the artificial dispersion of (R)..... 604
Foolish testimony (E)..... 707

Digitized by Google

Foreign trade opportunities..... 246
Fracture of axles originating in drilled holes (R)..... 903
France, electric power in..... 977
Frankfort central station, the, by B. F. Hirschauer*..... 417
Frequency meters, by F. Conrad..... 594
Friction and lubrication (R)..... 556
Fuel analysis for steam users (E).... 447
Fuel, water and gas analysis for steam users, by J. B. C. Kershaw..... 376 408, 459, 492, 544, 576, 624 666, 708, 748, 796, 838, 880
Fused magnesium oxide, on the physical properties of (R)..... 178

G

Gas-blowing engine plant for the Indiana Steel Company..... 150
Gas engine ignition..... 18
Gas engines, a method of starting.... 47
Gas engines, measurement of friction in, by A. H. Burnand*..... 160
Gasolene electric light plant, test of a small 252
Gasolene-electric motor car, a (R).... 24
Gas power, the evolution of, by F. E. Junge 985
Gas, power transmission by means of. 96
Gas turbines 1061
General Electric Company, strike at the works of the..... 984
General Electric Company to issue new stock 586
General Electric stock issue..... 637
Generating equipment for a gold mine, electric* 292
Generating station at Birmingham, England, the new, by A. H. Bridge* 800
Generators, some notes on the mechanical design of electrical, by R. Livingstone* 253
Gift to Union College..... 1063
Glasgow telephones 135
Glass, a low-resistance..... 333
Glidden, Charles J. and his automobile trophy 162
Glow-lamp standards and glow-lamp photometry, notes on (R)..... 557
Gold medal for the Brooklyn Rapid Transit Company..... 818
Gold mine, electric generating equipment for a*..... 292
Great Britain, electrical notes from, by Albert H. Bridge.....601, 754, 946
Great Britain, municipal telephony in (E) 157
Greater New York, electric traction in (E) 279
Greenock, Scotland, Electricity Works extensions 298
Greenwich observatory in trouble (E). 38
Greenwich power station of the London County Council, the, by Albert H. Bridge* 972
Ground-detector and cutout (P)*..... 143
Grounded neutrals with series resistance (R)..... 604
Guayule rubber development..... 246
Gymnotus electricus as a source of power, the (E)..... 243

H

Handling public complaints, by John A. Beeler 771
Hamilton, Ohio, new telephone exchange, the, by J. E. Peavey*..... 978
Harmonic party-line systems, by William W. Dean*..... 204
Heating of underground cable (R).... 774
Heusler magnetic alloys, experiments with the (R)..... 604
High-efficiency electric lamps (E)..... 877
High-speed and flying connections (E). 407
Hoisting apparatus when operated by continuous-current motors, a study of starting (R)..... 650
Holland, two exhibitions in..... 932
Home Telephone Company, Detroit, Mich., the new plant of the..... 603
Home Telephone Company of Detroit, organization of the..... 549
Horseshoe Falls, raise the, by Alton D. Adams..... 163
Hydroelectric and steam equipment of the Athens (Ga.) Electric Railway Company, the* 1010
Hydroelectric contract for J. G. White & Company..... 779
Hydroelectric plant at Lucerne, Switzerland, the, by Franz Koester*.. 200
Hydroelectric plant of the Baker Light and Power Company, Baker City, Ore., the*..... 10
Hydroelectric power plant and transmission lines of the North Georgia Electric Company, by R. W. Hutchinson, Jr.*..... 635

I

Ideal, progress toward an (E)..... 351
Ignition, gas engine..... 18
Igniter, electric (P)*..... 143
Illinois Independent Telephone Association 23
Illuminants, indoor, by James Swinburne 975
Illuminating engineering, a noteworthy example of modern*..... 1056
Illuminating Engineering Society..... 542 648, 737, 812, 869, 954, 1022, 1044
Illuminating Engineering Society of New England 1029
Illumination, data on indoor, by J. E. Woodwell* 713
Illumination, illustrated lectures on.. 783
Illumination, increasing the standards of (E)..... 623
Illumination, suitable methods of (E). 1003
Illumination tests..... 516
Incandescent electric lamps, the William J. Hammer collection of..... 847
Incandescent lamps, a new company to manufacture 343
Incandescent lighting, applications of rare metals to (R)..... 650
Increasing the constancy of batteries giving currents (R)..... 774
Increasing the standard of illumination 679
Independent Telephone Companies, combination of..... 639
Independent Telephone Company of Chicago 1025
Independent Telephone officers elected. 295
India rubber, importations of..... 1058
Indicator, electrically operated (P)*.. 333
Indicator for hardening steel, the magnetic (E)..... 406
Indianapolis, New Castle & Toledo Electric Railway, the..... 222
Indiana, Columbus & Eastern Traction Company, the*..... 854
Indiana Steel Company, Gary, Ind., the electrical equipment of the....148, 670

INDUSTRIAL SECTION.

Air compressors, National. N. B. & E. Co.*..... 394
Allis-Chalmers Company and the manufacture of Christensen air-brakes 149
Allis-Chalmers electric hoists. A.-C. Co.*..... 956
Allis-Chalmers induction motors for the Washoe smelter of the Anaconda Copper Company. A.-C. Co.* 228
Allis-Chalmers oil-insulated transformers* 781
Alternators, a new line of. W. E. Co.* 476
American-Ball engines and generators 149, 780
"American" portable voltmeters and ammeters. A. I. Co.*..... 111
Anderson electrical time switch, the. A. & J. M. A. Mfg. Co.*..... 1067
Apple ignition system for 1907, the. D. E. Mfg. Co.*..... 906
Arc lamps, new flame. S.-G. I. E. Mfg. Co.*..... 479
Arc lamps, new pole fixtures for. A. L. M. Co.*..... 653
Attachment plug, a new separable switch. S. Co.*..... 698
Automatic feeder regulators. G. E. Co.*..... 230
Automatic motor-controlling devices. N. Y. E. C. Co.*..... 521
Automatic Refrigerating Company, The exhibit plant of the. A. R. Co.* 30
Automatic starting compensator for induction motors. G. E. Co.*.... 1030
Automatic time switch, a commercial type of. G. E. Co.*..... 826
Blue-printing machine, a new form of electric. R. M. Co.*..... 736
Blue-printing machine, a new electric. J. H. W. & Co.*..... 779
Buckeye electric blue-printing machine, the. B. E. Co.*..... 825
Buckeye two-cycle single-acting gas engine for generator driving, the. B. E. Co.*..... 392
Capstan cable jack, a new. P. & S.*..... 562
Centrifugal pumps, Allis-Chalmers, motor-driven. A.-C. Co.*..... 475
Cleats and break-arms, new. A. L. M. Co.*..... 475
Commutating-pole variable-speed motors. G. E. Co.*..... 342
Commutators, Homer. H. C. Co... 479
Cook's automatic electrical testing and resetting plug. F. B. C..... 612
Crank mechanism for internal-combustion single-acting engines, a novel. R. E. Co.*..... 229
Diesel engines, effect of load-factor on fuel consumption of. A. D. E. Co.*..... 73

Digitized by Google

INDUSTRIAL SECTION—*Continued.*

Diesel oil engine test. D. E. Co.*. 610
"Dow" adjuster, the improved. M. E. Mfg. Co.*. 518
Dry cell, a fifty-ampere. F. B. Co.. 608
Drawbridge, gasolene-electric apparatus for moving a. F. M. & Co. 564
Electric fixtures. C. G. & E. F. Co.* 1031
Electric motor conquest, another. G. E. Co. 478
Electric motor drive in the packing industry. G. E. Co.*. 955
Electric power in the plant of the Springfield Metallic Casket Company, of Springfield, Ohio. 609
Electric Service Supplies Company announcement. 1070
Electric-tower control of surface-track switches. A. A. S. Co.*. 1068
Erecting shop, a busy. A.-C. Co.*. 112
Eureka electric flat-irons. W. J. B. E. Mfg. Co.*. 391
Feeder regulator, results obtained by the General Electric Company's automatic. G. E. Co.*. 435
Flasher, a large electric. R.-D. F. Co.* 433
Flashing sign, a new form of. L. S. Co.*. 148
Flush receptacle, a new. H. H. Inc.* 868
Franklin Electric Manufacturing Company, second annual conference of the. 76
Franklin Electric Manufacturing Company's street railway incandescent lamp, the. F. E. Mfg. Co.* 608
Furnace, the balanced-draft gas producer. E. Co.*. 517
Fuse, 250-volt indicating plug. D & W F. Co.*. 994
Gallatin Hotel, Uniontown, Pa., electrically operated refrigerating plant in the*. 232
Generators arranged for direct connection, small. C.-W. Co.*. 608
Generators for the Ottumwa Railway and Light Company, new. W. E. Co.*. 389
Generators for traction purposes, a large installation of gas-engine-driven. A.-C. Co. 563
Generator sets, crude and fuel oil. De La V. M. Co.*. 521
G. I. outlet boxes. S.-G. I. E. Mfg. Co.*. 305
Gleason universal molding box, the. J. L. G.*. 390
Gould's electric mine-sinking pump. G. Mfg. Co.*. 561
Gould telephone storage battery, the. G. S. B. Co.*. 183
Governor, a new water-wheel. L. G. Co.*. 73
Ground-connection clamp, an all-copper. C.-S. Co.*. 1031
"Harvard" outlet boxes. H. E. Co.* 1069
Hatches, power-operated. L.-A. Co.* 306
H. C. K. instantaneous electric water-heater. H. C. K. Co.*. 432
Holophane reflecting arcs, the new. H. G. Co.*. 780

INDUSTRIAL SECTION—*Continued.*

Horizontal type direct-current Curtis steam turbine generators. G. E. Co.*. 147
Hubbell candelabra socket, new. H. H. Inc.*. 73
Hudson Company's tunnels, electric equipment for the. G. E. Co.. 521
"Hylo" flasher, the. P. Co.*. 148
Incandescent lamps, weatherproof. R. E. L. Co.*. 391
Indicator for enclosed fuses, an improved. H.-M. Co.*. 183
Induction motors, single-phase. G. E. Co.*. 388
Induction motors, small riveted frame. G. E. Co.*. 29
"Keough" cord-grips. K. Bros. & Co.* 76
Lamp brackets, a new line of adjustable. W. L. Mfg. Co.*. 868
Lamp fixtures, adjustable incandescent. G.-W. Mfg. Co.*. 392
Lamp guard, a new. H. H. Inc.*. 612
Lamp guard, a portable. I. P. F.* 653
Laundry, the electric equipment of a modern. G. E. Co.*. 783
Lever switch, an improved type of. G. E. Co.*. 519
Lighting specialties, new outdoor. A. L. M. Co. 75
Lincoln variable speed motor, the. L. E. Mfg. Co.*. 436
Locke Insulator Manufacturing Company, Victor, N. Y., enlargement of equipment of the. 389
Magneto telephones, a new line of. A. E. Co.*. 184
Manual of wireless telegraphy. Collins. 957
Marshall Electric Manufacturing Company's standard dial switch, the. M. E. Mfg. Co.*. 608
Mechanical time recorders. B. Co.* 779
Mercury arc rectifier panel for charging ignition batteries. G. E. Co.*. 867
Metallic support for cross-arms, a* 607
Midget plug and receptacle, new type. M. E. Mfg. Co.*. 392
Motor drive for coal-crushing rolls. A.-C. Co.*. 269
Motors for testing purposes, high-speed, high-overload capacity. G. E. Co.*. 268
Multiple-voltage system of motor control in New England cloth-printing establishments, the. A.-C. Co.*. 561
National alternators in the plant of the Merchants' Heat, Light and Power Company, Canton, Ohio.. 826
National Electric Light Association Convention, central station advertising at the. C. A. Co.*. 30
National motor-generators in the substations of the Columbus, Ohio, Railway and Light Company. N. B. & E. Co.*. 609
"National" steel tube cleaner, the. H. W. J.-M. Co.*. 1070
New York Central & Hudson River Railroad storage battery equipment. 995

INDUSTRIAL SECTION—*Continued.*

Oaxaca Smelting and Refining Company equipped with Westinghouse electrical apparatus. 826
"Peerless" switch, the. M. E. Mfg. Co.* 343
Pipe cap, the "G. V." G. V. & Co.* 73
Plant of the Dean Electric Company, Elyria, Ohio, sold. 1070
Plug for fan motors, a rythmic regulating socket. P. Co.*. 343
Polyphase revolving-field engine-type generators. F. W. E. Wks.* 340
Portable air-compressor outfit. G. E. Co.*. 307
Power machinery exportations. W. M. Co. 307
Pumps for fire protection in large buildings, electric motor-driven.* 827
Push-button switch, new design of. M. E. Mfg. Co.*. 436
Receptacle and attachment plug, "G.-I." flush. S.-G. I. E. Mfg. Co.* 737
Receptacle, new type flush. M. E. Mfg. Co.*. 736
Refrigerating plant in the Gallatin Hotel, Uniontown, Pa., electrically operated.*. 232
Regulator for both alternating and direct-current systems, a voltage. P. Co.*. 341
Regulators, automatic feeder. G. E. Co.*. 230
Rolling mill motors. C.-W. Co.*. 149
Safety system for elevators. S. D. Co.* 111
San Francisco "branch office," a.. 563
San Francisco office of the Shelby Electric Company*. 267
Shipment from the Westinghouse Company, a large. W. E. & Mfg. Co.* 269
Slide-wire bridge, a new. L. & N. Co.* 995
South America, electrical machinery in. G. E. Co. 76
Splice protector, a new. J. B.*. 906
Stanley-G. I. arc lamps, a new line of. S.-G. I. E. Mfg. Co.*. 77
"Star" toggle bolt, the. S. E. B. Co.* 391
Steam turbine installations. W. M. Co. 114
Storage-battery plates, the manufacture of. G. S. B. Co.*. 563
Sturgess water-wheel governors. L. V. Mfg. Co.*. 518
Switch, a 250-volt, double-pole rotary flush. M. E. Mfg. Co.*. 562
Switch, the Dean hook. D. E. Co.* 520
Telephone drop, the improved G. D. E. S. S. Co.*. 827
Telephone instrument, a new. W. & T. Co. of A.*. 1032
Telephones, new types of interior. H.-C. E. Co.*. 697
Telephones, portable car. S.-C. T. Mfg. Co.* 611
Telephones, portable desk. D. E. Co.* 185
Telephone-testing sets, linemen's portable. H.-C. E. Co.*. 611
Test set, new Navy Department. Q. & Co.*. 434

Digitized by Google

INDUSTRIAL SECTION—*Continued.*
Torch, a new gasolene. Z. L. & B. Co.* 268
"Universal" electric light holder, the. G.-W. Mfg. Co.* 232
Vacuum drying and impregnating apparatus. J. P. D. Co.* 522
Vacuum impregnating method with "Voltax," applying the. E. C. Co.* 114
Victor combination meter, the. H. W. J.-M. Co.* 267
"Voltax," applying the vacuum impregnating method with. E. C. Co.* 114
Voltmeters and ammeters. "American" portable. A. I. Co.* 111
Wagner Electric Manufacturing Company, the opening of the new plant of the 736
Water softener, the "American." A. W. S. Co.* 993
Water-tight floor outlets. S. C. E. Co.* 268
Water-tight telephone system for battleships. H.-C. Elec. Co.* ... 113
Water-wheel governors, the manufacture of. L. G. Co. 735
Western Electric belted alternators. W. E. Co.* 780
Western Electric Company's new special design short arc lamp. W. E. Co.* 1067
Westinghouse managers' meeting.* 735
Window lighting. I. P. F. 783
"Wotton" single-coil ringers. E. Mfg. & E. Co.* 698
Wright demand indicators, a large order for. S.-G. I. E. Mfg. Co.. 869
Yale & Towne portable electric hoists* 74
Industrial training, an experiment in (R) 470
Installations and apparatus on the Continent, new electrical, by C. L. Durand* 288
Institute membership, increasing the (E) 836
Institution of Electrical Engineers, of Great Britain, bust of Volta presented to the 88
Institution of Electrical Engineers, of Great Britain, the circular tour of the 175
Insulator, a new Italian* 537
Insulator, electrical (P)* 223
Interborough-Metropolitan makes good showing 868
International Association of Municipal Electricians 88
International electrical standardization (E) 85
International Independent Telephone Association of America, the 416
International science (R) 144
International Telegraph Congress, interference in wireless telegraphy and the (R) 265
Interurban railway construction, sound engineering in, by Guy Morrison Walker 639
Interurban railway territory, developing (E) 158
Inverse square law and reflectors, the (E) 794
Irreversibility of the Heusler alloys, the (R) 1027
Irish International Exhibition, the 727
Iron and steel, electric smelting of (E). 3
Iron in alternating currents, application of unsymmetrical magnetization of (R) 334
Iron in distorting alternating-current wave-form, the effect of, by Frederick Bedell and Elbert B. Tuttle* 550, 595
Iron losses in pole shoes, due to armature teeth, a method for the determination of (R) 264
Iron under weak periodic magnetizing forces, the behavior of 863
Italian telephone systems, improving the 362

J
Japan, electrical developments in 564
Japan, telephones in 332
Jobbers at Niagara Falls, the meeting of the electrical 469
Jobbers, Niagara Falls meeting of electrical 426
Johns Hopkins University offers graduate courses in applied science 469

K
Kelvin on wireless telegraphy 799
Korean hydroelectric transmission plant, a (R) 511
King Edward Bridge, Newcastle-on-Tyne, (England), electrical plant of the (R) 428

L
Lamps and illuminating efficiency, location of, by Preston S. Millar* 814
Lancashire & Yorkshire Railway, electric traction on the (R) 179
Lehigh Valley Railroad, signaling on the* 646
Liberty and organization, by F. A. Pattison 420
Light and power plant wanted, small.. 827
Lighting proposition for Milwaukee, Wis., a unique 869
Lighting units in Ohio, high-efficiency.. 416
Lightning-arrester practice, the benefit of enquiry to, by N. J. Neall 365
Limiting device, electric 363
Link-Belt Company, the 270
Litigation, divided poles and field-winding 287
Liverpool's street lighting 842
Live-steam-heated feed-water—its effect on the output and efficiency of steam boilers, by G. Wilkinson..166, 218
Locomotives for the New York Central lines, the electric* 150
Locomotives for the Simplon tunnel, the three-phase (E) 38
Locomotives *versus* motor-cars (R)... 775
London County Council, the Greenwich power station of the, by Albert H. Bridge* 972
London power bills 845
London underground electric railways. 251
Long Acre Electric Light and Power Company, the 824
Long Island Railroad, the electric-car equipment of the, by W. N. Smith* 210
Lucerne (Switzerland) the hydroelectric plant at, by Franz Koester*.. 200
Lumber mill, electrical equipment of a* 424

M
Machinery, apparatus for automatically connecting in parallel polyphase (R) 384
Machinery, the life of electrical (E).. 349
Magnetic surveys of the ocean (E).... 39
Magnetic testing for faults and gas bubbles in iron (R) 300
Magnetized iron, stress in 632
Magnetograph records of earthquakes, with special reference to the San Francisco earthquake 901
Manchester (England) section of the Institution of Electrical Engineers 817
Manchuria, a letter from 497
Manhattan Transit Company sold 578
Manila Electric Railroad and Lighting Corporation, the September earnings of the 723
Manufacture of nitrites, the electrical (E) 87
Mariner's compass, discovery of the... 364
May the central station in the smaller city expect adequate returns from its new-business department* 822
Measurement, electrical means of (E)..313
Measurement of received energy at wireless stations, the, by Greenleaf W. Pickard* 980
Measurement of temperature rise in the windings of electrical machinery (R) 1026
Measuring instruments, bearing for electrical (P)* 67
Meeting of the provisional organization committee of the Cooperative Electrical Development Association.... 1025
Metal, an electrical method of measuring the elastic limit of a (E)..... 193
Metallic arc, the (R) 1062
Metallurgical furnace (P)* 67
Metals, a new method of testing magnetic 812
Metals, aspects of the inner structure of, by J. A. Ewing 463
Metals, the influence of cross-magnetization on the electrical conductivity of (R) 864
Methods of getting new business, the prize paper on (E) 3
METHODS OF GETTING NEW BUSINESS.. 26, 70, 110, 146, 180, 226, 266, 302, 336, 386, 430, 472, 512, 558, 606, 652, 696, 732, 777, 822, 866, 904, 952, 990, 1028, 1064.
Mexico, electricity as a power in mining in 847
Milan, American Navy safety appliances at 219
Milan Exposition, single-phase railway at the (R) 820
Milan honors for the "Long-Arm" system 869
Mine pumps at the Ward shaft, electrical, by Leon M. Hall* 632
Mines, electrical equipment for iron... 971
Mines, electrical machinery for (R)... 429
Modern electrical illuminants (R)..... 820
Montreal Light, Heat and Power Company's Soulanges Canal power station 508
Moore tube lamp, a report on the* 257
Motor controller (P)* 333
Motor installation, a unique electric... 363
Motor loads in small towns, by Howard S. Knowlton 13

Digitized by Google

Motor mail wagons..... 812
Motors for operating stone-crushing machinery, electric 363
Motors, distant control of, electric*... 255
Motors, some points about single-phase, by W. Langdon-Davies and F. B. O. Hawes 805
Mules and electric locomotives (R).... 950
Multiple switchboard construction (P)* 223
Municipal electric railways at Wellington, New Zealand, by Frank C. Perkins* 247
Municipal ownership 543
Municipal ownership abroad..... 304
Municipal ownership, a feature of (E) 241
Municipal telephones at Manitoba..... 1070
Municipal telephony in Great Britain (E) 157
Music by electricity 818
Muspratt laboratory of physical and electrochemistry at Liverpool University, the new, by J. B. C. Kershaw 770

N

National Association of Cotton Manufacturers, the 462
National Business Show, the fifth, held in New York city..... 737
National convention for the extension of the foreign commerce of the United States 849
National Electrical Trades Association, seventh annual meeting of the.... 23
National Electric Light Association, the 1907 question box of the.....722, 971
National Electric Light Association.... 553
National engineering society, the field of a, by Calvin W. Rice..... 358
National-Interstate Telephone Association, change of name of the..... 125
Nebraska Independent Telephone Companies, meeting of..... 161
Nernst lamps for the New York terminal of the New York, Pennsylvania & Long Island Railroad Company.. 287
New business: how to get it and how to keep it, applied to a large city, by F. M. Tait..... 430
New lamps and new opportunities..... 453
New type of continuous-current dynamoelectric machine with commutating poles, a* (R)..... 1026
New types of incandescent lamps, by Clayton H. Sharp*..... 939
New York & Ontario Power Company.. 304
New York Central & Hudson River Railroad, the present status of the electrification of the New York zone of the, by W. J. Wilgus*..... 354
New York Central & Hudson River Railroad, changes in the personnel of the engineering staff of the..... 751
New York Central electric train, trial of 543
New York Central lines, the electric locomotives for the*..... 150
New York city brings suit to get $5,000,000 23
New York city, important movement for the introduction of new electric lighting and transit system in..... 727
New York city may grant a telephone monopoly 992
New York City Railway earnings..... 634
New York city, telharmonic system in. 219
New York city tunnel of the Pennsylvania Railroad, all-steel cars adopted for the*..... 256
New York Electrical Society..... 469
773, 861, 984, 1044
New York Electrical Society, the telharmonium demonstrated before the* 542
New York, New Haven & Hartford Railroad, annual report of the..... 560
New York, New Haven & Hartford Railroad trolleys sold..... 328
New York pay-station telephone rates.. 23
New York subway, cooling the*..... 628
New York Telephone Company's bid to the city 89
New South Wales, electric railways in. 696
Niagara Falls, electric railway development at (E) 123
Niagara Falls, for the preservation of.. 923
Niagara Falls meeting of electrical jobbers 426
Niagara Falls, the meeting of the electrical jobbers at..... 469
Niagara Falls, the power plants at (E) 1
Nitrates from power gas (E)..... 242
Nitrites, the electrical manufacture of (E) 87
Noise maker, a safe (E)..... 39
Non-resident lectures at the University of Minnesota 898
North Carolina, electric developments in 723
North Georgia Electric Company, hydroelectric power plant and transmission lines of the, by R. W. Hutchinson, Jr.* 635
North Pacific Ocean, the magnetic survey of the (R)..... 69

O

OBITUARY.
Abbott, Arthur Vaughn.....932, 1066
Ball, Clinton Manning..... 484
Brady, James..... 188
Bragg, Charles A..... 161
Bottomley, Harry..... 34
Campbell, William H..... 829
Cassier, Louis..... 34
Dewar, D. C..... 188
Dredge, James..... 440
Eaton, L. W..... 345
Faben, Charles R..... 397
Farrell, George..... 81
Foxenberger, F. T..... 117
Green, Mrs. Norvin..... 829
Hambleton, T. E..... 528
Hambley, E. B. C..... 311
Hannam, E. T..... 397
Herring, George..... 784
Hood, J. M. 1073
King, Carlton..... 275
Kobbe, P. F..... 528
Ludwig, Daniel J..... 911
McDonald, John E..... 81
Miller, Charles C..... 188
Murphy, Martin F..... 528
Newton, Charles C..... 34
Oberg, John L..... 871
O'Day, Daniel..... 484
Powell, John E..... 658
Reynolds, Col. W. H..... 911
Sage, Russell..... 151
Saltar, John, Jr..... 151
Tanner, Dr. John A., Jr..... 34
OBITUARY—*Continued.*
Townsend, Fitzhugh 1037
Tripler, Charles Eastman..... 34
Whittlesey, William A..... 996
Oerlikon single-phase locomotives (R). 556
Oil-electric boats (E)..... 665
Oil from exhaust steam, removing, by Albert A. Cary..... 534
Oils for high-tension switches (R).... 300
Ohio Electric Light Association, convention (E)..... 313
Ohio Electric Light Association convention notes* 322
Old-Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps, reunion of the, by George C. Maynard..... 644
Oregon, electric railway building in.. 267
Organization and conduct of a new-business department suitable for central stations in cities of 50,000 population and under, by S. M. Kennedy 180, 226
Organization and conduct of a new-business department suitable for central stations in cities of 50,000 population and under, by J. M. Robb 336, 386
Organization and conduct of a new-business department suitable for central stations in cities of 50,000 population and under, by W. Randolph Sweany*..... 558
Organization and conduct of a new-business department suitable for central stations in cities of 50,000 population and under, by Charles Nathan Jackson*..... 732
Organization and conduct of a new-business department suitable for central stations in towns of 50,000 population and under, by James L. Wiltse* 904
Oscillations, a method of producing continuous high-frequency electrical (R)..... 989
Oscillations on magnetized bodies, the action of electrical (E)..... 449
Oscillographs and some of their recent applications (R)..... 605
Osram lamps..... 427
Ozone, apparatus for the production of pure (R)..... 109
Ozone water-sterilizing equipment, a new, by Frank C. Perkins*..... 329

P

Paper, a noteworthy (E)..... 966
Paris, large power scheme for..... 954
Paris, the new St. Denis electric plant at, by C. L. Durand*..... 127
Particles, the positive charge carried by the alpha (R)..... 300
Patent office, congestion in the..... 547
Peabody (Mass.) municipal light plant, report on the..... 52
Peradeniya, a rubber show at..... 825
Peru, the water powers of—their development and possible applications (R) 988
Peruvian electric railway, proposed.... 667
Phase differences, the measurement of (R) 471
Phase displacement in alternating-current electrolysis (E)..... 573

Digitized by Google

Phenomena, length of wave and speed of propagation of electrical..... 506
Photometry, color difficulties in (E).. 490
Photometry, color phenomena in, by J. S. Dow*..... 501
Photometry, some causes of error in (R) 224
Physical meaning of power-factor, and the significance of a power-factor less than unity without phase difference 1047
Piston action of the electric air-drill (R) 680
Pittsburg Railways Company, increase in power plant of the..... 126
Plans for an electrical supply in London 837
Plant of the H. T. Paiste Company, the new 610
Plant of the King Edward Bridge, Newcastle-on-Tyne, England, electrical (R) 428
Platinum in 1905—the production of.. 765
Platinum in the Yukon (R)..... 777
Polyphase systems of generation, transmission and distribution, by M. A. Sammett 927
Polytechnic Institute, Brooklyn, evening courses in direct-current testing at the 603
Portable motor, an interesting use of a (E)..... 241
Portable substation, the (E)..... 2
PORTRAITS.
Abbott, Arthur Vaughn..... 1066
Adams, H. H..... 687
Barnes, M. L..... 51
Beggs, John I..... 691
Bradley, Edgar C..... 199
Bruch, Charles P..... 81
Corrao, William A..... 50
Engel, W. P..... 322
Galloway, John R..... 48
Glidden, Charles J..... 162
Gary, Theodore 19
Gray, W. I..... 48
Harney, John A..... 20
Hilton, James..... 51
Hoge, James B..... 19
Jaehnig, Paul H..... 50
Lawton, E. M..... 51
Martin, T. B., Jr..... 49
Miner, F. J..... 50
Morton, W. H..... 49
Newbery, F. E..... 48
Rice, Calvin W..... 6
Sanborn, G. M..... 49
Sterns, J. C..... 51
Strong, James R..... 48
Taylor, F. H. 1038
Wetherbee, Seth B..... 49
Power business, the winning of, by S. M. Kennedy*..... 302
Power-factor, the physical meaning of (E) 1004
Power gas transmission (R) 68
Power-houses of the Brooklyn Edison Electric Illuminating Company, a visit to the*..... 326
Power plant for the San Joaquin Light and Power Company, new..... 162
Power plant, planning the construction of a (R)..... 510
Power plants at Niagara Falls, the (E) 1
Power plants, economical lubrication of large, by W. M. Davis..... 58
Power supply to tramway systems, by S. J. Watson*..... 140
Power station, the Birmingham (England) (E)..... 793
Power transmission by means of gas.. 96
Practice *versus* theory in electric railway substation operation, by Sydney W. Ashe*..... 843
Predetermining alternator characteristics (E)..... 877
Presence of neon in radioactive materials, the (R)..... 1026
Preservation of wooden ties and poles, the (R)..... 821
President of Cornell University, report of the..... 824
Prize paper on methods of getting new business, the (E)..... 3
Production of asbestos in 1905..... 76
Production of electrical machinery in 1905 929
Production of radium from actinium, the (R)..... 950
Professional ethics, by Rossiter W. Raymond 64
Propulsion of vessels by irreversible engines (R)..... 300
Protective apparatus for wireless-control systems (R)..... 1062
Public policy of the National Electric Light Association, committee on.. 644
Pupin telephone cable across Lake Constance 987

R

Radiation phenomena and their bearing on radiation pyrometry, recent advances in our knowledge of, by J. B. Henderson* 422
Radiators, high-efficiency (E) 491
Radioactive emanations by charcoal, absorption of 849
Radioactivity and future power supply (E) 447
Radiotelegraphic conference, the (E).. 747
Radiotelegraphy, a development in (E) 917
Radiotelegraphy, a method of producing undamped oscillations, and its application in (R) 951
Radium and geology (R).....730, 774, 820
Radium and thorium measured by the gamma radiation, on the relative activities of (R)..... 989
Radium and uranium in radioactive materials, the relative proportion of (R) 69
Radium controversy, the (E)..... 533
Radium on gelatine, the action of (R). 24
Radium, the recent controversy on, by F. Soddy 538
Rail Joint Company, the..... 653
Railroad, the possibilities of the high-speed (E) 277
Railway building in Oregon, electric... 267
Railway cars, the lighting of, by electricity 778
Railway coach electrification (R)..... 730
Railway equipment for the United Railroads of San Francisco..... 31
Railway generators operated on a three-wire lighting service*..... 932
Railway mail cars, electrically lighted.. 776
Railways and the baggage men, electric (E) 277
Railways in England, single-phase..... 863
Railways, mechanical brakes for city (E) 531
Railway Signal Association, the..... 362
Railway signaling, new system of..... 343
Railway substations, small, by W. L. Waters* 372
Railway switches and signals by power, operation of (R)..... 264
Railway systems, distribution of electrical energy in street (R)..... 988
Rateau exhaust steam turbine plant, a (R) 109
Rational lightning rods (R)..... 903
Recent storage-battery improvements, by Sherard Cowper-Coles.....858, 920
Recharging dry cells, an interesting experiment in (E)..... 121
RECORD OF ELECTRICAL PATENTS*..... 403
445, 487, 529, 571, 619, 660, 704, 743
791, 833, 875, 915, 963, 1001, 1039, 1077
Reflection and transmission of electric waves by screens of resonators and by grids, the 818
Regenerative control and the bow collector (R) 384
Regulating alternators, a new method of (E) 746
Rejuvenated Sons of Jove, the..246, 753, 869
Report of the Alameda (Cal.) municipal electric light plant..... 776
Report on the New York telephone situation 949
Ridgefield, Ct., electric lighting plant for* 1059
"Roaring" or "corrugated" steel rails (R) 144
Rochester, Syracuse & Eastern Railway, the 807
Rock drills, a successful use of electric (E) 575
Roentgen apparatus, a current interrupter for (R) 24
Rolling mills, electricity applied to (R) 429
Roosevelt cup races, wireless telegraph work in reporting the..... 541
Rotary converters *versus* motor-generators, by Miles Walker 1006
Rotating magnetic field, the, by R. E. Hellmund* 450
Rotating sector-disc photometer, the (E) 350
Rubber, problems in the chemistry of.. 361

S

Safety devices, an exposition of..... 282
St. Denis electric plant at Paris, the new, by C. L. Durand*..... 127
Sanderson & Porter, staff additions for 516
San Francisco's progress toward recovery 578
San Joaquin Light and Power Company, new power plant for the.... 162
Sao Paulo Tramway, Light and Power Company, the, by F. M. Feiker*... 378
Schaffhouse, the electrical installations of the city of (R)..... 385
Schenectady, N. Y., railway men visit.. 23
Science, educating the public in (E).. 314
Science, the advance of, by E. Ray Lankester 244
Science, the cosmopolitanism of..... 297
Science, the, meeting of the American Association for the Advancement of 88
Scientific progress, effect of recent (E) 278

Digitized by Google

Scientific unbelievers (E)..... 279
Seeing electrically (E)..... 664
Seeing electrically 804, 943
Selection and testing of materials for construction of electric machinery, by J. Epstein..... 1048
Selective system (P)*..... 107
Self-regulating system of electrical distribution (P)* 177
September telephone gain in New York breaks all records..... 582
Sernf Valley, Switzerland, the railway system of the, by Franz Koester* 535
Seville, a 50,000-volt transmission for.. 297
Shelby Electric Salesmen's Association, meeting of the*..... 390
Signaling on the Lehigh Valley Railroad* 646
Simplon tunnel electric locomotives, the, by B. F. Hirschauer*..... 40
Simplon tunnel, electric traction in the (R) 650
Simplon tunnel, power plant for the (R) 681
Simplon tunnel, the three-phase locomotives for the (E)..... 38
Simplon tunnel, train service *via*..... 69
Sixty-five-mile interurban line in Texas 1031
Slipway at Dublin, electrically operated (R) 335
Smithsonian, new head of..... 981
Smoke, society to abate..... 335
Smoke, the suppression of industrial, with particular reference to steam boilers, by A. Bement*..... 688
Snowdon hydroelectric installation of the North Wales Power and Traction Company, Limited, the (R)... 1063
Society for the Promotion of Engineering Education 98
Some measurements of phase displacements in resistances and transformers (R) 950
Sons of Jove, the..... 364
Sound engineering in interurban railway construction, by Guy Morrison Walker 639
South Africa, magnetic survey of..... 863
South American power plant, a new... 255
South, electric power in the (E)..... 37
Southern Power Company lets contract for extensive equipment..... 975
Southern Power Company, new developments of the..... 841
Southern Power Company's system to Concord, N. C., extension of..... 295
Southern waterfalls, electric power from, by J. W. Fraser*..... 367
Special potentiometer for the standardizing laboratory, a (R)..... 1062
Spier Falls power-house, by C. J. Hopkins* 91
Spokane & Inland railway, the*..... 294
Standardization of brake shoes..... 165
State University of Iowa, the new engineering building of the, by William G. Raymond..... 292
Static trouble, a peculiar (R)..... 865
Statistics for Greater New York, electric railway 255
Steam engine, the maximum development of the..... 600
Steam-line electrification and electric railway development, the single-phase system in, by Calvert Townley 359
Steam plant, the efficiency of..... 89
Steam railroads, electricity on..... 5
Steam turbine, an investigation of the. 51
Steam turbine, test of a 5,000-kilowatt Curtis* 4
Steel works, electricity in (R)..... 730
Stone-crushing machinery, electric motors for, operating..... 363
Storage-battery improvements, recent, by Sherard Cowper-Coles*.....858, 920
Storage-battery litigation, decision in.. 578
Street lighting fiesta at Oakland, Cal... 1044
Street opening stopped in New York city 819
Street railway convention, the (E).... 665
Street railway week at Columbus, Ohio. The conventions of the railway, engineering, accountants' and claim agents' association, and the Manufacturers' exhibition, October 15-19 682
Students in a municipal power-house, electrical (E) 795
Submarine boats, wireless control of (R) 264
Submarine cable with a locomotive, drawing (R) 108
Submarine telegraphy (Kitsee) (P)*.. 299
Submarine telephone tests 297
Substation practice (E)..... 837
Substation, the portable (E)..... 2
Suburban electrification at Boston, by Howard S. Knowlton..... 252
Subway, cooling the New York*..... 628
Subway system for Chicago 578
Suitable methods of illumination (E).. 1003
Switchboards and transformer stations dangerous (R) 264
Switzerland, the electric railroad between Schleitheim and Schaffhausen, by Frank Koester*..... 283

T

Tantalite in Australia 883
Tantalum lamp, improvements in the.. 362
Target, a self-registering electric (R). 428
Technical education, sensible remarks upon (E)..... 705
Technical Publicity Association....954, 1044
Telegrams, cuts off free..... 975
Telephone, an anticipation for the (E). 407
Telephone and telegraph..... 250
Telephone, an interesting use of the.. 818
Telephone as a measuring instrument, the (E)..... 835
Telephone at automobile races..... 647
Telephone crossing at Council Bluffs, Iowa (R)..... 864
Telephone developments, New York State 755
Telephone exchange system (P)*..... 107
Telephone exchange, the Hamilton, Ohio, new, by J. E. Peavey*..... 978
Telephone exchange system (Scribner) (P)* 299
Telephone in the permanent seacoast defenses of the United States, the use of the, by M. C. Sullivan*.... 540
Telephone Manufacturer's Association, the 984
Telephone operators, instructing..... 602
Telephone rates, New York pay station 23
Telephone relay (P)*..... 67
Telephone, results by..... 776
Telephones in Japan 332
Telephones in railway work (E)..... 194
Telephone situation in Chicago, the.. 381
Telephone situation, report on the New York 949
Telephony, a proposed method of wireless (E) 966
Telharmonic system in New York city. 219
Telharmonium at the Automobile Club dinner, the..... 992
Telharmonium demonstrated before the New York Electrical Society, the* 542
Telpher for conveying coal, electric (R) 178
Teltow canal, electric operation of the, by Frank C. Perkins*..... 498
Teltow canal, opening of the..... 18
Test of an electric car brake..... 696
Testing electrical materials (E)..... 1042
Thermochemical electric generator, a (R) 510
Thermodynamics, its basis in intuition and common sense, the second law of, by William S. Franklin, Sc.D.. 352
Thermodynamics, the second law of (E) 349
Ties of different materials, values of.. 209
Tin-plate mill, an electrically driven*. 251
Traction in Greater New York, electric (E) 279
Traction Managers' and Auditors Association 597
Traffic, railway-motor-car, by T. Hurry Riches and Sidney B. Haslam.... 285
Train service *via* Simplon tunnel..... 69
Tram-cars on gradients, the control of (R) 224
Tramway brakes, the advantages and disadvantages of different systems of (R)..... 557
Tramway lines on the Continent, by C. L. Durand*..... 589
Tramway motors, standardization of.. 862
Tramway systems, power supply to, by S. J. Watson*..... 140
Transformation of electric power into light, by Charles Proteus Steinmetz* 924, 968
Transmission, a rival of electrical (E) 86
Transmission lines and distribution mains, English overhead..... 554
Transmission systems compared, three-phase and direct-current (E).... 448
Transmission, the Moutiers-Lyons (France) high-tension, direct-current (R)..... 335
Transportation, the agents of (E).... 195
Transvaal, electric power in the..... 888
Trolley construction, underground conduit construction and subways for Chicago, report relating to..... 98
Truckee River General Electric Company, the*..... 454
Tungsten filament lamp, a..... 270
Tunnel of the Electrical Development Company, of Ontario, completed, the 304
Turbines—land and marine, recent advances in steam..... 363
Turbine, the present standing of the gas (E)..... 243
Turbine water-wheel tests..... 819
Turbo-alternators, recent tests of (R) 265
Turbo-generators, tests of*..... 90
Twin lead-covered wire for electric lighting, a new method of employing, by E. L. Berry..... 669

Digitized by Google

Two thousand six hundred dollars in prizes for an electrical solicitor's handbook 909

U

Underground substations, practical notes on (R)..... 470
Underwriters' National Electric Association, annual meeting of the electrical committee 1009
United States, the use of the telephone in the permanent seacoast defenses of the, by M. C. Sullivan*..... 540
Units and standards..... 931
University of Illinois, the engineering experiment station of the*..... 103
University of Illinois, the..... 979
University of Pennsylvania, the engineering building of the*..... 671
Useful or useless races (E)..... 747
Use of storage batteries in the electric lighting of steam passenger equipment, the, by J. R. Sloan*..... 920
Utilization of power, modern tendencies in the (R)..... 251

V

Valle Maggia single-phase railway, the (R)..... 265
Valve tube, a new type of electric (R). 178
Vaudeville performance during Street Railway week at Columbus, Ohio, the 723
Victoria Falls power scheme, the (E).. 1005
Victoria Falls, to harness..... 909
Vienna Railway, electric hauling on the (R)..... 989
Virginia State Independent Telephone Association, organization of the.. 711
Volcanic heat, the nature and origin of (R) 301, 470
Voltage regulator (P)*.....107, 177

W

Washington, Baltimore & Annapolis Railway, single-phase equipment for the..... 602
Washington Water Power Company, a new steam relay plant for the... 654
Waterfalls, electric power from southern, by J. W. Fraser*..... 367
Water-power plants, the value and design of, as influenced by load-factor (R) 681
Water purifer (P)*..... 67
Wehnelt interrupter with the Righi exciter for electric waves, the use of the (R)..... 605
Welding, method of electrical (P)*.. 299
Wellington, New Zealand municipal railways at, by Frank C. Perkins* 247
Western Electric Company, the..... 819
Western Union Telegraph Company, annual report of the..... 758
Westinghouse Electric and Manufacturing Company, election of directors of the..... 161
Westinghouse Electric and Manufacturing Company, the report of the.... 207
Westinghouse gets orders for large electrical pumping stations to supply Mexico City with water—five stations to be installed..... 867
Westinghouse interests, the growth of the 759
West Jersey & Seashore Railroad, electrification of the*..... 717
West Jersey & Seashore Railroad, the electrification of the (E)..... 705
West Jersey & Seashore Railroad, the opening of the Camden-Atlantic City line of the.....509, 761
What is an engineer-constructor, by George A. Damon..... 944
W. H. Blood, Jr., retained as insurance expert by the National Electric Light Association 751
Whitney development on the Yadkin, the, by J. S. Miller*..... 1045
Wind power, electric lighting by..... 753
Wiring calculations, what degree of accuracy is feasible and necessary in (R)..... 510
Wiring plans, standard symbols for.. 554
Wireless apparatus to prevent collisions at sea..... 209
Wireless telegraph circuit (P)*..... 263
Wireless telegraph companies, merger of 869
Wireless telegraph conference (E).... 532
Wireless telegraph conference.....161, 631
Wireless telegraphy, a new receiver for: the audion, by Dr. Lee De Forest* 724
Wireless telegraphy in time of war, rules for 560
Wireless telegraph station, high-power, at Nauen, Germany (R)..... 902
Wireless telegraph receiver, a new (E). 706
Wireless telegraph work in reporting the Roosevelt cup races..... 541
Wireless telegraphy, directed (E).... 122
Wireless telegraphy for railway signaling (R)..... 650
Wireless telegraphy, interference in (R) 145
Wireless telegraphy, the present condition of (E)..... 123
Wireless telephony by means of electric waves (R)..... 988
Wireless telephony for the deaf (E).. 1043
Wiremen, a prayer to the..... 758
Wisconsin Electric and Interurban Railway Association..... 824
Wood preservation (R)..... 301
"Wood preservation"..... 560

Y

York (England) meeting of the British Association, the, by John B. C. Kershaw 280
"Young" system of signaling for the Philadelphia & Western Railway, the 436

Z

Zinc-lead accumulator, a new (R).... 179

AUTHORS OF ARTICLES IN VOL. XLIX OF THE ELECTRICAL REVIEW

Abbott, W. L., Some Characteristics of Coal as Affecting Performance with Steam Boilers*..... 411
Adams, Alton D., Raise the Horseshoe Falls 163
Ashe, Sydney W., Electric Railway Engineering Preliminaries*..... 579
Practice *versus* Theory in Electric Railway Substation Operation*. 843
Bedell, Frederick, and Elbert B. Tuttle, The Effect of Iron in Distorting Alternating-Current Wave-Form*. 550, 595
Beeler, John A., Handling Public Complaints 771
Bement, A., The Suppression of Industrial Smoke, with Particular Reference to Steam Boilers*..... 668
The Testing of Coal..... 597
Berry, E. L., A New Method of Employing Twin Lead-Covered Wire for Electric Wiring..... 669
Bibbins, J. R., An Enquiry into the Operation, Efficiency and Construction of a Typical Modern Industrial Producer Gas Power Plant*..... 1013
Blackwell, F. O., The Power Plant of the Electrical Development Company, of Ontario..... 138
Bridge, Albert H., Electrical Notes from Great Britain.....601, 754, 946
The Greenwich Power Station of the London County Council*..... 972
The New Generating Station at Birmingham, England*..... 800
Buck, H. W., The Electrical Plant of the Canadian Niagara Power Company* 53
Burnand, A. H., Measurement of Friction in Gas Engines*..... 160
Cary, Albert A., Removing Oil from Exhaust Steam..... 534
Conrad, F., Frequency Meters..... 594
Cowper-Coles, Sherard, Recent Storage Battery Improvements* 858, 920
Damon, George A., What is an Engineer-Constructor? 944
Davis, W. M., Economical Lubrication of Large Power Plants..... 58
Dean, William W., Harmonic Party-Line Systems*..... 204
De Forest, Dr. Lee, The Audion, a New Receiver for Wireless Telegraphy* 724
Dow, J. S., Color Phenomena in Photometry* 501
Durand, C. L., Alfortville Central Station and the System Controlled by the Est-Lumiere Company (near Paris)* 170
Electrical Notes from Europe..... 59, 220, 638, 848
New Electrical Installations and Apparatus on the Continent*..... 288
The Entraygues (France) Hydroelectric Plant*..... 933
The New St. Denis Electric Plant at Paris* 127
Tramway Lines on the Continent*.. 589
Easton, W. H., Fire-proof Insulated Magnet Wire*..... 908
Epstein, J., The Selection and Testing of Materials for Construction of Electric Machinery 1048
Ewing, J. A., Aspects of the Inner Structure of Metals..... 463

Digitized by Google

Feiker, F. M., The Sao Paulo Tramway, Light and Power Company*. 378
Franklin, William S., The Second Law of Thermodynamics; Its Basis in Intuition and Common Sense..... 352
Fraser, J. W., Electric Power from Southern Waterfalls*..... 367
Hall, Leon M., Electrical Mine Pumps at the Ward Shaft*..... 632
Hann, E. M., Some Notes on the Mechanical Equipment of Collieries. 296
Haslam, Sidney B., and T. Hurry Riches, Railway-Motor-Car Traffic. 285
Hawes, F. B. O., and W. Langdon-Davies, Some Points About Single-Phase Motors..... 805
Hellmund, R. E., The Rotating Magnetic Field*..... 450
Henderson, J. B., Recent Advances in Our Knowledge of Radiation Phenomena and Their Bearing on Radiation Pyrometry*..... 422
Herdt, L. A., Armature Relation in Polyphase Alternators*..... 889
Hirschauer, B. F., The Frankfort Central Station*..... 417
The Simplon Tunnel Electric Locomotives* 40
Hooghwinkel, Gerald H. J., Electric Pumping at Collieries..... 100
Hopkins, C. J., Spier Falls Power-House* 91
Hubert, H., The Design of Blast-Furnace Gas Engines in Belgium.. 196
Hutchinson, R. W., Jr., A Combined Heating and Lighting System at Canton, Ohio* 756
Hydroelectric Power Plant and Transmission Lines of the North Georgia Electric Company*..... 635
Ibbotson, E. C., Kjellin Electric Steel Furnace 198
Jackson, Charles Nathan, Organization and Conduct of a New-Business Department Suitable for Central Stations in Cities of 50,000 Population and Under*..... 732
Junge, F. E., The Evolution of Gas Power 985
Kennedy, Sir Alexander B. W., Engineers and Their Work..... 1020
Kennedy, S. M., The Organization and Conduct of a New-Business Department Suitable for Central Stations in Cities of 50,000 Population and Under 180, 226
The Winning of Power Business*.... 302
Kershaw, J. B. C., Fuel, Water and Gas Analysis for Steam Users..... 376
408, 459, 492, 544, 576, 624
666, 708, 748, 796, 838, 880
The Bunsen Society Meeting at Dresden 94
The New Muspratt Laboratory of Physical and Electro-Chemistry at Liverpool University..... 770
The York (England) Meeting of the British Association..... 280
Knowlton, Howard S., Motor Loads in Small Towns..... 13
Suburban Electrification at Boston.. 252
Koester, Franz, The Electric Railroad Between Schleitheim and Schaffhausen, Switzerland*..... 283
The Hydroelectric Plant at Lucerne, Switzerland* 200
The Railway System of the Sernf Valley, Switzerland*..... 535
Langdon-Davies, W., and F. B. O. Hawes, Some Points About Single-Phase Motors 805
Lankester, E. Ray, The Advance of Science 244
Lee, W. S., Jr., Electricity: the Power Behind the South..... 62
Livingstone, R., Some Notes on the Mechanical Design of Electrical Generators* 253
Lloyd, E. W., The Relation of the Alternating-Current Motor to Central-Station Power Business..... 506
Lottermoser, Alfred, Notes on Colloids. 555
Maynard, George C., Reunion of the Old-Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps..... 644
McCarty, Norman, Diesel Engines for Interurban Railway Service..... 907
Millar, Preston S., Location of Lamps and Illuminating Efficiency*..... 814
Miller, Julian S., The Whitney Development on the Yadkin*..... 1045
Mohr, Howard K., Costs of, and Results from, Soliciting and Advertising 512
Mozley, Henry, Car Brakes*..... 676
Neall, N. J., The Benefit of Enquiry to Lightning-Arrester Practice.... 365
Pattison, F. A., Liberty and Organization 420
Peavey, J. E., Athletic Sports for Operators* 893
The Hamilton, Ohio, New Telephone Exchange* 978
Perkins, Frank C., A New Ozone Water-Sterilizing Equipment*..... 329
Electric Operation of the Teltow Canal* 498
Municipal Electric Railways at Wellington, New Zealand*..... 247
Pickard, Greenleaf W., The Measurement of Received Energy at Wireless Stations*..... 980
Rae, Frank B., Jr., Advertising Electricity 952, 990, 1028, 1064
Raymond, Rossiter W., Professional Ethics 64
Raymond, William G., The New Engineering Building of the State University of Iowa..... 292
Reynolds, L. E., How Electricity was Served to Consumers and Street-Car Lines by the San Francisco Gas and Electric Company After the Fire..... 584
Rice, Calvin W., The Field of a National Engineering Society..... 358
Riches, T. Hurry, and Sidney B. Haslam, Railway-Motor-Car Traffic.... 285
Robb, J. M., Organization and Conduct of a New-Business Department Suitable for Central Stations in Cities of 50,000 Population and Under 336, 386
Roberts, E. P., Electric Railways in Sparsely Settled Communities..728, 766
Russell, C. J., Adjuncts to the Power Load* 850
Rust, Samuel, Best Methods to Increase Business Applied to a Small City Where the Population is not Increasing 472
Sammett, M. A., Polyphase Systems of Generation, Transmission and Distribution 927
Seaver, Charlotte D., Comparative Cost of Cooking with Various Fuels.... 1024
Sharp, Clayton H., New Types of Incandescent Lamps*..... 939
Shoemaker, John V., Electricity in the Treatment of Disease..... 841
Shuster, J. W., Balancers*..... 99
Sloan, J. R., The Use of Storage Batteries in the Electric Lighting of Steam Passenger Equipment*.... 920
Smith, W. N., The Electric Car Equipment of the Long Island Railroad* 210
Soddy, F., The Recent Controversy on Radium 538
Steinmetz, Charles Proteus, Transformation of Electric Power Into Light* 924, 968
Sullivan, M. C., The Use of the Telephone in the Permanent Seacoast Defenses of the United States*.. 540
Sweany, W. Randolph, Organization and Conduct of a New-Business Department Suitable for Central Stations in Cities of 50,000 Population and Under..... 558
Swinburne, James, Indoor Illuminants. 975
Tait, F. M., New Business: How to Get It and How to Keep It, Applied to a Large City..... 430
Townley, Calvert, The Single-Phase System in Steam Line Electrification and Electric Railway Development 359
Tuttle, Elbert B., and Frederick Bedell, The Effect of Iron in Distorting Alternating-Current Wave-Form*.. 550, 595
Vignoles, Walter A., Efficiency of Steam Plant*..... 259
Walker, Guy Morrison, Sound Engineering in Interurban Railway Construction 639
Walker, Miles, Rotary Converters *versus* Motor-Generators 1006
Walker, Sydney F., Electrical Mining Notes 135, 176, 1018
Waters, W. L., Small Railway Substations* 372
Watson, S. J., Power Supply to Tramway Systems*..... 140
Weeks, W. C., The Largest Movable Dam of the Bear-Trap Type in the Country 711
Wilgus, W. J., The Present Status of the Electrification of the New York Zone of the New York Central & Hudson River Railroad*..... 354
Wilkinson, George, Economy in Central Station Operation..... 855
Live Steam Heated Feed-Water—Its Effect on the Output and Efficiency of Steam Boilers.....166, 218
Willey, D. A., Adaptations of Electrically Driven Conveyers*..... 752
Wilson, Professor Harold A., The Theory of "Moving Coil" and Other Kinds of Ballistic Galvanometers. 633
Wiltse, James L., Organization and Conduct of a New-Business Department Suitable for Central Stations in Cities of 50,000 Population and Under 904
Woodwell, J. E., Data on Indoor Illumination* 713

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 1. NEW YORK, SATURDAY, JULY 7, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. L. W. MARSHALL, Manager
BOSTON OFFICE: Delta Bldg., 10 Post Office Square, M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad St., London, E. C., HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.
Copyright, 1906, by Electrical Review Publishing Co.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

CONTENTS.

EDITORIAL:
The Power Plants at Niagara Falls . . . 1
Progress in Electrification . . . 2
The Portable Substation . . . 2
The Prize Paper on Methods of Getting New Business . . . 3
Electric Smelting of Iron and Steel . . . 3
Test of a 5,000-Kilowatt Curtis Steam Turbine . . . 4
Electricity on Steam Railroads . . . 5
Calvin W. Rice Accepts the Position of Secretary of the American Society of Mechanical Engineers . . . 6
Electric Railways in Australia . . . 6
The Electrical and Mechanical Equipment of the New Clubhouse of the Engineers' Club, New York City . . . 7
Belgian Telegraph and Telephone Service . . . 9
BOOK REVIEWS . . . 9
The Hydroelectric Plant of the Baker Light and Power Company, Baker City, Ore . . . 10
Motor Loads in Small Towns, by Howard S. Knowlton . . . 13
The Electrical Works of the Allis-Chalmers Company . . . 14
The National Electrical Contractors' Association . . . 18
Gas Engine Ignition . . . 18
Opening of the Teltow Canal . . . 18
Flour Bleaching with the Aid of Electricity . . . 18
The National-Interstate Telephone Association . . . 19
Illinois Independent Telephone Association . . . 23
New York Pay-Station Telephone Rates . . . 23
Seventh Annual Meeting of the National Electrical Trades Association . . . 23
Railway Men Visit Schenectady, N. Y . . . 23
New York City Brings Suit to Get $5,000,000 . . . 23
The World's Coal Supply . . . 23
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 24
METHODS OF GETTING NEW BUSINESS—"Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under," by M. S. Seelman, Jr . . . 26
INDUSTRIAL SECTION:
Small Riveted-Frame Induction Motors . . . 29
Central Station Advertising at the National Electric Light Association Convention . . . 30
The Exhibit Plant of the Automatic Refrigerating Company . . . 30
Railway Equipment for the United Railroads of San Francisco . . . 31
CURRENT ELECTRICAL NEWS . . . 32

THE POWER PLANTS AT NIAGARA FALLS.

The recent convention of the Canadian Electrical Association at Niagara Falls, Ontario, created an opportunity for describing the large hydroelectric plants there and called attention again to the remarkable work going on. No other place in the world offers anything like it, for there are there not only the largest hydroelectric plants ever constructed, but there are five such plants, all of magnificent proportions, constructed on at least three plans. In fact, it might almost be said that there were five different types. Three plants, it is true, are of the wheel pit type, but one of these is really two independent plants placed side by side. The second is one large plant placed over a single long wheel pit, while the third differs from the other two in employing a shorter tunnel driven under the bed of the river. The second of the five plants to be erected uses an open canal with vertical steel penstocks, while the remaining plant, which, indeed, is the largest of all, carries its water from the headworks through large steel pipes, from which it is taken through penstocks to the turbines.

The first three stations use vertical turbines, while in the latter two the horizontal type has been adopted. A significant feature of the newer work is the larger size of the units. Those of the original power-house were rated at 5,000 horse-power, while in one of the newer stations the rating is 13,000. Such an enlargement indicates a wonderful development in the construction of both hydraulic and electrical machinery.

Another feature of the newer plants is the separation of the transformer house from the power-house. While at the original station this was done, the two houses there were separated by a short distance only, but on the Canadian side, due probably to the topographical features of the land, these houses have been placed much further off, and in one case—that of the Ontario Power Company—the switching apparatus has been taken along with the transformers, thus dividing the power plant into two sections—generating and controlling houses. The operation of this plan in practice will be watched with considerable interest, for although a more or less complete separation of the switchboard room from the generating room has been adopted in a few instances, this has been only at smaller plants, and the switchboard room has always been adjacent to the generating room. In the new plant the only communication will be by means of signals and the telephone.

A very essential feature of the new work is the guarding against all possible accidents. Reserve apparatus is provided, conduits are in duplicate, and, in one case, four are provided, one being held entirely in reserve. The stations are as fireproof as iron and concrete can make them, and no possible contingency seems to have been overlooked. It is also noteworthy that all of these stations are providing for high-voltage transmission up to 40,000, 50,000 or even 60,000 volts.

Any one of these notable stations would be sufficient to attract visits of engineers from all parts of the world, but we have here not merely the largest hydroelectric station in the world, but five such installations, and these offer examples of considerably differing practice, rendering the vicinity far more interesting to engineers. The work going on there can only be described as stupendous, although we have grown more or less familiar with it, since the original plant has been in operation long enough for the novelty to have worn off. The work, nevertheless, is unparalleled anywhere else in the world, and it seems likely to remain so, for the plans proposed for developing Victoria falls, in South Africa, seem to have made little or no headway.

Digitized by Google

PROGRESS IN ELECTRIFICATION.

That progress is being made in the question of electrifying steam railroads was made evident at the recent meetings of steam railway men at Atlantic City, N. J., where there were about 5,000 in attendance at conventions, representing nearly all of the great railroad systems of the country. Here there was a strong undercurrent of enthusiasm on all questions connected with this great problem. On the other hand, it is probably safe to say that some of the large railway systems have not been averse to delays in the development of apparatus and machinery for this electrification, because of the vast amount of capital which is tied up in their present motive power, and any developments which might abruptly force the casting away of this valuable equipment are to be dreaded.

But on the whole, the attitude taken by the engineers who are dealing with these questions, and the open mind which the operating railway officials maintain, indicate that, mentally at least, if not physically, this movement has made much progress, and probably the next few years will bring about large and momentous changes.

An incident of this coming together of railway men was the report of a committee to the American Railway Master Mechanics. This committee had been instructed to consider and present to the association a report upon the relative advantages of electric traction as applied to interurban and suburban lines. The committee did not think that it had sufficient accurate data to point out the relative operating costs of the electric system as compared with steam, but it called attention to features of the electric system which are drawing traffic away from the steam roads. These are, as has often been pointed out, the more frequent service obtainable and the absence of smoke and cinders. The latter feature will appeal strongly to all who are forced to use steam trains during the hot months. In the cities, abatement of the smoke nuisance has been under consideration for some time past, and some headway has been made. The steam roads, however, are left pretty much to themselves to use any fuel they see fit in outlying districts. Little or no importance seems to be attributed to this irritating condition, and, in general, that kind of coal seems to be employed which is cheapest from the purchasing agent's point of view. It is true that at certain of the larger cities in this country the adoption of electric propulsion is being considered, or is even being carried out, but this is work requiring a good deal of time, and the electrical zones which have been mapped out do not extend very far into the country. One would think that the steam roads would recognize the ill effects of the nuisance and do something, at least, to abate it, thus diminishing in part the contrast between their method of operation and the competing electric lines. Even though the promise to electrify may hold their patrons for a year or so, the experience of a prospective patron on such a road during a hot day is almost sure to drive him elsewhere. Are the steam roads willing to stand still while their rivals forge ahead?

Part of the report referred to above dealt, in a general way, with the so-called independent motor cars—that is to say, cars equipped with gasolene or oil engines which drive directly or through electric gearing. The equipments of a number of cars were described, and some approximate figures for the cost of operation given, but no definite conclusions were reached. The committee, in fact, seemed more impressed with the prospect that the members of the association would soon have to take care of electrical apparatus, and the necessity of becoming familiar with it, than with the possibility of competing electric roads drawing away the traffic of those steam roads which do not give more consideration to the comforts of their passengers.

THE PORTABLE SUBSTATION.

The description of the two portable substations which form a part of the equipment of the Long Island Railroad's electrical zone calls attention to an interesting development in electric railway engineering. These substations, which were referred to in the ELECTRICAL REVIEW for June 30, are merely two heavy cars on which are mounted one complete unit of a standard substation, this unit consisting of a 1,000-kilowatt rotary converter with its accompanying group of three stationary transformers, each rated at 375 kilowatts, and with the necessary switches and indicating apparatus. These substations are intended to be used at outlying points where there are occasional excessively heavy loads. For example, during the racing season, one of the substations may be run out near the race-tracks and assist in handling the many and heavy trains which must be started from that point within a short time. At other times the substation may be utilized elsewhere, and when there is no special load it can be stationed at a regular substation, where it may act as a reserve or take care of such unusual loads as may come there.

The equipment of each of these portable substations forms in itself what would, in many places, constitute a very respectable stationary equipment. In fact, it is only a few years ago that we looked upon a 1,000-kilowatt rotary converter with a good deal of awe; and, a little further back, generators of the same rating were spoken of as evidences of the remarkable development in electrical design and construction. But here we have two such machines, each placed upon a truck, to be carted out at will. It reminds one of the practice in the old days of the horse-car, when hill horses were placed at steep sections of the road during certain parts of the day, so as to help out the regular team.

This development of the portable substation is an outcome of the adaptation of high-tension polyphase power transmission to electric railway operation. As soon as the electric railway had been shown to be practicable, the excursion feature was developed, resulting in occasional heavy loads which the ordinary equipment could not handle. The same problem was met in dealing with the crowds which gathered at places of amusement. In those days great difficulty was experienced in getting the cars away on account of the heavy load on the feeder line. Sometimes what was, in effect, a breakdown took place, as it was possible to start the cars only every few minutes. The first step to meet this condition was to run extra feeders to these

Digitized by Google

points, but the expense and poor economy of doing this was evident. Then arose the practice of installing boosters—that is to say, machines intended merely to compensate for the loss of potential in the feeders. They were connected in series with the load and raised the voltage some 200 volts or so, so as to maintain it normal at the point of load. Such a device was undoubtedly extremely wasteful, since the whole output of the booster was lost in the line; but it had the effect of keeping the road running, and where the meetings were somewhat infrequent, it was, on the whole, less costly than paying interest on a large amount of copper.

The introduction of high-tension transmission for this work offered another solution, which, if we remember correctly, was utilized first at St. Louis, and which was substantially that now adopted by the Long Island Railroad. It was nothing more than the mounting of a rotary-converter equipment on a car, which could be hauled around the city to whatever point was needed. Its use by the Long Island Railroad on a larger scale is a noteworthy feature of this road's magnificent equipment.

THE PRIZE PAPER ON METHODS OF GETTING NEW BUSINESS.

Last March the Cooperative Electrical Development Association, of Cleveland, Ohio, announced a competition, open to all central station managers and their employés in the commercial department, for the three best papers on the organization and conduct of a new business department suitable for central stations in cities of 50,000 population and under. The decision as to the winners was left to a committee of three central station managers to be appointed by the president of the National Electric Light Association. At the recent convention of the National Electric Light Association at Atlantic City, N. J., the winners of these prizes were announced. The first prize was $500; the second prize, $300, and the third prize, $200. It is the purpose of the Cooperative Electrical Development Association to give these papers as wide publicity as possible, and as the initial step in this programme of publicity the three papers winning the three prizes and four papers receiving honorable mention will, from time to time, be published in the technical journals, and later distributed in pamphlet form.

We take pleasure in publishing on other pages of this issue the first portion of a very interesting and practical paper by M. S. Seelman, Jr., of the Edison Electric Illuminating Company, Brooklyn, N. Y., winner of the $500 prize. No one who reads Mr. Seelman's paper can help becoming enthusiastic over the suggestions he makes for improving the demand for current. There is not a single suggestion, apparently, that is impracticable; in fact, it would seem that as Mr. Seelman lays it out, the matter is one of great simplicity. Too much can not be said in praise of the organization which initiated this movement, and if the papers receive the attention they deserve, a vast amount of good will be accomplished.

About ten months have passed since active work was begun in a systematic way to stimulate the use of electric current, and reports giving definite figures of the results accomplished would be interesting as well as helpful in directing the progress of the movement.

ELECTRIC SMELTING OF IRON AND STEEL.

In the ELECTRICAL REVIEW for June 23 some comments were made upon the recently issued report of the Canadian commission appointed to investigate the electrosmelting of iron ores. While that report took a most optimistic view of the problem, hope was expressed that further experiments and studies would be made before committing the Canadian government to any heavy expense. The feeling was expressed that the matter was too important to be decided hurriedly, and upon a single series of tests conducted on a comparatively small scale.

Since this hope was expressed, a brief report has come to hand of an opinion given before the Institution of Civil Engineers, of Great Britain, by Mr. R. E. Hadfield, on electric smelting. Mr. Hadfield is a metallurgist of long experience, so that his statements must be accepted with weight, even though he be inclined to look somewhat coldly on the proposal to use the electric furnace for producing iron and steel. He holds that not all the problems involved in the electrical production of steel have been solved, and he believes that the Bessemer and Siemens-Martin processes, with possibly some refinements, will continue in use for a long time. About one-seventh of the world's production of coal is used in smelting iron alone. This is aside from the large quantities utilized in making steel. Furthermore, Mr. Hadfield questioned whether the electric furnace does produce any purer quality of steel than the older processes.

These opinions, coming from one who undoubtedly believes that the old processes have been highly developed, need not be accepted without question. Electrical methods have usually been successful for reasons other than a reduction in the cost of power. Many advantages always follow from the use of this convenient form of energy, and a comparison of the costs of heat supplied electrically and by means of coal will not settle the question any more than will a few experimental trials. The true outcome will probably be neither that predicted by the electric furnace advocates, nor that feared by the users of older processes. The former, as has been true of many engineers and others who have assisted in developing an electrical method, are apt to be a little too enthusiastic; or perhaps it would be better to say a little too confident. To some anything is possible, if only an electrical method is obtainable. Fifteen years ago we were told that the steam locomotive was on its last wheels, and shortly would become a curiosity; yet how many to-day have really been displaced, and, on the other hand, who will now venture to say what will be the railway motive power ten, or even only five years from now? Would it not be better if we paid more attention to past experience and were a little less positive in our predictions?

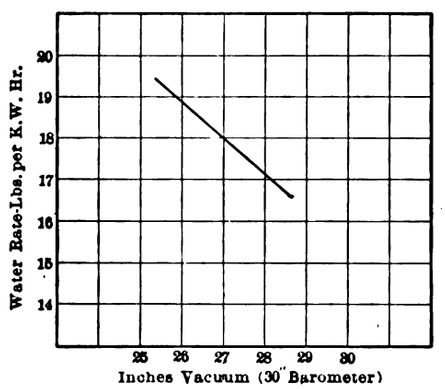
The electric furnace has to its credit a great deal of invaluable work. We now use in large quantities, which before its application were chemical curiosities. But there have been good reasons for its use here, and they do not necessarily prove that it is the best apparatus for all thermal processes.

Digitized by Google

Test of a 5,000-Kilowatt Curtis Steam Turbine.

In March, 1906, a series of tests was made on one of the 5,000-kilowatt Curtis steam turbines which has been in commercial service for about one year in the Fisk street station of the Commonwealth Electric Company, Chicago, Ill. The turbine set is one of four installed in this station.

The generating unit consists of a 5,000-kilowatt turbine, direct-connected to a six-pole, three-phase, 5,000-kilowatt, 9,000-volt, 500-revolutions-per-minute revolving



TEST OF STEAM TURBINE.

field generator. All the tests, except those for speed, were made under regular commercial load conditions. On account of the change in frequency during the speed tests, the load was absorbed by a water resistance, composed of plates in the Chicago river. It was found that the water rate for the commercial load was identical with that obtained by use of the water rheostat, other conditions remaining the same.

In the commercial tests the load despatcher maintained a constant load on the turbine under test by varying the tension of the auxiliary governor spring by means of a motor controlled from the switchboard. The steam pressure and superheat were kept as constant as possible by giving proper attention to the boilers.

The load was measured by special indicating wattmeters, connected to independent potential and current transformers. All instruments were carefully calibrated at Schenectady and the calibration later verified in the laboratory of the Commonwealth Electric Company. As an additional precaution to insure accuracy, the readings taken were checked by readings obtained from a duplicate set of instruments calibrated by the Electrical Testing Laboratories, of New York. The load readings were recorded at intervals of two minutes.

All tests were made at about 150 degrees Fahrenheit superheat, the temperature being read by calibrated mercury thermometers. The thermometers were placed in wells filled with mercury and proper correction was made for the exposed stem. Temperatures and pressures were recorded every five minutes.

The amount of steam used was obtained by discharging the condensed steam into tanks, where it was weighed. After each run the condenser was tested for leaks, which, as shown by the tables, were of small amount.

The detailed results of the test at 500 revolutions per minute are shown in table i. Table ii gives the readings obtained at 650 revolutions per minute. To make the tests comparable, all results were reduced to 150 degrees superheat, one and one-half inches back pressure and 175 pounds (gauge) steam pressure. The reduced water rates are given in the ninth column of tables i and ii. Tables i and ii are summarized in tables iii and iv, respectively, and from these are obtained the curves shown in Fig. 1. Fig. 2 shows the performance of the turbine at 500 and 650 revolutions per minute.

TABLE III (SUMMARY TABLE I).

500 revolutions per minute. 150 degrees Fahrenheit superheat. 1½ inches back pressure. 175 pounds steam pressure (gauge).

Kilowatt.	Load.	Water Rate.
2,500	½	17.74
3,750	¾	17.08
5,000	Full	16.62
6,250	1¼	16.52
7,500	1½	16.90

TABLE IV (SUMMARY TABLE II).

650 revolutions per minute. 150 degrees Fahrenheit superheat. 1½ inches back pressure. 175 pounds steam pressure (gauge).

Kilowatt.	Load.	Water Rate.
3,750	¾	16.85
5,000	Full	16.07
6,250	1¼	15.88
7,500	1½	15.80

The tests were conducted under the supervision of the representatives of the purchaser, Sargent and Lundy, and those of the General Electric Company, Schenectady, N. Y.

TABLE I.

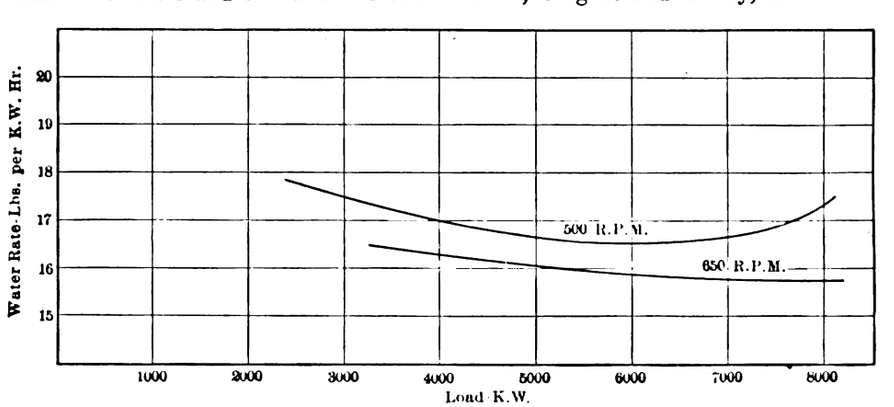
Load. Kilowatt	Steam Pressure (Gauge).	Superheat. Degrees Fahrenheit.	Gross Flow. Pounds Hour.	Condenser Leakage. Pounds Hour.	Back Pressure. Inches Mercury.	Revolutions per Minute.	Water Rate. Pounds per Kilowatt-Hour. Actual.	Water Rate. Pounds per Kilowatt-Hour. Reduced.*	Notes.
3,340	171	151	56,690	1,070	0.89	500	16.66	17.29	Water rheostat.
5,940	169	180	98,370	950	1.72	"	16.40	15.55	Commercial.
2,920	172	158	50,930	1,050	1.08	"	17.08	17.61	"
4,860	179	180	81,550	1,700	1.55	"	16.50	16.81	Water rheostat.
7,525	175	147	130,200	820	2.09	"	17.19	16.91	" "
4,950	180	171	80,370	220	1.48	"	16.23	16.55	Commercial.
0	178	150	3,520	220	1.40	"	....	....	Full voltage.

* Reduced to 150 degrees Fahrenheit superheat; 1½ inches back pressure; 175 pounds gauge steam pressure.

TABLE II.

Load. Kilowatt.	Steam Pressure (Gauge).	Superheat. Degrees Fahrenheit.	Gross Flow. Pounds Hour.	Condenser Leakage. Pounds Hour.	Back Pressure. Inches Mercury.	Revolutions per Minute.	Water Rate. Pounds per Kilowatt-Hour. Actual.	Water Rate. Pounds per Kilowatt-Hour. Reduced.*	Notes.
3,530†	170	165	55,900	1,070	0.85	650	15.55	16.40	Water rheostat.
5,140	180	179	81,930	1,700	1.50	640	15.67	16.03	" "
8,090	177	141	131,160	820	2.03	640	16.11	15.80	" "

* Reduced to 150 degrees Fahrenheit superheat; 1½ inches back pressure; 175 pounds (gauge) steam pressure; 650 revolutions per minute.
† Average of two points.



TEST OF STEAM TURBINE.

Digitized by Google

Electricity on Steam Railroads.[1]

The instructions of your committee on electricity on steam railroads read as follows: The committee shall consider and present to the association the relative advantages of electric traction now in use as applied to interurban and suburban lines; also, as far as possible the relative cost of operating such lines by electricity and steam. The committee is also instructed to include in its investigations the different systems of gasolene, gasolene-electric and steam motor cars.

This commission is almost the first recognition in this association of other motive power than the steam locomotive and your committee doubts its ability to cover the whole ground of its instruction in a perfectly satisfactory and comprehensive manner, for the reason that the factors in each railroad proposition vary from its neighbor even as men vary in their personal characteristics.

We understand that main line operation is not to be considered, but that branch lines, suburban and interurban lines which are feeders to main lines are to be discussed. We understand, also, that the question relates mainly to passenger traffic on account of the expression "now in use," as electric traction of freight is carried on to a limited extent only at the present time. Mail, baggage and express are being handled, but these are generally considered in connection with or a part of the passenger traffic.

In early electric street railway traction several attempts were made to utilize an electric locomotive, but these were generally abandoned, although it is customary now on some roads to have trail cars attached to leading motor cars. The latest and most advanced practice is to have all cars equipped with motors controlled from the leading car. The development in electric cars has been marked not only by their increase in size and carrying capacity, but also in the size of motors employed. The earlier cars had fifteen or twenty horsepower equipment, but it was soon found that these were inadequate to properly accelerate loaded cars, and now many heavy suburban cars are equipped with four seventy-five-horse-power motors, each, and in some cars the motor equipment totals 400 horse-power.

We have, therefore, available for comparison the steam railroad train, consisting of a locomotive with as many cars as the service demands, running at infrequent intervals, and covering perhaps 200 miles per day, as against the same road operated with individual electric cars, obtaining power from a general source, running at frequent intervals and fairly equivalent mileage.

The travel which is contemplated is the local, short runs, which in many cases have been taken from steam railroads by competing electric lines, this proving that the more frequent service and general convenience of the trolley line is more attractive. Absence of smoke and cinders, open cars in season, connections with city lines, all add to the popularity of the trolley and give a business that can be profitably carried at lower rates, which, after all, is the main inducement.

RELATIVE COSTS OF OPERATING BY ELECTRICITY AND STEAM.

The relative costs of operation with electricity and steam are difficult to state as there is very little accurate information of value. The results obtained by attempting to draw comparisons from hypothetical roads would depend entirely upon the assumptions which were made. For instance, a set of conditions could be assumed which would show a much lower cost of operation by electricity than by steam; another set could be assumed which would show practically equal cost, and a third set which would show that steam operation would be the most economical. In view of the fact that the assumptions would govern the results, it is believed that information of this nature would not be of value to the association and might lead to erroneous assumptions and misunderstanding.

A number of electrifications are under way at the present time employing various systems of distribution, and a considerable amount of data will no doubt be available in the near future.

Relative subjects which would be of interest and value to this association are the character of the shops, shop equipment and apparatus necessary for the maintenance and repair of electric equipment; also the power-houses and their equipment.

GASOLENE, GASOLENE-ELECTRIC AND STEAM MOTOR CARS.

Some time prior to the development of electric interurban railways the steam motor car or dummy, in many cases hauling a trailer, was used to a moderate extent, but at the present time few of these remain. In response to a demand from railroad managers for a motor car to operate on branch lines and special situations there has been recently a development of motor cars employing gasolene in an internal combustion engine, this engine either directly driving the car or driving a dynamo to generate current to be used for driving motors on the trucks. Some builders interpose batteries between generator and motors to store the current when it is not all needed for propulsion, and to assist in starting on grades when the generator capacity may be insufficient. There is very great flexibility and convenience in this combination, but it is attained at very considerable expense and complication, and requires unusually skilled attendance not commonly available in railroad service.

The examples of the gasolene engine, electric generator, battery and motor types are the cars of the St. Joseph Valley Traction Company's line, built by F. M. Hicks, and the Strang car that lately made a successful run from New York to Kansas City. The gasolene engine on these types is set to run at a constant speed, and this characteristic is essential for the best economy of the internal combustion engine. The size of the engine used may be proportioned to the average power required for normal operation, and the speed variation and excess of power above normal requirements may be supplied by the battery equipment, which also comes into play for lighting and short movements and would also be available to bring the car in in case of a breakdown of the engine or generator.

The gasolene-electric type not employing batteries is illustrated by the D. & H. car recently built by the General Electric Company. The generator on this type of car has to be equal to the maximum requirements, and in order to vary the current for the conditions to be met, the field excitation is handled by a separate exciter, chain-driven from the main generator. The controller is semi-automatic and can be set for any predetermined maximum acceleration, and the speed of the car is governed by varying the field strength of the generator. The speed of the engine remains constant after acceleration. This application is very ingenious and effective, and we understand that the car has been put into regular service between Schenectady and Saratoga.

The Union Pacific motor car, representing the direct mechanical drive application of gasolene power, is driven by a six-cylinder reversible gasolene engine, with crank shaft at right angles to the length of car; a sprocket mounted on same, driving a special chain transmits the power direct to the driving axle through a second sprocket attached to the axle. The chain easily shows a transmission of power with an efficiency of ninety-seven per cent, which clearly demonstrates that this meth-

[1]Committee report to the convention of the American Railway Master Mechanics, Atlantic City, June 18-20.

Digitized by Google

od of transmission is very close to the maximum efficiency possible.

For the initial start of car, or putting it in motion, a reducing gear is used, and, until the car attains a speed of six or seven miles per hour the economy of this transmission is somewhat reduced; but, as the use of the gears is only temporary and lasts only a few seconds, it can almost be left out of consideration.

The first cars—fifty-five feet long, seating capacity seventy-five, and with an engine of 100 horse-power—are particularly adapted for branch line service, where the traffic is insufficient to support a steam service or anything like electric service.

Interest in the steam car is also being revived, as, for example, the Ganz cars imported from Budapest by the Florida East Coast Railways; the Erie and the Canadian Pacific are also experimenting with a steam car equipped with a Scotch marine type of boiler, using a superheater and oil fuel. It is believed that some one may undertake to make a so-called flash boiler that will be applicable to this service.

SERVICE AND UTILITY OF MOTOR CARS.

It is recognized that the so-called motor car, one carrying its own motive power plant, whether gasolene, gasolene-electric or steam, occupies a distinct field of usefulness. Many branch lines, now existing, where travel is light, and on new extensions into unsettled country where the business will not return a profit on steam train service, it would have to be run at a loss until a sufficient business was induced or built up by the travel facilities afforded. These situations are the distinct field of the motor car, which can be operated for less per car-mile than by regular steam train or electric methods until the volume of business will warrant the regular transportation methods.

The use of motor cars on the Union Pacific in picking up passengers on branch lines and in delivering passengers at connecting points for through trains, is exceedingly lucrative. The matter of giving the branch line patrons of any steam road increased service, with more frequent trips per diem, is very much appreciated by the local community, and their good will is beneficial.

On the hypothesis of the same density of traffic, with the same class of service as would be encountered on one of the ordinary branch lines of the territory west of the Missouri river, the cost per mile for local train service, equipment consisting of two cars and a locomotive, would be about twenty-four cents, including repairs, fuel, oil, labor, cleaning, etc.; this for passenger, as well as baggage, mail and express service.

Electric service equipment, consisting of one car and trailer figuring that the density of traffic is sufficiently regular to support same seven days in a week, is estimated at about eighteen cents a mile.

The gasolene service (mechanical-drive only considered), consisting of one car and trailer, with baggage, mail and express service, would cost fifteen cents per mile. The latter, of course, would be independent of whether service was six days or seven days per week, the cost simply depending upon the service rendered.

Railroads, therefore, have a choice of the systems proposed, and a study of the conditions to be met and facilities afforded, both in the way of care and maintenance, as well as the train service proposed, will give the elements by which each situation will have to be studied. The motive power departments will be called upon to participate more and more in advising as to these questions, and in order to be qualified to undertake such work it is very desirable to introduce information and discussion of these subjects in this association.

The report is signed by C. A. Seley, W. R. McKeen, Jr., L. R. Pomeroy, C. F. Street, F. J. Cole.

Calvin W. Rice Accepts the Position of Secretary of the American Society of Mechanical Engineers.

Calvin W. Rice has accepted the position of secretary of the American Society of Mechanical Engineers, which was offered him by a vote of the council some time ago, and entered the service of the society on July 1. Mr. Rice is a graduate in engineering from the Massachusetts Institute of Technology. He has had a very complete experience in machine shop practice, operating all manner of tools. After graduation he entered the employ of the General Electric Company, working up to the position of assistant engineer of the power and mining department, which he retained until 1885, when he was appointed local engineer at Cincinnati, Ohio, for the General Electric Company. In 1895 and 1896 he was electrical superintendent of the Silver Lake mines, Silverton, Col., and later was connected with the Anaconda Copper Mining Company. In 1898 he was electrical engineer of the Kings County Electric Light and Power Company, Brooklyn, N. Y., and soon after became electrical engineer of the Consolidated Telegraph and Electrical Subway Company, owning and operating the high-tension subways of New York. He has been chief of the meter and testing department of the New York Edison Company, and second vice-president and sales manager of the Nernst Lamp Company. Since 1904 he has been a consulting engineer with the General Electric Company.

Mr. Rice is a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the Institution of Electrical Engineers, of Great Britain (having been proposed by Lord Kelvin), a member of the American Association for the Advancement of Science, the Society of Colonial Wars, and several other organizations.

Mr. Rice's wide experience in handling large organizations, and his keen appreciation of the possibilities of cooperation among the national engineering societies is indeed fortunate, in view of the closer relationship which is existing among these organizations at the present time. Mr. Rice, it would seem, enjoys the unique distinction of being the man for the place both by training and by nature, and there is no doubt that he will prove a worthy successor to that faithful and beloved genius, Professor Hutton, who retires after a long and faithful service which will always stand as a monument to his integrity and character.

CALVIN W. RICE.

Electric Railways in Australia.

A report from United States Consul-General J. P. Bray, Melbourne, Australia, states that there are fifty miles of electric road in operation in Australia. These are short lines in Melbourne, Sydney, Hobart, Ballarat and Bendigo. Further extension of the electric lines is under consideration more or less by the state governments of most of the states, particularly Victoria, New South Wales, South Australia and West Australia. In Victoria many of the suburban municipalities have under consideration the construction of lines, and much interest is being displayed in that direction.

Digitized by Google

The Electrical and Mechanical Equipment of the New Clubhouse of the Engineers' Club, New York City.

The new home of the Engineers' Club, which is being built on West Fortieth street, New York city, will be equipped with an electrical and mechanical installation possessing a number of features which have not been tried heretofore to any considerable extent in buildings of a similar character.

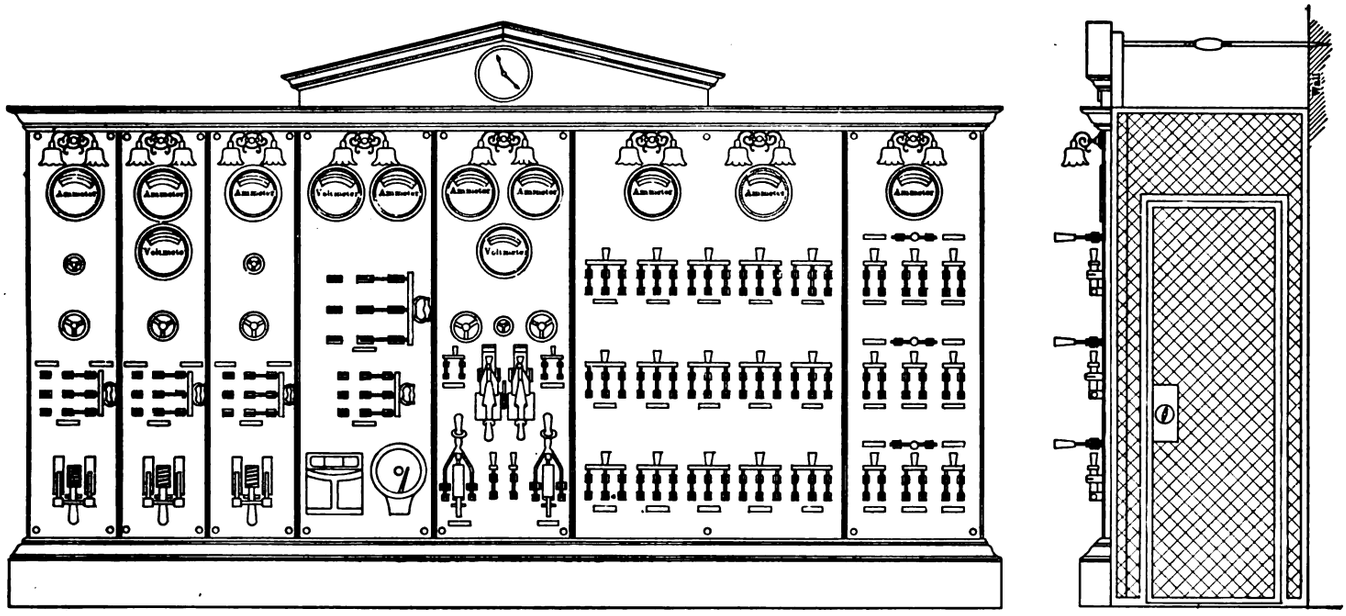
On the first floor of the building there will be located the vestibule, reception rooms, administration office, coatroom, grand stairway, foyer and main hall. This hall will be served by three electric elevators, and at the extreme end of the first floor the main café and grillroom will be situated. The large clubroom will be situated in the front part of the second story, with the library in the rear. The billiard room will occupy the front of the third floor, and the remaining space will be given up to committee rooms and cardrooms. The six stories above will be devoted to bedrooms, and immediately above the bedroom floors there will be the breakfast room, serving room and two private dining rooms with a large reception room adjoining. The entire eleventh story will be taken up with a banquet room, and the twelfth story will be given over to the service work. On this floor there will be located the cooking range, plate warmer, dish washer, steam tables, etc., all of which require service from the heating, ventilating or power system of the building.

The front portion of the roof will be devoted to a roof garden, and at the rear there will be the laundry and a room in which will be located some of the machinery for the ventilating system.

The basement will contain the general toilet, barber shop, steward's office, storerooms, etc. The machinery for the operation of the lighting, heating and refrigerating plant and elevator equipments, and also a portion of the ventilating machinery, will be installed in the sub-basement.

The boiler equipment will include a battery of two water-tube boilers, each having approximately 200 horse-power capacity. Adjoining the boiler room there is provided a coal storage room and a larger storage room in front of the building for handling coal in quantity. The boilers are connected by a steel-plate flue and breechings with the steel smoke-stack which passes up the rear of the building. A hand damper is provided in the smoke connections at each uptake from the boilers. There will also be a balance swinging damper in the main smoke connection, operated by shafting controlled by a Locke automatic damper regulator. A No. 6 "Monitor" pattern Nathan injector will handle the feed water for the boilers.

The primary source of boiler feed supply will be handled by two six-inch by four-inch by six-inch duplex return circulating boiler feed pumps located in the central portion of the sub-basement, just outside of the boiler room. These pumps will also handle the water of condensation from the heating system and will feed fresh water to the boilers. For returning the water of condensation from the tempering coils of the ventilating system to the boilers there will be installed two five and one-quarter-inch by three and one-half-inch by five-inch duplex pumps, and for emptying the blowoff tanks there will be one duplex pump of the same size, making a cross-connection from the draining pit back of the boilers. A four and one-half-inch by two and three-quarter-inch by four-inch duplex pump, connected with the high-pressure drip compartment of a "Utility" tank, and arranged to discharge into the sewer or to the boilers, will take care of the high-pressure drips. All of these pumps are to be controlled by Kiely automatic pump governors. The feed-water equipment will include a heavy pressure feed-water heater and purifier of the closed type, equipped with a thermometer to indicate the temperature of the feed water, and there will also be installed one No. 4 "Utility" combined grease extractor and exhaust muffler tank.



FRONT ELEVATION OF SWITCHBOARD, MECHANICAL AND ELECTRICAL EQUIPMENT, ENGINEERS' CLUB BUILDING, NEW YORK CITY.

A main high-pressure line will take off branch connections extending from the steam drums of each boiler, and from the main line a high-pressure line will run to the engine room, connecting with a high-pressure distributing header for the engines. There will be separate high-pressure branch connections to each engine, with long-sweep bends instead of fittings.

From the high-pressure line a branch main will be taken off near the boilers, connecting with all the steam pumps and moistening apparatus, the kitchen and laundry service, the hot-water tanks, refrigerating apparatus, heating apparatus, air compressors, sewage ejectors, vacuum system exhauster, reducing valves, etc., all individual power branches being run from the top of the main.

The electrical equipment will include

Digitized by Google

three generating sets, each of the engines being protected by a Cochrane vertical steam separator in the branch pipe. The drip connections from these generating sets will be through automatic discharge taps to the high-pressure receiver of the muffler tank.

A back-pressure valve will be installed on the main exhaust pipe, and the heating and ventilating apparatus and the kitchen apparatus will be protected by pressure-reducing valves.

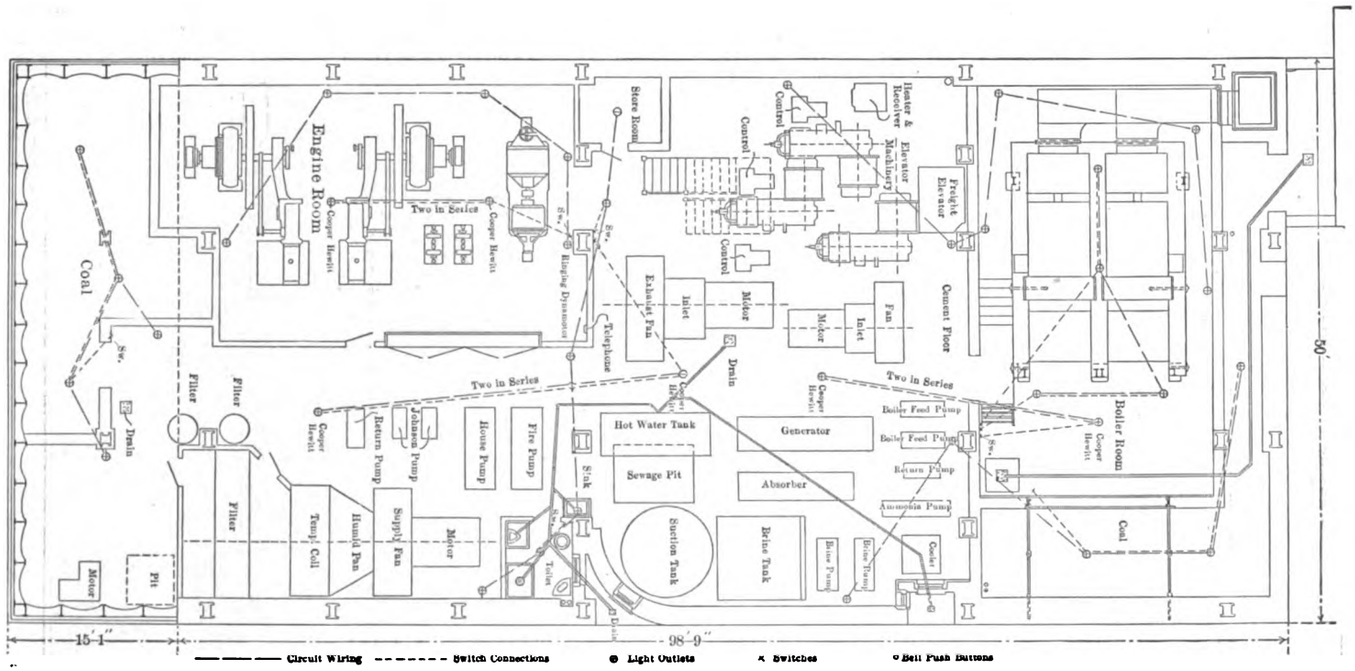
All the rooms in the building will be warmed by direct radiation. There will be about 228 radiators and heating coils aggregating 9,600 square feet of heating surface.

A forced-air system of ventillation will supply fresh air throughout the building For the positive and independent ventilation of certain other rooms, motor-driven blower and exhaust fans will be installed.

For the refrigeration and cold-storage equipment the Carbondale Machine Company will furnish an absorption exhaust steam refrigerating system capable of cooling 1,168 cubic feet of refrigerating box space, and of cooling twenty gallons of brine from ten degrees to zero degrees Fahrenheit per minute.

The equipment of this building affords a very practical demonstration of generosity on the part of the manufacturers the Allis-Chalmers Company and the General Electric Company giving all three generating sets to the club without charge, the boilers being given outright by the Babcock & Wilcox Company, and the elevators being furnished at cost by the Otis Elevator Company. Two fifty-kilowatt units will be given to the club by the Allis-Chalmers Company, consisting of Corliss-type, simple horizontal engines, direct-connected to Bullock generators running at 125 revolutions per minute. These units will be identical, except that one will be right-hand, and the other left-hand. The General Electric Company has donated a seventy-five-kilowatt unit, consisting of a Curtis steam turbine designed to operate non-condensing and to run at a speed of 2,400 revolutions per minute. The generator will be of the turbo type, and will be direct-connected to the extension of the shaft of the turbine. The complete unit is assembled on one cast-iron sub-base and set horizontally. All three of the generators will be compound-wound for 245 volts at full-load current, and will furnish current for a mixed motor and lighting load throughout the building.

Two rotary balance sets, each consisting of two compound-wound, 120-volt, direct-current generators mounted on a common base, and direct-coupled, will be installed in the engine rooms. The full-load carrying capacity of each of these machines will be forty amperes, and they will be used to furnish current to the neutral of the three-wire lighting system. The main switchboard will consist of seven white marble panels, each seventy-two inches high and one and one-half inches thick. The equipment will include three generators, one total output, one equalizer, one lighting feeder and one power panel.



LAYOUT OF SUB-BASEMENT, MECHANICAL AND ELECTRICAL EQUIPMENT OF ENGINEERS' CLUB BUILDING, NEW YORK CITY.

in general and in all the important rooms. The building as a whole has been treated as though it consisted of two separate structures. An independent equipment of blower and exhaust fans will be installed in the sub-basement for the lower half, and a similar equipment in the machinery room on the roof for the upper half of the building. The air-supplying fan for the lower stories will be located in the sub-basement, and will have a blast wheel six feet in diameter and three feet. six inches wide. This fan is of the centrifugal type, and has the same dimensions as the centrifugal exhaust fan which will remove the used air. The upper stories will be provided for in a similar manner, the blast wheel of these fans, however, having a diameter of five feet, eight inches, and being three feet wide.

The switchboard will be set in an opening in the engine-room wall, saving considerable valuable space. The front will face the engines, and the board, which will be protected by fireproof doors, will be accessible from the sub-basement. The panels will be mounted on a substantial angle-iron frame, and the front of the board will be finished at the top and bottom with a white marble moulding four inches deep. All of the instruments on the switchboard will be finished in polished copper.

All conduit distribution throughout the building will be concealed in the walls, floors or ceilings, and a panel box will be installed on each floor, from which the conduits for the branch lighting circuits will be run to the various outlets. The power feeders have been treated as a sys-

Digitized by Google

tem independent of that for the lighting service. The conduit for these feeders will be run direct to the various outlets to be provided near the respective motors for the elevator machines, sidewalk hoist, freight elevator, blower and exhaust fans and other machines. The current for the various motors throughout the building will be distributed at 240 volts by means of the two-wire system.

Separate lighting feeders will be run from the feeder switches on the lighting feeder panel to each floor of the building and to the roof, and connected to distribution panel boards. These feeders will each consist of three wires, and the current will be distributed on the 120-240-volt, three-wire system. From the panel boards two-wire branch circuits will run to the various lighting fixtures throughout the building.

A combination of incandescent lamps and Cooper Hewitt mercury vapor lamps will be utilized for the lighting of the sub-basement.

A call-bell system will be supplied with current from a motor-generator set capable of supplying seven and one-half amperes at eight volts, and an auxiliary primary battery to be used when it becomes desirable to shut down the motor-generator.

For the accommodation of telephone wires a complete conduit system will be installed. The telephone instruments and wires will be furnished and installed by the New York Edison Company. Of the three elevators, two will run from the basement to the roof, and the third from the sub-basement to the roof. The elevator machines will be located in the sub-basement at the foot of the elevator shafts. Each will be of the worm-driven drum type with direct-connected motor of about twenty horse-power, which will drive the cars at a speed of 300 feet per minute. The maximum load which each elevator will carry is 2,000 pounds.

The architects for the building are Messrs. Whitfield & King, and Mr. Putnam A. Bates is the consulting engineer in charge of all the electrical machinery and equipment.

Belgian Telegraph and Telephone Service.

Consul J. C. McNally, of Liege, writes that Belgium has a very good government telegraph and telephone service. The inland telegraph rates are ten cents for fifteen words, twelve cents for sixteen to twenty words, and fourteen cents for twenty-one to twenty-five words. The telephone service costs twenty cents for a five-minute talk, or thirty cents for ten minutes. Each person having a telephone in the house is provided with a numbered ticket, the presentation of which enables the party to use the telephone at pay-stations without further expense. Each member of the family has the same privilege.

BOOK REVIEWS.

"Modern Polyphase Machinery." Andrew Stewart. London. S. Rentell & Company. Cloth. 296 pages. 5 by 7½ inches. Illustrated. Price, 5 shillings.

This book resulted from the revision of a series of articles published in *Electricity*, London, and which were subsequently revised and brought up to date. The matter is clearly presented, no puzzling mathematics being employed. It deals briefly with the underlying principles of the production of electromotive force, describes methods of winding electrical machinery, goes into some detail over standard practice and construction of alternating-current apparatus, in this dealing also with the newer types of machines brought out for use with steam turbines, and tells something of the performance of these machines and the auxiliary apparatus for controlling them. It forms a very good elementary treatise of the subject.

"Things That Are Usually Wrong." John E. Sweet. New York. Hill Publishing Company. Cloth. 52 pages. 5½ by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 50 cents.

This is a refreshing little book, in which the author takes issue with a number of mechanical practices usually accepted as good, but which are clearly shown to be absurd or bad. As early as 1872 Mr. Sweet broke away from standard methods in certain lines of work, and he says that ever since those days he has been preaching right and doing both right and wrong—right when he had the courage, and wrong when he was silly or too much of a coward. He does not expect that much good will come of his tirade with the older fellows, for they are not given to changing their practice, even should they be convinced that they are wrong. It is only those who come to think of the best way who are likely to do the best, and those also who think that the best way is bad enough.

"Electrical Engineering in Theory and Practice." G. D. Aspinall Parr. New York. The Macmillan Company. Cloth. 448 pages. 6 by 9 inches. 282 illustrations. Supplied by the ELECTRICAL REVIEW at $3.25.

This work has been prepared to be used as a textbook for students in electrical engineering, and does not differ markedly in character from many other similar works. The title is rather misleading, for the matter dealt with is more of a physical nature than engineering. The fundamental electrical principles are discussed, and methods of measuring electrical quantities. Galvanometers, ammeters and voltmeters and other electrical instruments are described, a few of these being of commercial types. There is a chapter dealing with incandescent lamps, which describes the method of construction; and another on arc lamps, in which some of the newer types of luminous arcs are described. A chapter on the production of electromotive force deals with primary and secondary batteries. There is no discussion of electrical machinery.

"The Principles of Electric Wave Telegraphy." J. A. Fleming. New York. Longmans, Green & Company. Cloth. 672 pages. 6 by 9 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $6.60 net.

During the past few years Dr. Fleming has been giving not a little of his attention to the subject of wireless telegraphy, cooperating in this work with Mr. Marconi. In his book he has given us what is probably the most complete treatise on the subject in the English language. The subject of electrical oscillations is discussed from the point of theory and experimental results. The different methods of using these phenomena for transmitting signals through space are explained, as well as the method by which this transmission is supposed to proceed. Methods of detecting and measuring electric waves are described in Part II. Part III deals with the practice of wave telegraphy, giving in some detail descriptions of the great mass of work which has been done in this field. Reference here is made most frequently to the work of Marconi, who, in fact, is given credit for being the originator and first practical exhibitor of the new art.

"The Practical Telephone Handbook." Joseph Poole. New York. The Macmillan Company. Cloth. 530 pages. 5 by 7½ inches. 473 illustrations. Supplied by the ELECTRICAL REVIEW at $2.

The author of this book is a member of the technical staff of the National Telephone Company, of Great Britain. In it he confines himself chiefly to British practice, mainly as followed by his company. The book forms a fairly complete exposition of the art of telephony, taking up first the underlying physical principles and dealing briefly with the history of the telephone and then passing to a discussion of the apparatus now in use. All auxiliary appliances are dealt with, and the various systems are described and methods of operating them. The outside plant also comes in for some attention here, English practice in both underground and overhead work being described. Methods of locating trouble and the apparatus employed are dealt with in the latter part of the book. The automatic systems come in for a brief discussion, as well as other miscellaneous appliances. There is an appendix which gives the agreement reached between the British Postoffice and the National Telephone Company.

Digitized by Google

The Hydroelectric Plant of the Baker Light and Power Company, Baker City, Ore.[1]

THE Baker Light and Power Company is the successor to the original Gas and Electric Company which were at one time separate corporations. The first lighting plant at Baker City, Ore., was built in the early days. It was of the usual type, one high-speed engine driving two forty-kilowatt Edison direct-connected generators feeding into a three-wire network. Later, this plant was abandoned and an alternating-current equipment installed on the outskirts of town, burning sawdust from the mill of the Oregon Lumber Company The little plant finally grew into the South Baker steam plant. The present machinery at this plant consists of two 250-horse-power Cahill water-tube boilers equipped with Dutch ovens for burning sawdust, and one 500-horse-power Nordberg Corliss engine running at seventy-five revolutions per minute, belted to two 250-kilowatt General Electric generators three-phase, 2,300 volts, sixty cycles. This plant delivers current to the substation in Baker City, 1.5 miles distant.

The main power plant is located on Rock creek, a rapid mountain stream heading in the Blue mountains, seventeen miles northwest of Baker City. This stream has a catchment area of eighteen square miles. The greater portion of the basin is between 6,000 and 8,000 feet above sea level. The snowfall runs from six to fourteen feet, rarely disappearing altogether in the summer. The stream above the intake to the flume lies within the Baker forest reserve. The policy of the United States government is to protect especially the young timber and underbrush a policy which will insure against the injury of the watershed by stripping the country of its timber.

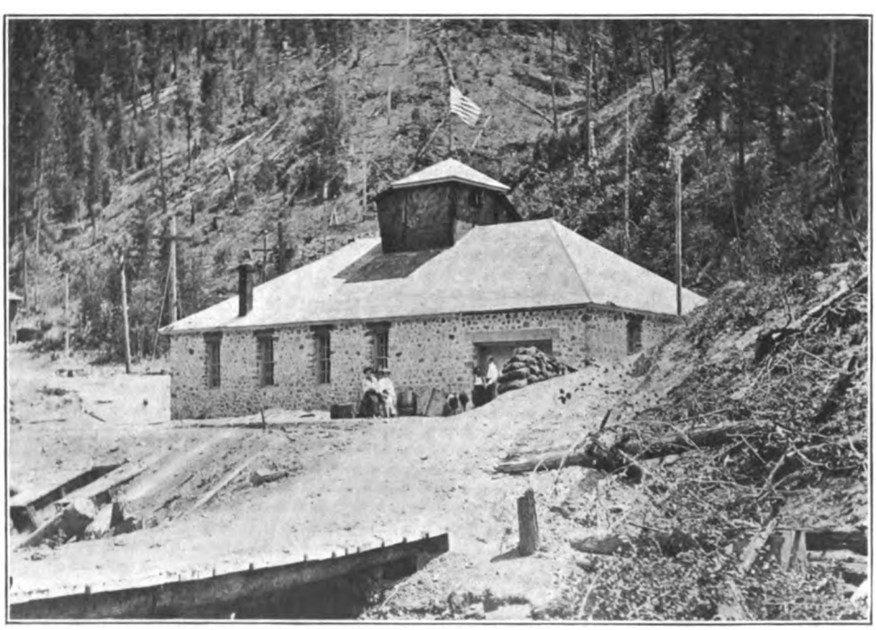
There are two seasons of low water, one in August, before the fall rains, and the other in the early part of January, during the extreme cold weather. The summer low-water is dependent upon the snowfall of the previous winter. The winter low-water depends mainly upon the weather conditions which exist at the time and upon the amount of the fall rains. In the normal season the fall rains fill the ground with water and before steady freezing weather sets in sufficient snow falls to protect it. Melting goes on slowly next to the ground insuring a supply of water not to be expected from a casual inspection.

The intake to the flume is located two miles from the edge of the main valley at an elevation of 5,000 feet.

Water is diverted into the flume by means of a masonry dam thirty feet long and four feet high. The flume is of wood three feet by six feet inside. It is constructed of Oregon red fir two by twelve inches resting directly on mud sills. It is covered the entire length, both for protection from snow and to keep out falling leaves and twigs. During the winter the heavy fall of snow is a protection against freezing. It lies on a dirt bench excavated in the hillside without trestle work. The flume is built on a grade of ten feet to the mile with a capacity of seventy second-feet, with the water two feet deep, and is one and one-quarter miles long.

The intake is provided with a coarse

FLUME, ROCK CREEK POWER-HOUSE OF THE BAKER LIGHT AND POWER COMPANY, BAKER CITY, ORE.

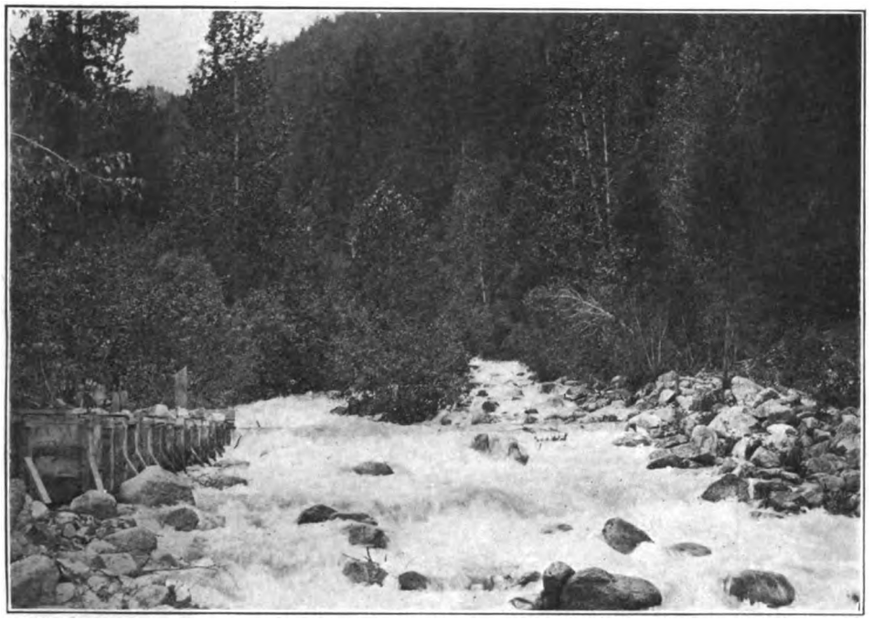


ROCK CREEK POWER-HOUSE, BAKER LIGHT AND POWER COMPANY, BAKER CITY, ORE.

[1] Part of a forthcoming volume on "Hydroelectric Plants of the United States, Canada and Mexico," by A. W. Clapp.

Digitized by Google

trash-rack while at the lower end, where the water enters the pipe line, a twelve-foot iron rack is built, set at an incline in the flume. This is made of three-eighth



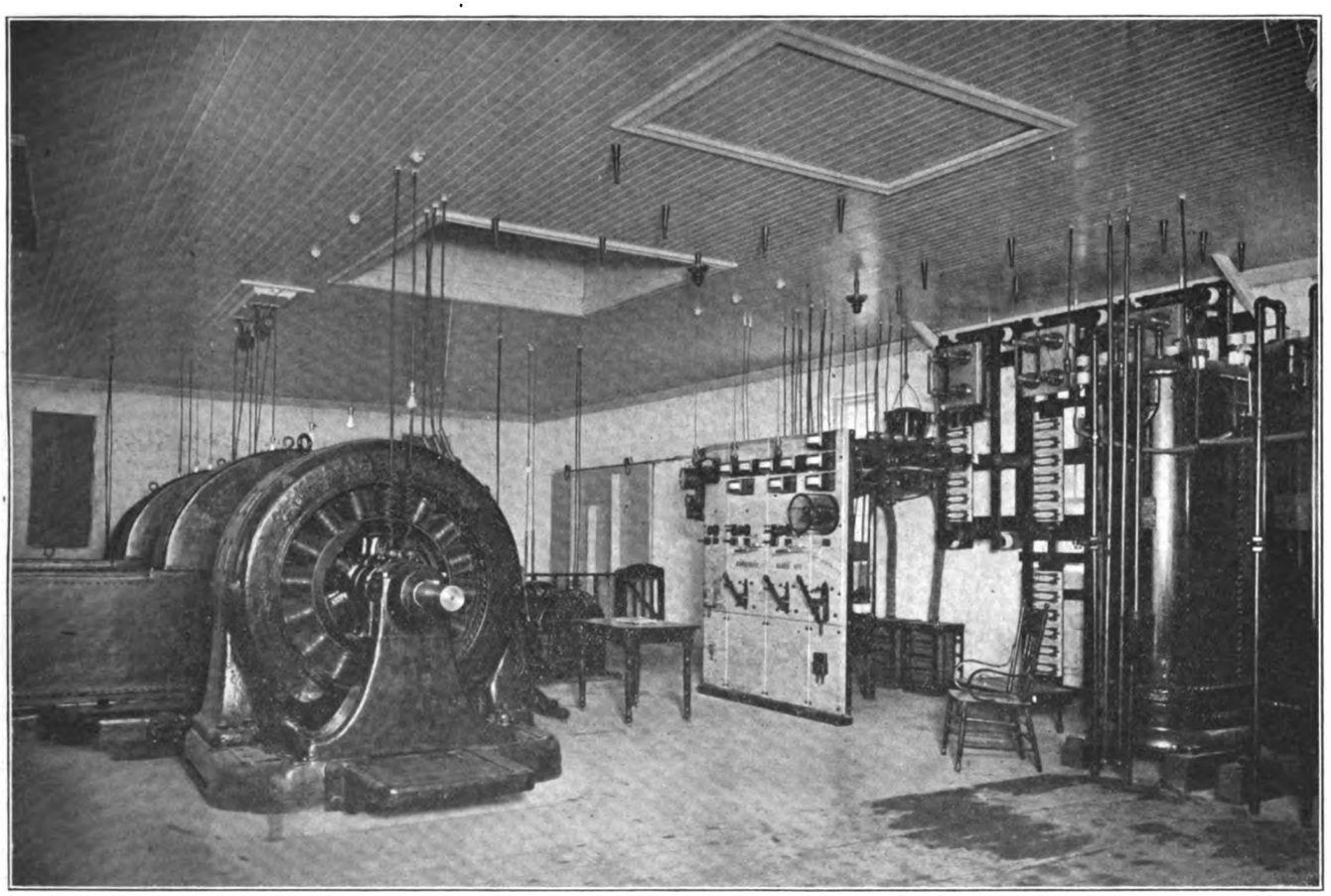
DIVERTING DAM AND INTAKE TO FLUME, ROCK CREEK POWER-HOUSE, BAKER LIGHT AND POWER COMPANY, BAKER CITY, ORE.

fourteen cubic feet per second, and there is ample capacity in both the flume and iron trash-rack.

The pipe line is connected to the pen-

2,600 feet long. It is twenty-four inches in diameter, No. 12 steel at the upper and fourteen inches in diameter, three-eighth-inch steel at the lower end, with four intermediate sizes and gauges. The lower half is double-riveted longitudinally and single-riveted on the transverse seams. The upper half is double-riveted, the lengths being joined by caulked joints covered by steel leaded collars. The pipe line has a thirty-five-degree curve at the lower end. It is thoroughly anchored in concrete block at all bends. There are six air valves distributed along the line. The pipe line comes through a fourteen-inch gate valve with a twenty-four-inch receiver made of one-half-inch steel. It is provided with three twelve-inch outlets, two fourteen-inch main outlets and one three-inch outlet for the exciter and relief valve. The receiver is anchored to a solid block of concrete.

The power-house is built of rough dressed stone laid up into a twenty-four-inch wall. The inside dimensions are thirty-four feet by sixty-four feet and fifteen feet high in the clear. All foundations are of concrete six feet deep. Two wheels



VIEW IN INTERIOR OF ROCK CREEK POWER-HOUSE, BAKER LIGHT AND POWER COMPANY, BAKER CITY, ORE.

by two-inch flat iron set edgeways to the current, with three-eighth-inch spaces.

At full load in the station the flow is

stock by a taper joint thirty-six inches in diameter at one end and twenty-four inches at the other. The pressure pipe is

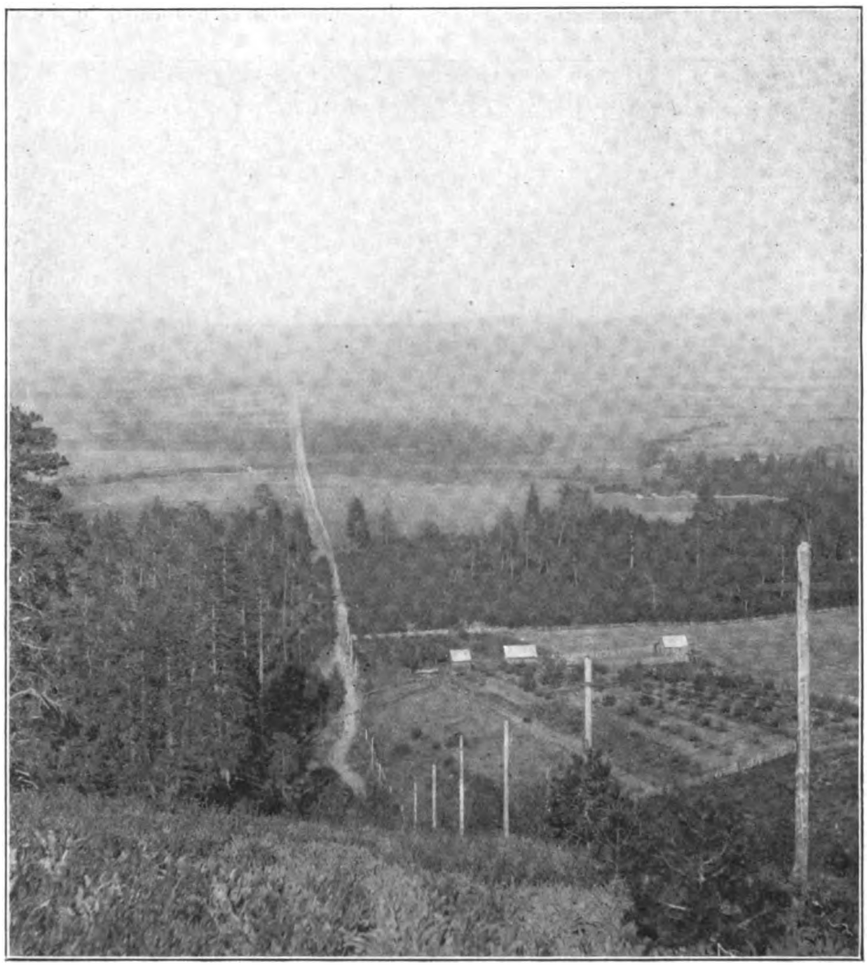
and generators are installed with room for a third. The two units consist each of one fifty-inch special Pelton wheel which will

Digitized by Google

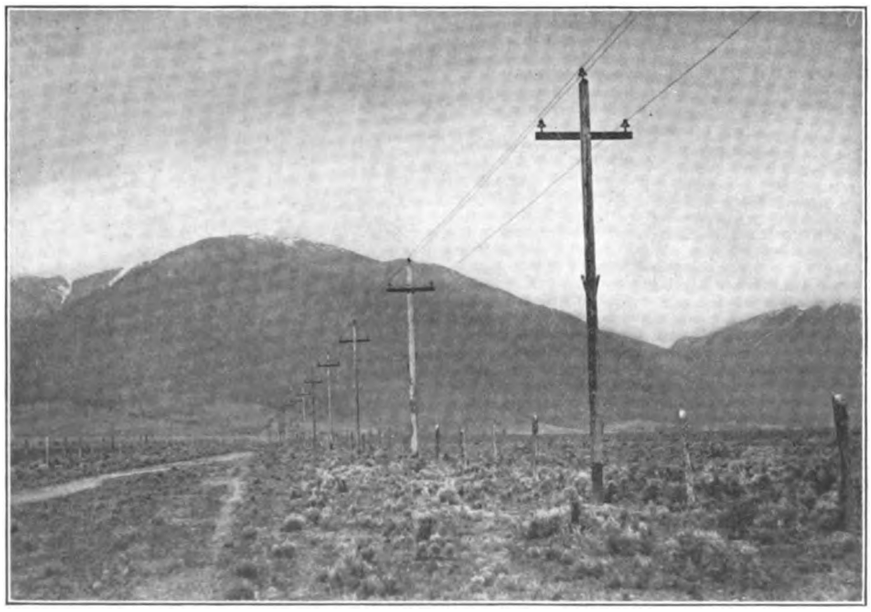
develop 750 horse-power with a 2.45-inch nozzle under a head of 960 feet, driving through leather-link couplings a 400-kilowatt revolving-field, sixty-cycle, 2,300-volt, three-phase General Electric generator at 450 revolutions per minute. One Lombard governor controls both wheels. There is one forty-five-kilowatt exciter driven by a Pelton water wheel overhung from the exciter bearings. The switchboard consists of one exciter panel, two generator panels and one feeder panel with a synchroscope on a swinging bracket. The lightning arresters are of the General Electric multiplex type, three banks of three each to the line, through single-pole high-tension switches. The voltage is controlled by a Tirrill regulator.

There are three step-up transformers oil insulated and water cooled, 300-kilowatt, 2,300 to 22,500 volts, connected in delta. The high-tension wires leave the building through a twelve-inch tile closed with a circle of glass with a hole drilled in the centre for the wire. These tiles are built into a tower on the roof of the station. There is but one set of wires leaving the building. These run to a platform built between four poles carrying the horn type disconnecting switches for disconnecting either of the two transmission lines.

One transmission line runs to Baker City, seventeen miles southeast through the level Baker valley. The poles were cut from the local timber with eight-inch to ten-inch tops. The butts were treated with carbolineum, set five feet in the ground and spaced fifty-two to the mile. The line follows the country roads. All corners are double armed and thoroughly braced. The cross-arms are four by six inches Oregon fir, six feet long, bored for one and one-half holes and bolted to the poles. The top wire is carried on a pin inserted in the top of the pole. The three wires form a triangle five feet on a side. The pins are California eucalyptus, oil treated. The insulators are the Hemingray "Provo," 40,000-volt type. The copper is No. 4 gauge. The telephone wires are carried on brackets ten feet below the power circuits and are transposed every fourth pole.



THE TRANSMISSION LINE AND TRIBUTARY TERRITORY SERVED BY BAKER LIGHT AND POWER COMPANY, BAKER CITY, ORE.



TRANSMISSION LINE, LOOKING TOWARD BLUE MOUNTAINS.

The second transmission runs to Bourne, thirteen miles southwest across the main summit of the Blue mountains into the Cracker Creek mining district. This line reaches an elevation of 8,300 feet. The poles were taken from the surrounding timber. The country is so rough that all line material had to be delivered by pack horses. The poles are tamarack and black pine. Above 6,500 feet elevation there were no suitable poles and poles had to be snaked up the mountain at a very heavy expense. The poles are thirty feet long with eight-inch tops set five feet in the ground. A large number of the pole-holes were blasted in rock. The poles are spaced forty-five to the mile, except in difficult places. The top wire is carried on a spe-

Digitized by Google

cial bracket bolted to the side of the pole at its top. The other details are the same as those of the line to Baker City.

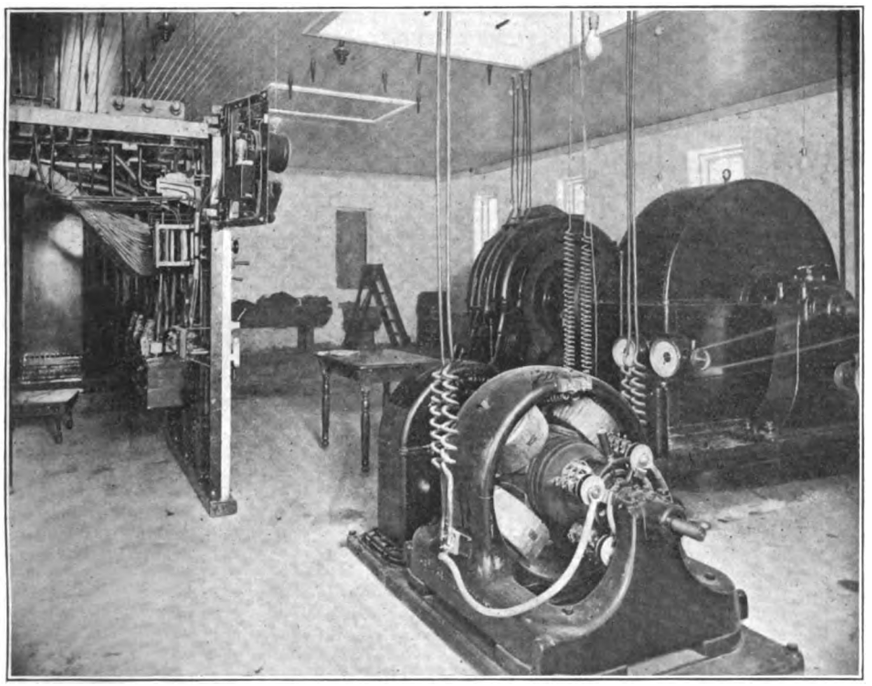
There is a branch line five miles long tapping the Baker City transmission line supplying power to the United Elkhorn mines and a second line of the same length running from the substation at Baker City, five miles east, to the Virtue and several other mines.

The substation at Bourne is a frame building twenty by thirty feet, cemented inside and out on expanded metal lath, with a concrete floor. Ten feet of one end is partitioned off for a room for the station attendant. There are two 200-kilowatt transformers connected in delta with the usual arrangement of lightning arresters and switchboard. Three-phase current at 2,300 volts is delivered to the various mines.

The principal substation is in Baker City. This consists of a two-story brick building near the business centre. It contains two 200-kilowatt transformers connected in delta. The station is equipped with automatic remote-control, high-tension switches in brick cells, a marble switchboard and high-tension lightning arresters. An extra 200-kilowatt transformer is on hand in case of breakdown either in this station or at Bourne. The gas works are owned by this company and are built on the same plat of ground so that the gas maker acts as substation attendant. This substation is the distributing point for the power line from the steam plant at South Baker, the line to the Virtue mines and the local service, which last is at 2,300 volts.

The officers of the company are: President, Clarence M. Brown, Philadelphia, Pa.; vice-president and general manager, Isaac W. Anderson, Spokane, Wash.; secretary-treasurer, J. M. Rhodes, Jr., Philadelphia, Pa.; assistant secretary and treasurer, F. N. Averill, Baker City, Oregon; superintendent, F. N. Averill, Baker City, Oregon.

G. L. Thayer, Walla Walla, Wash., is the consulting engineer to whom credit is due for the data given herewith.



ANOTHER VIEW IN THE ROCK CREEK POWER-HOUSE OF THE BAKER LIGHT AND POWER COMPANY, BAKER CITY, ORE.

MOTOR LOADS IN SMALL TOWNS.

BY HOWARD S. KNOWLTON.

The small town is often looked upon as a poor field for profitable power service, and in many such communities the central station output is entirely confined to lighting work during the hours of darkness. The equipment stands idle anywhere from twelve to eighteen hours per day, and the all-day load factor shrinks to fifteen or twenty per cent. Lighting rates have to be high to carry the burden of fixed charges during non-productive hours, and the business in general suffers from the paralysis of the equipment during the daytime.

In a town where more or less manufacturing is carried on, there is seldom any excuse for failure to supply current in the daytime. If there are several mills in the place driven by steam power with the usual accompaniment of wasteful and inflexible belts and line shafts, the field for aggressive motor applications is clear. Communities of this character are frequently so conservative that even a low power rate does not attract the mill people, but sometimes a start can be made in equipping a single department or an extension. Even if a mill has an isolated plant it should not be lost from sight, for the capacity of most isolated plants is much more limited than the capacity of the central stations operating in the same territory. Extensions are now planned by mill owners many months ahead of their construction, and if a motor load can be inaugurated in such cases as an entering wedge, the result is likely to be a greatly increased output for the central station. Increased production by individualized department or machine drive is the point to emphasize even more than operating economy.

As an actual fact there is more power business in a small town than is generally realized, even in towns where very little manufacturing is done. There are coffee mills in grocery stores, grindstones, blacksmith blowers, feed cutters, circular saws, small pumping plants for private use as well as small municipal pumping equipments, meat choppers, small refrigerating plants, church organ blowers, milk shakers, soda fountain carbonators, ice cream freezers, newspaper presses and elevators awaiting the motor drive. Very few communities are fully supplied with electric power for these purposes, but depend upon either muscular effort or non-condensing engines for their operation. The fan motor field is almost untouched in many small towns, and the proper ventilation of halls and churches is unknown to not a few communities. One of the best things which can be done to raise the standards of living in small towns above the dead level of rural monotony is to introduce electrical conveniences in every possible way. The improvement of station economy resulting from a better load factor is by no means the sole reason for the inauguration of daylight service by central stations in small towns; the increased volume of profitable business as a whole is a benefit to the town as well as to the operating company. It sometimes happens that the establishment of day service in a small town brings in additional factories, and thus increases the prosperity and purchasing power of the community. These plants can be most economically operated by the electric drive when rates are reasonable, and by being in a position to supply such service the small central station becomes a factor in the building up of the place. Power rates of four or five cents per kilowatt-hour are well worth considering in such cases.

Digitized by Google

The Electrical Works of the Allis-Chalmers Company.

THE name Allis-Chalmers, for many years a synonym among power users for excellence of design and workmanship in the construction of steam-driven engines of all kinds, has, within the past few years, come to be more and more associated in the public mind, not only with the production of the reciprocating steam engines, but also with the design and construction of prime movers and power equipment of every description —steam turbines, gas engines, hydraulic turbines and electrical machinery.

The electrical works are located at Norwood, a suburb of Cincinnati, Ohio, and comprise the original model plant of the Bullock Electric Manufacturing Company, with extensive additions which have been and are being made by the Allis-Chalmers Company in order to provide adequate facilities to meet the rapidly increasing demand for space. Electrical generating, transforming and driving apparatus of every type is built here, including direct-current dynamos and motors, alternating-current generators, induction motors, transformers, rotary converters, railway motors, air-brake motors, controllers, switchboards and a great variety of auxiliary apparatus.

The plot of ground on which the works have been built is approximately sixteen acres in area and is situated in close proximity to the tracks of the B. & O. and C., L. & N. railways as indicated in Fig. 1, showing the general plan of the works. All of the main buildings are of modern iron, steel and brick or concrete construction, exceedingly well lighted and ventilated. As a group, the buildings of this plant present an appearance which is above the average, being faced with buff-colored pressed brick and designed exteriorly with considerable reference to a pleasing architectural effect. As shown in Fig. 1, all buildings, with the exception of the foundry, face on Forest avenue, and are provided with wide and well-kept grass plots between the pavement and the building proper. Figs. 2, 3 and 4 are general views of the administration building, and the principal works buildings, with the exception of the pattern shop and the foundry, which are located opposite the main group.

The foundry building, an interior view of which is shown in Fig. 5, is 202 feet long by 103 feet wide. The structure is so arranged that it may be readily extended in the rear toward the pattern storage building if a larger capacity is at any time required. The foundry is equipped with two cupolas, with a capacity each of twelve tons per hour. The main bay of the foundry is served by two electric traveling cranes of twenty-five and fifteen tons' capacity, respectively. Each of the side bays is served by a smaller five-ton crane. Coke-heated core ovens are employed for the treatment of cores and moulds.

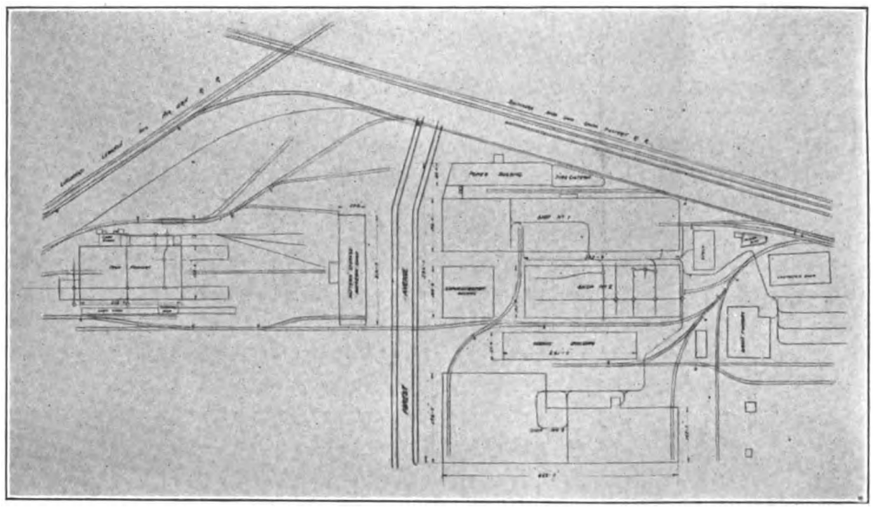


FIG. 1.—GROUND PLAN OF THE NORWOOD, CINCINNATI, WORKS OF THE ALLIS-CHALMERS COMPANY.

The second building opposite the main buildings, and facing them, is the pattern shop and pattern storage. This building is new and of modern construction throughout. It is fifty-three feet by 216 feet and four stories in height. The slow-burning mill type of construction has been followed, the floors being of heavy timber with no openings of any description. A tower in the rear of the building contains the elevator, staircase and main electrical wiring. There are no openings from this tower directly into the various floors of the building, but at each landing a fireproof sliding door leads into the main building. The heating system is carried out by means of the hot blast, all the air ducts being built in the walls, thus avoiding the use of galvanized-iron pipes. Each floor consists of a single large room, the two upper ones being provided with suitably numbered racks for storing patterns. The storage capacity is approximately 30,000.

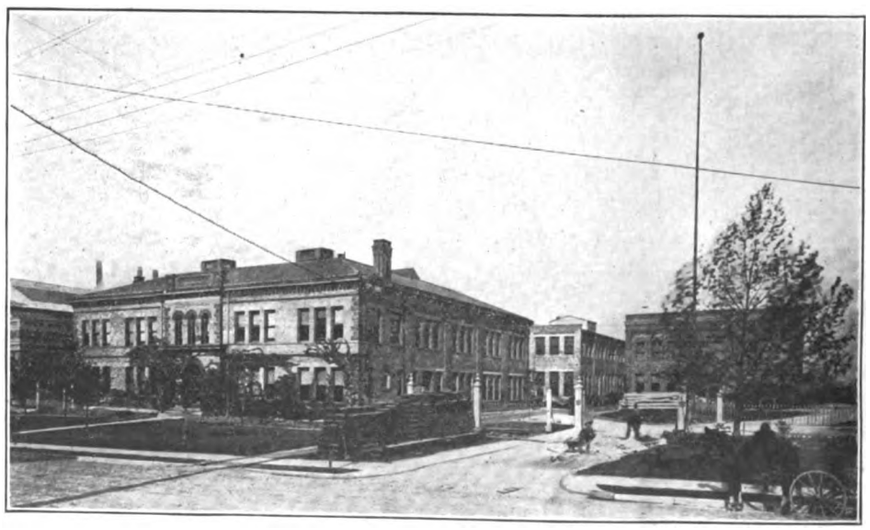


FIG. 2.—ADMINISTRATION BUILDING, SHOP NO. 2 AND SERVICE BUILDING, NORWOOD, CINCINNATI, WORKS OF THE ALLIS-CHALMERS COMPANY.

The second floor is used as a pattern shop, providing room for forty pattern-makers. The most approved forms of woodworking machinery comprise the

Digitized by Google

equipment, each tool being driven by an individual electric motor, permitting the most advantageous placing of tools wherever most effective and doing away with all line shafting.

All parts of the building are exceptionally well lighted, as the rooms are comparatively long and narrow, with windows on all sides and with the interior walls coated in white.

The first floor is used as a storage room for small dynamos and motors carried in stock. It is divided into two bays running the entire length of the building and separated by a line of columns which, together with other columns at the side walls, carry the runways for two five-ton traveling cranes. Freight cars can be run into one end of the building on a depressed track and material can thus be loaded or unloaded directly.

Machine shop No. 1 of the main group, opposite the pattern building just described, is one of the original Bullock buildings, 102 feet by 462 feet. The equipment throughout is composed of motor-driven machine tools of all kinds used in the manufacture of electrical apparatus. Several different applications of the motor drive used are shown in Figs. 6 and 7. The building is identical in general appearance and construction with the others of the group. The central bay is served by two cranes of twenty and thirty tons' capacity respectively, and the side bays each by a five-ton crane. In addition to the machine tool work performed in shop No. 1, a portion of the armature winding for large machines is carried on here, and a testing department for the smaller machines has been provided in the front portion of the building. The Allis-Chalmers motors, used to drive the machine tools, are operated on the multiple voltage system of variable speed control having a speed ratio of six to one, giving twelve speeds in the forward direction and nine in the reverse.

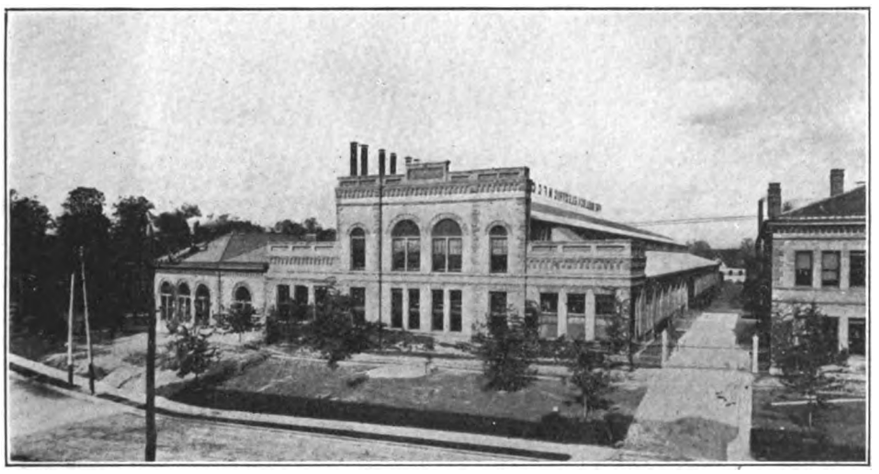


FIG. 3.—SHOP NO. 1 AND POWER-HOUSE, NORWOOD, CINCINNATI, WORKS OF THE ALLIS-CHALMERS COMPANY.

FIG. 4.—FRONT END OF SHOP NO. 3, NORWOOD, CINCINNATI, WORKS OF THE ALLIS-CHALMERS COMPANY.

In each machine shop, there is a separate balancer installed for splitting the voltages and which may be used independently in case of the failure of those installed in either of the other shops. The connections of these balancers are such that one set may be made to carry the load of the others.

Machine shop No. 2 is identical in general appearance with the other buildings of the group. It is 100 feet by 303 feet and two stories in height. The roof has a wide skylight area which secures a flood of diffused light to the interior of the building. This unit, with the others of the group, is also heated by means of the overload blower system which draws in fresh air, and having passed it around steam-heated pipes, blows it out through the tubes. This same system keeps the shop at an even and agreeable temperature in summer by the circulation of cooled air.

A five-ton electric traveling crane serves the entire length of the shop. An industrial railway connects the punch department with the annealing. At both ends of the shop freight elevators driven by electric motors connect the upper and lower floors. The drying ovens are also connected directly with the insulating department by means of a smaller elevator.

On the first floor is located the punching department where the sheet steel punchings for armatures and field-poles are made. This shop is provided with a complete equipment of motor-driven punch presses. On this floor the armature cores for direct-current dynamos and motors, and the stator cores for small alternating-current machines, are assembled. The commutator department is located at the rear, and in a room separated from the remainder of the building by fireproof walls the punchings for armature and stator cores are annealed and japanned.

The annealing equipment consists of two ovens arranged for oil fuel, each oven with a capacity of about 30,000 pounds of steel at each charging. Those ovens are of latest design, provided with recording pyrometers and arranged so that the heat is under complete control at all times. The upper floor of shop No. 2 contains the

Digitized by Google

coil-winding department where armature, field and transformer coils are wound and insulated.

In this shop every machine tool, from the ponderous drill presses, making laminations for turbo-generators, to the small tapping machines for insulating armature coils, is driven by an individual electric motor. The initial cost of many of the smaller tools is somewhat increased by driving each separately; but by this arrangement the machines are rendered independent of each other, so that an accident to one does not interfere with the operation of the others. The system becomes also extremely flexible. Not only can the tools be moved to the work, when it is desirable to do so, but they can be shifted easily from one portion of the shop to another without disarrangement of the power connections. Other advantages are clear headroom, better light, freedom from dirt, economy of operation (as power is only used when the machines are working) and reduction of the liability of accidents to employés. The greatest advantage to be derived from this individual drive, however, is the increased output due to the fact that the machines can be run at the proper speeds to suit the work. As labor is the greatest single item of expense in a machine shop, a very small percentage of saving in its cost per year will more than balance a comparatively large initial

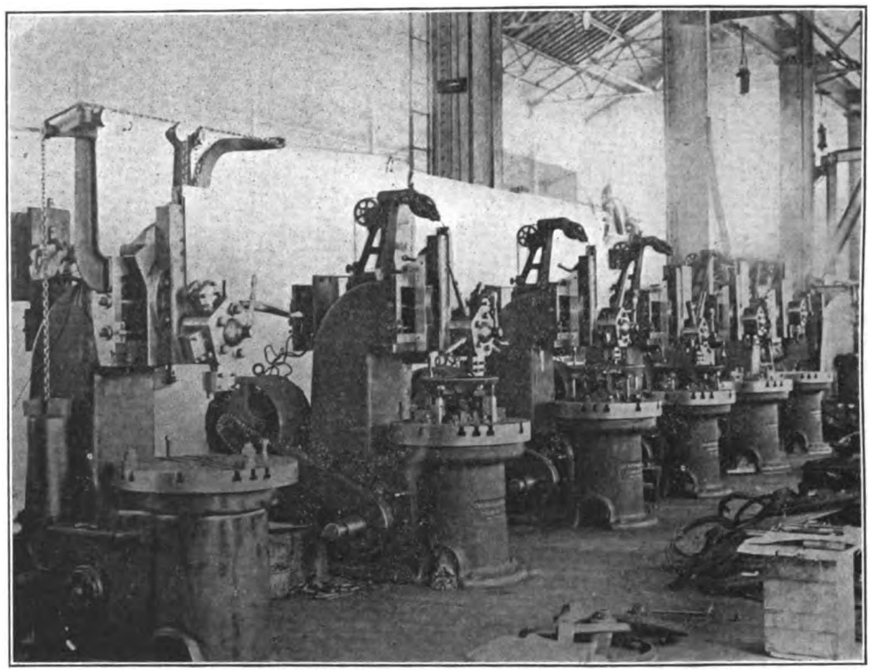


FIG. 6.—VIEW IN SHOP NO. 1, SHOWING ROW OF MOTOR-DRIVEN BORING MILLS, NORWOOD, CINCINNATI, WORKS OF THE ALLIS-CHALMERS COMPANY.

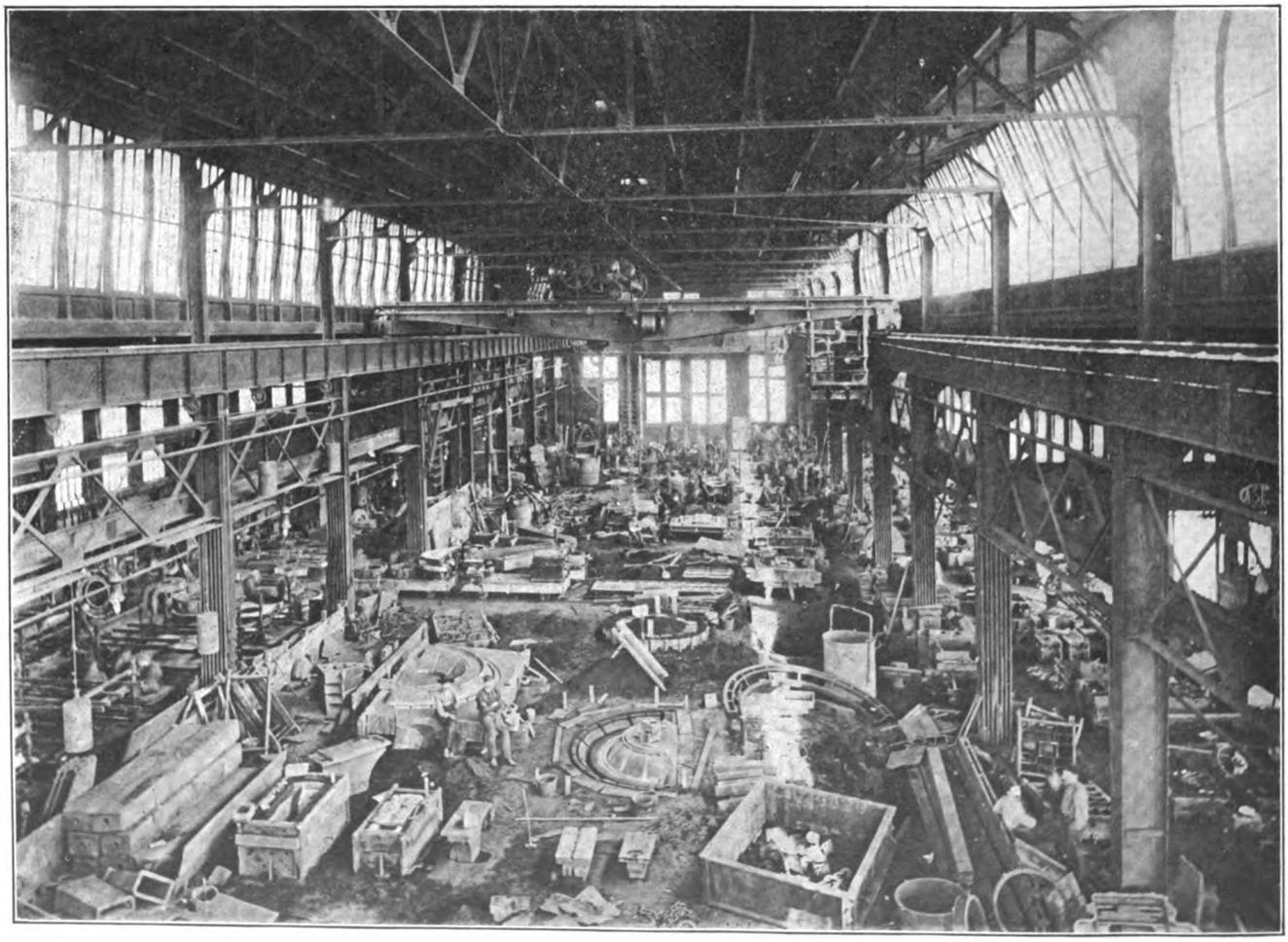


FIG. 5.—VIEW IN FOUNDRY, NORWOOD, CINCINNATI, WORKS OF THE ALLIS-CHALMERS COMPANY.

Digitized by Google

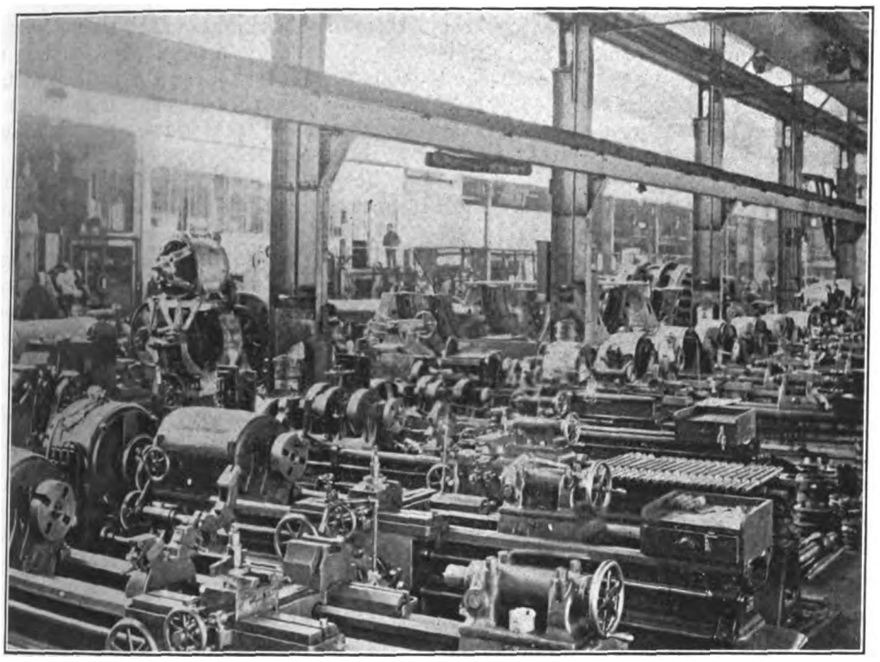


FIG. 7.—VIEW IN SHOP NO. 1, SHOWING MOTOR-DRIVEN LATHES, NORWOOD, CINCINNATI, WORKS OF THE ALLIS-CHALMERS COMPANY.

increase in the expense incurred for tools. Shop No. 3, a general view of which is shown in Fig. 8, is 462 feet long, the front portion being one story high and 176 feet wide, the rear portion 107 feet wide and two stories high. The two-story extension in the rear is a recent addition; it is of ferro-concrete construction and is faced with brick on the outside to match the other buildings. Both upper and lower floors are divided into bays by rows of columns, and on the lower floor two ten-ton cranes are provided; the work on the upper floor being of a lighter character, two five-ton cranes are installed. An elevator is located at about the middle of the extension. On the second floor are the tool room and brass department for the manufacture of small brass parts entering into the construction of machines. The front portion of this unit is used for the construction of large machines and is divided into three bays. The central bay is sixty-eight feet wide and sixty feet high under the roof trusses and is equipped with a sixty-ton traveling crane having a fifty-foot lift. Each side bay is forty-eight feet wide, one served by a twenty-ton crane and the other by one of thirty tons' capacity. Part of the central bay is provided with iron floor platens for the use of portable drills, slotters, etc.

The power-house and boiler plant of the

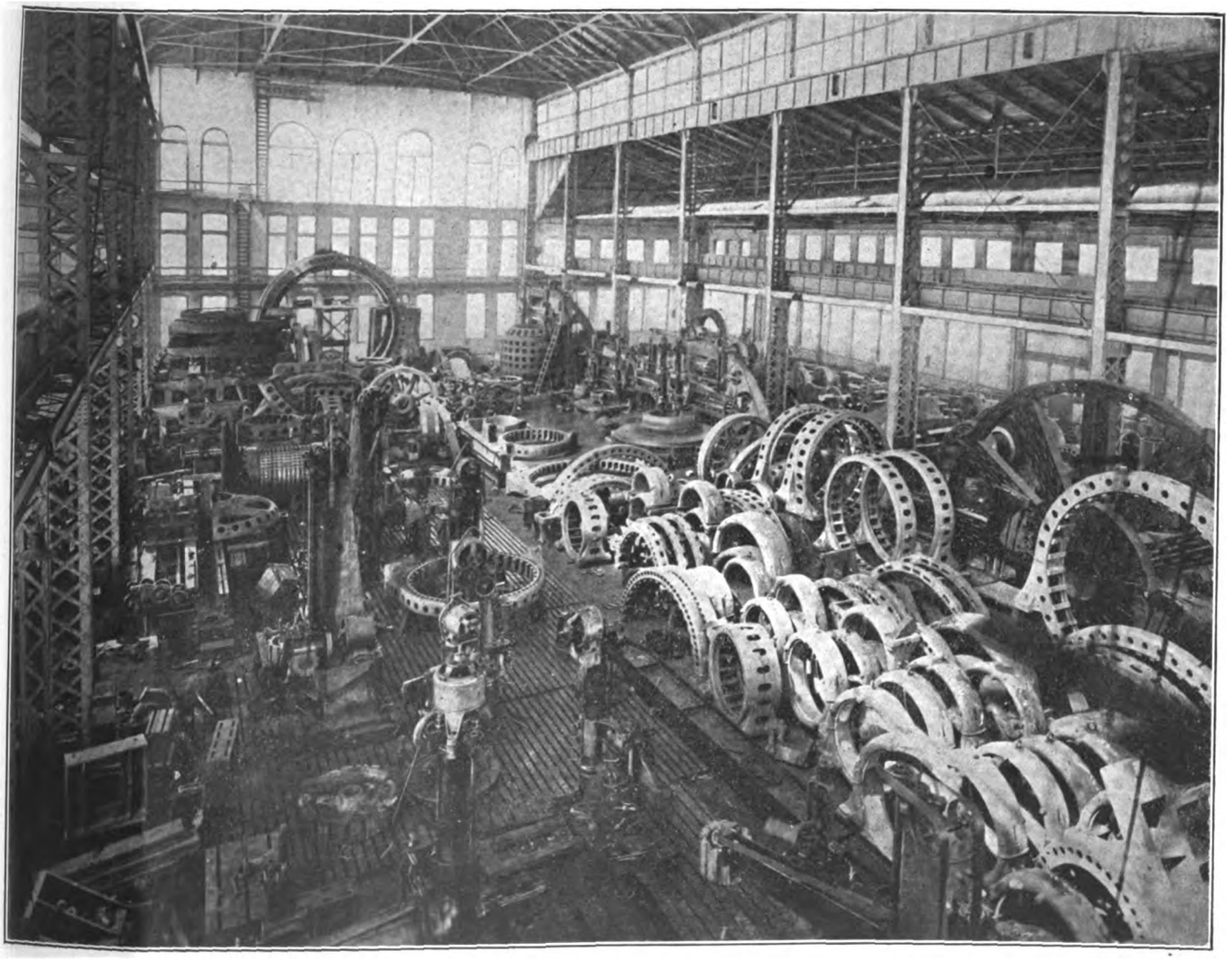


FIG. 8.—INTERIOR VIEW OF SHOP NO. 3, NORWOOD, CINCINNATI, WORKS OF THE ALLIS-CHALMERS COMPANY.

Digitized by Google

works are located alongside of shop No. 1. The power-house equipment consists of two Allis-Chalmers 800-kilowatt, 240-volt direct-connected engine type generators, one of which is driven by a Lane & Bodley engine, and the other by an Allis-Chalmers Reynolds cross-compound Corliss engine. There is further equipment consisting of a small 100-kilowatt unit and an air-compressor outfit used for operating pneumatic tools used in various operations throughout the shops. Two artesian wells furnish the entire water supply for engines and fire service. A water storage reservoir is provided for use in fire, with a fire pump in connection with a complete sprinkler system for all buildings. The engines are run non-condensing. The boiler house equipment is comprised in six 250-horsepower Cahall vertical, water-tube boilers, fitted with Mansfield chain grate stokers.

The service building, fifty-three feet by 261 feet, is located between shops Nos. 2 and 3. A wire storage room and locker and wash rooms for employés occupy its lower floor. The upper floor is fitted up as a dining room for factory and office employés.

The administration building is 100 feet by 100 feet and two stories in height. It provides accommodation for the various administrative offices and departments, drafting room, engineering department, purchasing department, superintendent's office, etc.

The general plan of buildings and grounds shown in Fig. 1 gives the layout of standard-gauge railroad tracks in yards and buildings. In addition, there is a complete equipment of narrow-gauge industrial railway interconnecting the various shop units. All the yard track is equipped with overhead trolley, and motor-driven cars equipped with electrically operated jib cranes are used for loading and unloading material and conveying it between the shop buildings.

The National Electrical Contractors' Association.

The sixth annual convention of the National Electrical Contractors' Association will be held at Cleveland, Ohio, July 18, 19 and 20. The Hollenden Hotel has been selected as headquarters. At present the indications are that this will be a well-attended and successful convention. The master of transportation, Alexander Henderson, has been doing a giant's work in securing liberal concessions from the passenger departments of the various railroads. Beginning with March 1, eleven bulletins have been published up to June 26. These bulletins have given every conceivable kind of information concerning railroad affairs, hotel headquarters, hotel rates and instructions concerning the method of applying for and utilizing railroad certificates where a rate of a fare and a third has been conceded.

The Central Passenger Association, the Trunk Line Association, the Western Passenger Association, the New England Passenger Association and the Southwestern Excursion Bureau have all made liberal concessions to members attending the convention.

For the convenience of passengers from New York and adjacent points, arrangements have been made with the New York Central & Hudson River Railroad for a special Pullman equipment, leaving New York (Grand Central Station), July 17, at 5.29 P. M., arriving in Cleveland, July 18, at 6.55 A. M.

Gas Engine Ignition.

In an article by L. W. Scudder, in the *Yale Scientific Monthly* for June, on "Some Disputed Points in Automobile Manufacture," the author compares the advantages of the two electrical ignition methods. The majority of American manufacturers use the jump spark system, with a length of spark about one-thirty-second of an inch. The make and break system is used on nearly all of the foreign cars and on one or two American machines. The make and break system gives but a single spark, so that if this fails there is no chance for ignition until the next stroke. The points of contact are liable to wear out quickly on a high-speed engine, and their renewal is difficult and expensive. With this system it is impossible to start the engine without cranking. The greatest trouble met with in the jump spark system is due to the breakdown of the insulation. The spark plugs necessary for this system are a source of endless annoyance, and the induction coils and their vibrators are apt to give trouble. The author concludes that where the cost of the system is not of much importance, the make and break plan is the better, but where the apparatus must be left to the care of less skilled workmen and must be less expensive, the jump spark gives better results.

Opening of the Teltow Canal.

The ceremony of opening the new Teltow canal was performed by the German emperor on Saturday, June 9. The canal has been constructed and will be worked entirely by the municipal authorities of Teltow, the total cost of construction having amounted to about £2,000,000. The greatest feature of the canal is that electric towing will be exclusively adopted, and barges will not be allowed to be propelled in any other way. Electric towing locomotives are used, running on rails on the banks and supplied by an overhead wire. A special power station has been erected near the canal containing two generating sets, each driven by a 1,000-horse-power Zoelly turbine. Three-phase current is generated at 6,000 volts, fifty cycles, and is converted to continuous current at 600 volts in substations. Each tractor is capable of hauling a load of 1,500 tons at 3.3 miles per hour. On portions of the canal which pass through lakes, where it is impossible to tow from the bank, electrically propelled tug-boats are used.

The new Teltow canal is twenty-three miles long, sixty-six feet wide, and has a uniform depth of rather more than eight feet, thus permitting the passage of barges laden with as much as 600 tons of cargo. It is spanned by forty-two bridges, and when finally completed, will have cost nearly two millions sterling.

Flour Bleaching with the Aid of Electricity.

An interesting and useful application of electricity which is finding considerable favor in the milling trades is described in the *Electrician* (London) for June 8. It is essential that flour should be of the purest white color, and various bleaching processes have been employed from time to time, to which the flour is subjected after being ground. The latest of these is that due to the Allsop Flour Process Company, of London, which has been in use for the past two years.

The method consists briefly in passing a current of air through a chamber containing a high-voltage, continuous-current arc. This is then led through the flour, which has been placed in an agitator, and the flour emerges from the agitator with a considerably whiter tint that it had previously. The company explains that the air is ionized in its passage through the arc chamber, and that ionized air has a distinct bleaching action on flour.

The arc is formed in a peculiar way. A double-acting pump draws air through the arc chamber, the piston of the pump at the same time drawing out the arc. The electrodes between which the arc is struck are usually mild steel, and are insulated from the wall of the chamber. They are arranged to fit snugly in the holder, but can be easily replaced. When the suction stroke of the pump starts the electrodes are together, and as the stroke proceeds they are separated and the arc is lengthened by raising the upper electrode until it is extinguished. During the pressure part of the stroke which forces the air through the bleaching chamber the electrodes are brought together again. The rocking arm which operates the electrodes in the two chambers has a travel slightly greater than that taken by the electrodes, the difference in motion being taken up by a spring.

The voltage employed is 400, and to increase the length of the arc an inductance of considerable size is included in the circuit. The arc is from two to five inches in length, according to the size of the drum. The current employed ranges from one and one-half to twelve amperes, according to the amount of flour to be treated, or the degree of bleaching required. With a double pump, running at fifty revolutions per minute, and having pistons ten inches in diameter with ten inches stroke, thirty sacks of flour can be treated in one hour.

Digitized by Google

The Second Annual Convention of the National-Interstate Telephone Association.

Auditorium Hotel, Chicago, Ill., June 26-28.

THE second annual convention of the National-Interstate Telephone Association was held at the Auditorium Hotel, Chicago, Ill., June 26, 27 and 28. In point of attendance and enthusiasm this was the most successful independent telephone convention ever held. As published in the last issue of the ELECTRICAL REVIEW the manufacturers made a splendid showing and, as usual, helped materially to make for the success which was attained.

TUESDAY SESSION—JUNE 26, 3 P. M.

The first session was called to order June 26, at 3 P. M., with President James B. Hoge in the chair. Mr. Hoge presented J. Hamilton Lewis, corporation counsel of the city, who delivered the address of welcome.

Following the address of welcome a photograph was made of those present, and the response was made by E. H. Moulton, president of the Twin City Telephone Company, Minneapolis, Minn.

JAMES B. HOGE, PRESIDENT.

President Hoge then delivered the annual address, saying, in part:

The securities of our companies are now regarded in an entirely different light from what they were two years ago or even one year ago, and the investing public are analyzing them critically, finding them in most cases more conservatively financed and upon a more substantial basis than many of the securities that have heretofore been selling at much higher prices than our securities.

A great majority of the companies to-day are using the best material and the latest type of equipment to be had; operating rules and regulations, systems of accounting, and systems of advertising have all become more uniform, and yet, when you stop to consider the possibilities ahead of you in this great work, you will see that you have more victories to win, many problems yet to solve. It has been well said that no other public-serving utility, except the water companies, fills so important a place in the daily life of the American people as the telephone.

We represent to-day an investment of over $300,000,000, with over 3,000,000 telephones installed. Let this coming year be one of education along organized lines. Let us help our neighbors as well as ourselves. The next ten years will see over 3,000,000 additional telephones connected with our systems if we do our full duty. Strong interests are coming into the field each month. We are getting young men of wealth and influence interested who are following their money into the business in a way that is a power for good. But a greater power for good is the fact that the masses are investing their money in these properties, and it is their property that is furnishing this service in their community, the same as it is their money that is furnishing the banking capital of their community and they are going to lend their influence in seeing that the business is run on proper lines to give good service and fair returns upon the money invested. What we need to-day is a better and stronger organization, provided with sufficient capital to prepare records of our system, to carry on a campaign of publicity and furnish to the press the information that they desire about the greatest industry ever developed in this country.

President Hoge announced the following committees:

Committee on ways and means—J. G. Splane, Pennsylvania, chairman; R. B. McPherson, Michigan; Henry Barnhart, Indiana; James S. Brailey, Ohio, and Charles E. Sumner, Oregon.

Committee on amendments to constitution—Cyrus Haling, Ohio, chairman; Senator Kline, Pennsylvania; J. B. Ware, Michigan; J. B. Earl, Texas, and E. R. Conkling, Illinois.

Committee on nominations—E. H. Moulton, Minnesota, chairman; O. C. Snider, Missouri; M. B. Overly, Kentucky; W. G. Thompson, Ohio; P. C. Holdoegal, Iowa.

Photograph committeee—George F. Hughes, Iowa, chairman; R. E. Mattison, Nebraska; Wm. L. Morlering, Indiana. This is a special committee that was appointed this year in order to take charge of certain exhibits of photographs of exchanges and equipment in various states. This exhibit was one of the features of the convention.

Committee on credentials—A. C. Davis, West Virginia, chairman; Louis Bruckner, Ohio; A. C. Lindemuth, Indiana; Linton Reber, Maryland, and Louis Blankenhorn, California.

Entertainment committee—C. E. Stiger, Illinois, chairman; George Ihmsen, E. B. Overshiner, J. Y. Cracraft, W. H. McDonough, W. W. Dean, C. D. Norton, H. B. McMeal, J. F. Bailey, C. Y. McVey and George N. Bandy.

THEODORE GARY, FIRST VICE-PRESIDENT.

John A. Harney, assistant secretary, presented his report, an abstract of which follows:

There are 7,450 independent telephone companies, operating in 11,925 cities and towns of the United States. There is a handsome balance in the treasury, and the supply department shows a fair profit. Concerning the progress the association is making in the preparation of maps of the independent lines, there are at present on file post-route maps for forty-two states. On twenty-nine of these data have been spotted and tracings have been completed for seventeen.

WEDNESDAY SESSION—JUNE 27, 10 A. M.

The convention met pursuant to adjournment, the president, James B. Hoge, in the chair.

The secretary proceeded to the roll-call

Digitized by Google

of states, the representatives giving various details concerning the condition of affairs in their territories. Alabama made no response and Mack Hammett responded for Arkansas.

Telephone rates are uniformly $1.50 and $2.50, the largest places $2 and $3, extension rates $1. Toll rates are about three-quarters of a cent per mile; a usual minimum charge of twenty-five cents is made. It is impossible at this time to say definitely what the earnings of the toll lines would be, because the business is as yet undeveloped, but the actual figures from the sub-license company show that the average toll line business varies between $8 and $9 from a subscriber per year. This large percentage is due to the cotton planters of the state who reside in the country, and who frequently have recourse to the telephone for business and pleasure, and especially to expedite their business. The negro farm hands on the plantation also use the telephone, and there being quite a number, this naturally increases the earnings. The independent telephone companies are situated at the following places in Arkansas: Texarkana, Pine Bluff, Carlisle, Little Rock, Russellville, Adkins, Ozark, Altus, Fort Smith, Eureka Springs, Bald Knob, Walnut Ridge, Black Rock, Imboden, Horning, Paris, Rector, Pigott, and Elton, with a total number of subscribers of 6,305.

For California Louis Blankenhorn stated that the independent companies are now reaching into the northern part of the state, to San Francisco and Oakland. Oakland is nearly built, and will be in operation in the course of six months, probably, in any event, starting with 5,600 subscribers. San Francisco has given a franchise to the Home Telephone Company, and they will start in there with 15,000 at least, but will probably exceed that in their initial installation. The Southern California business is represented by now close to thirty companies, representing, perhaps, ten millions of capital.

Prices range from a minimum for house telephones, individual lines, of $1.50 to $5, the extreme limit in the city of Los Angeles for business telephones, in outside cities from $3 to $2.50.

Theodore Gary, upon permission, as a special order of business, presented a recommendation from the executive committee admitting manufacturers to membership in the association. After considerable discussion this matter was placed in the hands of the committee on constitutional amendments.

Proceeding with the roll-call of states, Mr. Norton replied for Indiana. There are 400 companies, 15,000 stockholders, 200,000 independent telephone subscribers, and $20,000,000 of capital invested.

For Iowa P. C. Holdoegal stated that in Iowa they have been somewhat active during the past year, have placed a state agent at a salary in the field, and are realizing the benefits from these efforts. The independents have increased about ten per cent, and are now reaching practically every point in the state, and the long-distance toll lines before the summer closes will reach every corner, so that practically the subscribers in each community may talk to those in every other community in the state.

For Kentucky Mr. Cole stated that from 1,500 and 2,000 towns are supplied with independent telephone exchanges. Recently the long-distance developments have begun in good earnest, until now they can connect from the western to almost the remotest eastern portion of the entire state, and a company has been organized recently to devote itself more especially to the betterment of the long-distance lines of the state.

JOHN A. HARNEY, ASSISTANT SECRETARY.

For Michigan J. B. Ware stated that Michigan has at the present time over 80,000 independent telephones. Six years ago at the time the Detroit company sold to the Bell and the Kalamazoo company also sold, some 10,000 telephones were taken out of the independent ranks, leaving less than 30,000 so that during the past six years the greatest portion of the territory has been redeemed.

For Missouri W. B. Scruggs stated that they have districted the state and organized every district except one. There is only one part of the state that is not fully organized in districts, and working with the state association. They claim some 50,000 units in Missouri, and an independent company in nearly every town in Missouri in operation to-day. Springfield will be developed soon, and St. Joe will be entirely rebuilt within the coming year.

For Nebraska R. E. Mattison stated that Nebraska operates 265 independent telephone exchanges. This development has been accomplished in the past six years. They have about 4,000 toll lines. The state association represents 43,000 telephones, and is organized on the Ohio plan.

For Illinois C. V. Cheadle stated that Illinois has a well-organized independent telephone association. It is comparatively new. It has very little history back of it, but they have a wonderful, fertile future ahead. In round numbers there are approximately 160,000 independent telephones. There are probably sub-licensee companies representing over 30,000, so that there is approximately 200,000 independent telephones in the state.

For Canada Dr. J. F. Deners stated that in the Province of Quebec they have 2,750 miles of toll line construction. There are now around 3,000 subscribers, and the main line is 300 miles along the St. Lawrence river, with a copper circuit. In the province there are about twelve independent telephone companies, with a capital each invested of from $2,000 up to $350,000. The total amount of money invested in the province is about $1,000,000. The total amount of subscribers is about 7,000.

For Ohio F. L. Beam reported that the independents had 248,304 telephones in service, 797 exchanges, 1,705 toll stations, a growth in the past twelve months of over 54,000 telephones.

For Oregon Charles E. Sumner reported that there has been organized the Home Telephone Company, of Portland, for the purpose of building an exchange in the city of Portland; a second company, known as the Home Telephone Company, of Puget Sound, for the purpose of building in the cities of Tacoma and other cities of that district; a third company, known as the Home Telephone Company, of Spokane, has been organized for the purpose of building in the cities of Spokane and Walla Walla; a fourth company, known as the Long Distance Telephone Company, has been organized for the purpose of covering the entire two states, and connecting all the exchanges in the entire two states with long-distance lines.

For Pennsylvania Senator Kline reported that there are in operation with

Digitized by Google

companies belonging to the state association 150,000 telephones. There are 25,000 miles of toll line, with about 300 exchanges, and 2,486 toll stations.

WEDNESDAY SESSION—JUNE 27, 2.15 P. M.

The secretary called the roll of states for those who had not responded at the previous sessions, Alabama, Alaska, Arizona, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Idaho, Indian Territory, Louisiana, Maine, Maryland, Massachusetts, Nebraska, Missouri, Mississippi, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Oklahoma, Rhode Island, South Carolina, Tennessee and Texas making no response.

For West Virginia Mr. Davis stated that there are twenty-six companies in the state association, with an invested capital of $1,244,000 and gross receipts are $67,416.

For Vermont Mr. Buzzell reported there are over 100 independent companies in the state, with about 20,000 telephones.

For Texas J. B. Earl reported that at Austin the independents have built several exchanges in the central territory and north of Austin there are two companies in connection with the independent company. The rates are good. The long-distance rates are much more.

For Wisconsin Mr. Webb reported that there are over 42,000 independent telephones in operation, but a considerable number are Wisconsin Bell licensees.

For Keystone Telephone Company, of Philadelphia, N. T. Folwell reported that they have conduits in 280 miles of street; all large buildings are directly connected to the conduit system; smaller buildings are connected from junction boxes on the rear of buildings, and in outlying districts, the only overhead construction is one pole in each block, reaching only the subscribers in the block. The company has only eighteen miles of pole line in Philadelphia county; less than three miles of aerial cable, and about 450 miles of underground cable. They have $500,000 invested in real estate and buildings in Philadelphia county, all of which are of the most substantial and permanent character, the larger ones being fireproof, and the smaller ones semi-fireproof. The territory is covered by six exchanges, the ultimate capacity of the three larger ones being 7,200 lines and the smaller ones 4,800 lines. Through the Keystone State Telephone and Telegraph Company they are operating in the counties surrounding Philadelphia in Pennsylvania. They have six exchanges in this territory and 3,000 miles of toll line connecting with the Delmarvia Telephone Company and the Maryland Telephone Company on the south, the United Telephone Company on the west, the Consolidated Telephone Company on the north, and the Interstate Telephone Company in New Jersey on the east. They have recently acquired the Eastern Telephone and Telegraph Company operating in Camden and Gloucester counties of New Jersey, and the Telephone Company of South Jersey operating in Cape May county. They are operating in Philadelphia and suburbs and in Camden 25,000 telephones and handle an average of 4,000 toll messages per day. The gross revenue of the Keystone properties is nearly $1,100,000 per year, and the demand for the service is greater than ever.

The paper by Ivy L. Lee, New York, on "Telephone Publicity—Appealing to Public Opinion," was read, and a vote of thanks tendered to the author.

The independent companies should recognize the necessity of securing the good will of the public. This can only be done by teaching it what the independent telephone companies have done and how strong they are. Only in this way is it possible to overcome the opposition in its stronghold. The public ear must be reached through legitimate news items published in the newspapers, items which are not paid for and which have the element of novelty. It was suggested that the association adopt a comprehensive policy for informing the people of the country of the achievements of the independent companies.

A resolution relative to the independent movement looking to an entrance into Washington, D. C., Chicago and New York city was introduced and adopted.

After a lengthy discussion upon the status of the Kellogg Switchboard and

A MEETING OF THE NATIONAL-INTERSTATE TELEPHONE ASSOCIATION, AUDITORIUM HOTEL, CHICAGO.

Digitized by Google

Supply Company, a resolution was passed recommending that members of the association not now using equipment made by that company refrain from purchasing such apparatus, and in the event of the company passing into the control of independent people the resolution to be void.

R. A. Walker, Iowa, read a paper, entitled "Look for the Shield." Mr. Walker made an earnest plea for the universal use by independent companies of the shield adopted as an emblem by the association last year.

THURSDAY MORNING SESSION.

The convention was called to order at 10 A. M. Thursday morning by President Hoge. The committee on standard operating rules and regulations reported progress and recommended that it be allowed to report at a later session which was done.

Charles S. Norton delivered an address entitled "Official Organs—National and State." In this he dwelt upon the powerful fighting machine which such an organ would be. The journal should be divided into departments devoted to the various branches of telephone work. He urged the association to take up the matter. The address was referred to the executive committee with power to act.

L. G. Parker read a paper entitled "Southern Toll Line and Exchange Development." This calls attention to the opportunities for telephone development in the South, and points out the present conditions, which seem to be very favorable for such development.

The report of the committee on amendments to the constitution and by-laws was read by the chairman, C. W. Kline. The committee has revised the entire constitution, making slight changes in nearly all sections. It seems that the present constitution has never been adopted, but it was taken as a basis for the amended form. The report was taken up article by article, and adopted, in some cases with slight changes. In Article I the name of the association is designated as the International Independent Telephone Association of America. The idea of the committee was to make the name inclusive, so as to admit Canada, Cuba and Mexico if they desire to come in. It is provided that an annual meeting shall be held within thirty days of June 1, and special meetings when decided upon by the executive committee. Article X, on membership, has been changed considerably. It is in two sections. Section I provides that any state, provincial or independent telephone association shall be eligible to membership in the association. Section II provides that manufacturers of independent telephone apparatus, manufacturers of cable and other telephone equipment, dealers in telephone apparatus, publishers of telephone magazines and telephone construction companies may become associate members.

It was moved and carried that copies of the new constitution be printed and distributed to the members.

The report of the committee on standardization of equipment was presented by E. E. Clement. The committee thought it impracticable and inadvisable to select one unvarying type of telephone equipment as a standard for all companies; but recommends that such details of apparatus as screws, lamp bases, etc., be standardized. A unit of carrying value for telephone circuits should be determined and adopted. It recommends that a permanent committee on physical standards be authorized and appointed. The report of this committee was discussed in a communication from S. G. McMeen, who agreed with its recommendations, and by I. H. Thiedick, Charles S. Norton, E. F. Wasson and L. Reber. The report was accepted and referred to the executive committee.

The report of the committee on standard forms of accounting was presented by Charles F. Bender. This divides the work into six parts: standard forms, classification of income, classification of construction, general accounts, operating accounts, and maintenance accounts. The committee did not feel itself competent to formulate a standard system of accounting, with the expectation that all companies would adopt it at once. Such an outcome would require some time, and it recommends that a permanent committee of five members be appointed to consider the matter further. The report was accepted and referred to the executive committee.

The report of the committee on credentials was read by the secretary. This recommends that delegates from a number of states, who have been properly certified, be seated. The report was accepted.

The convention then adjourned, to meet at 1.30 P. M.

THURSDAY AFTERNOON SESSION.

The convention was called to order by President Hoge. The report of the committee on standard operating rules and regulations, which had been held over from the preceding session, was submitted by Charles C. Deering. Mr. Deering called attention to the desirability of devising some method of handling and accounting for free business. This business is, in some cases, particularly heavy, and it is desirable that it should be carefully studied. The report suggests that a committee should be appointed to take the matter into consideration. The report was discussed by Messrs. John M. Baer and J. B. Ware favorably, and was adopted, the committee to report at the next meeting.

The following papers were ordered to be published: "Independent Advertising—Getting Results," W. B. Woodbury, Detroit, Mich.; "Revenues," by W. B. Humboldt, Topeka, Kan.; "Suggestions on How to Finance Small Telephone Property," by Theodore Gary; "Texas," by J. B. Earl.

A resolution was presented by A. C. Lindemuth, urging the mayor, the board of public works and the common council of the city of Evansville, Ind., to grant a franchise to the Citizens' Telephone Company. This resolution was sharply discussed by Messrs. Baer, Ware, Norton, Fisher and Thiedick. It was adopted in a modified form, in which the words, "an independent telephone company," were substituted for "the Citizens' Telephone Company." A number of those who took part in the discussion intimated that they would present similar resolutions with respect to other cities where independent companies were receiving franchises, and on motion of Mr. Baer, a similar resolution referring to Milwaukee, Wis., was adopted.

The report of the nominating committee was presented by P. C. Holdoegal. The following were the nominees:

President—James B. Hoge, Cleveland, Ohio.

First vice-president—Theodore Gary, Macon, Mo.

Second vice-president—Charles E. Sumner, Portland, Ore.

Secretary—Charles C. Deering, Boone, Iowa.

Treasurer—James G. Splane, Pittsburg, Pa.

John A. Harney was also nominated for the position of secretary by Mr. Ware, but he withdrew his name. The nominees were elected.

President Hoge thanked the association for its confidence in his administration, and urged upon the members unabated interest in its work.

On motion of George N. Bandy, Mr. Harney was recommended for appointment as assistant secretary. The motion was carried.

The report of the committee on photographs was presented by George T. Hewes. Fifty views of independent telephone buildings had been exhibited, and the following prizes were recommended:

Keystone Telephone Company, Philadelphia, Pa., first prize.

Digitized by Google

Lincoln Telephone Company, Lincoln, Neb., second prize.

Sioux City Telephone Company, Sioux City, Iowa, third prize.

Louisville Home Telephone Company, Louisville, Ky., honorable mention.

The report was adopted.

A motion was made and carried, that a thousand copies of the full proceedings of the convention be printed for distribution by the association. This has not been done heretofore.

The question box was then taken up, some of the questions being read by J. B. Rhodes. These are of a very varying character, a few of them being discussed briefly by members. One of the questions was, "How Should the Technical Schools Train Young Men for the Telephone Field?" This was considered at some length by A. B. Smith, of Purdue University, who outlined the work offered there and wished for an expression of opinion as to what should be the character of the instruction given to prepare young men for telephone work.

On motion of Charles S. Norton, which was adopted, a committee was appointed to wait upon the officers of large municipalities and present arguments in favor of independent companies seeking franchises. Those appointed to the committee were Messrs. Norton, Woodbury and Holdoegal.

Mr. Rhodes was authorized to edit and publish the question box.

The convention then adjourned *sine die*.

ASSOCIATION BANQUET.

The banquet of the association was held at the College Inn, "White City," on the evening of June 27. About 350 members were present and an enjoyable time was had. Colonel J. D. Powers, of Louisville, Ky., acted as toastmaster.

Illinois Independent Telephone Association.

The first annual convention of the Illinois Independent Telephone Association was held at Peoria, Ill., June 20 and 21. A feature of the session on June 21 was the address by F. Dagger, of Ottawa, Canada, on the subject of "Telephone Competition *versus* Monopoly." A paper on "Discipline in the Switchroom," was also presented.

The following officers were elected: president, E. R. Conklin, Aurora; vice-president, Manford Savage, Champaign; secretary, C. B. Cheadle, Joliet; treasurer, C. B. Hawkins, Decatur. Members of executive committee: E. R. Conklin, Aurora; C. B. Cheadle, Joliet; C. O. White, Princeton; J. W. Barrett, Pekin; Manford Savage, Champaign; C. S. Haskins, Decatur and W. S. Bassett, St. Louis.

New York Pay Station Telephone Rates.

As announced last February by U. N. Bethell, vice-president of the New York Telephone Company, a five-cent pay station telephone rate was made effective in each of the boroughs of New York city on July 1.

In laying out the territory in which a five-cent call can be made the companies have been liberal, in most instances the territories exceeding the borough limit.

For example, Manhattan and the Bronx have been divided into three districts. District 1 comprises the territory below One Hundred and Tenth street on Manhattan Island; district 2, Manhattan Island north of One Hundred and Tenth street, together with the two exchanges, Melrose and Tremont, in the Bronx. District 3 comprises all of the Bronx except the Melrose and Tremont exchanges.

According to the new rates all telephone calls within districts are to be five cents, and all calls to adjoining districts will be five cents. The only ten-cent charge in the two boroughs is for telephone calls between southern Manhattan and northern Bronx.

The borough of Brooklyn, together with Astoria and Long Island City, have also been divided into three districts in which a five-cent rate will obtain in the same manner. Rates between adjoining boroughs are ten cents. From remote points they are fifteen cents.

Seventh Annual Meeting of the National Electrical Trades Association.

The seventh annual meeting of the National Electrical Trades Association was held June 14 at the Hotel Imperial, New York city, representatives being present from affiliated local associations throughout the country. A number of members of the New York society were also in attendance.

At the business session lasting the whole afternoon important matters came up for consideration and reports were rendered by the delegates from the local asssociations showing them to be in a flourishing condition and becoming more and more potent in assisting the members to run down bad debtors. The general secretary's report was particularly replete with instances of the great good being accomplished by the affiliated bodies.

C. C. Sibley, of the firm of Sibley & Pitman, New York city, was elected president for the ensuing year; Geo. A. Cragin, of the American Steel and Wire Company, Worcester, Mass., was made vice-president, and Attorney Frederic P. Vose, local secretary of the Chicago association, was reappointed general secretary. Chicago was selected as next year's meeting place.

Immediately after adjournment of the meeting the party was transported in a large sight-seeing automobile to Coney Island where dinner was served and the mysteries of Luna Park and Dreamland were explored.

Railway Men Visit Schenectady, N. Y.

Delegates to the recent Saratoga Springs convention of the Street Railway Association of the State of New York visited Schenectady at the invitation of the General Electric and American Locomotive Companies. The party included some fifty members of the association and was in charge of Manager E. F. Peck of the Schenectady Railway Company, chairman of the entertainment committee, and other officials. Special cars furnished by the local railway company brought the guests to the city, where they were received by officials of the American Locomotive Company. After viewing the works, the party proceeded to the factories of the General Electric Company, where an informal lunch was served in the new Firemen's Headquarters building. The reception committee at the works of the General Electric Company included J. G. Barry, G. P. Haskins, G. H. Hill, E. D. Priest, Theo. Beran, manager of the New York office, F. H. Gale and others. After lunch the party spent the afternoon in viewing the works, leaving about 4 o'clock.

New York City Brings Suit to Get $5,000,000.

Corporation Counsel Delaney, of New York city, claims $5,000,000 from the Consolidated Telegraph and Electrical Subway Company and the Empire City Subway Company, Limited, for the city of New York, under the agreement entered into as a condition upon which these companies were given the exclusive use of the electric subways laid during the administration of Mayor Grant. The companies claim that they owe the city nothing. On June 27 Justice Giegerich, of the Supreme Court, upon the application of Assistant Corporation Counsel Burr, appointed Hamilton Odell, Eugene A. Philbin and Adrian H. Joline to take an accounting in the dispute.

As a condition for the electrical subway privilege, the two companies agreed to pay to the city all over ten per cent net profit earned under their monopoly, expenses of operation being first deducted. It is alleged by the city that this now amounts to more than $5,000,000. The companies' counsel, however, deny that they have ever earned anything like ten per cent.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

The Action of Radium on Gelatine.

In this communication John Butler Burke explains the experiments he has been conducting to determine the action of radium on gelatine and bouillon, and replies to certain criticisms made of his work. There is no doubt in his mind that subdivision takes place because of the nature of the cleavage. He believes that the radium salt produces ultra-microscopic bubbles, due to the gaseous emanation which it emits. These bubbles act as the nuclei of larger aggregates, due, no doubt, to direct chemical action on the surrounding medium, or to indirect ones brought about by the intense electromagnetic disturbances from the radio-atoms, as in the case of photographic actions. The cellular bubble and emanation will multiply as the emanation increases, since it will force its way through the cell walls at the lines of least resistance. Their mode of subdivision will be different from that of aggregates which divide up into clean-cut segments or sections, while the emanation cells retain their smooth surface, due to surface tension. It seems not improbable that the subdivision of natural cells is accomplished in some similar way, although not necessarily by radium. It seems probable that there is in the nucleus a substance with somewhat similar properties, but in a more or less marked degree, which enables the cell to perform this cyclic process, each portion possessing some of the original nuclear substance. His radiobes and the eobes noticed by M. Dubois, although differing in some respects, have enough in common to show that negative experiments and observations are not altogether to the point. It seems probable that in these negative experiments the salts used have been in excess, and that the microscope powers employed have not been high enough. The criticism that the action may be chemical, because similar effects will be produced by barium, seems not to cover the point, for it is to be expected that barium will behave in much the same way as radium. It has been found that sulphur must be present in the gelatine, otherwise no marked results will be obtained. Also, it should be noted that these bodies are soluble in warm water, and hence solutions of radium should not be employed. There is nothing fortuitous in this subdivision any more than there is in the subdivision of natural cells. These bodies are unquestionably a unique and highly developed form of cell. If they are organic crystalloids, as they resolve themselves into these, they are, at any rate, more remarkable than any of that type hitherto observed.—*Abstracted from the Electrician (London), June* 15.

A Current Interrupter for Roentgen Apparatus.

A method is given here by M. J. O. Januszkiewicz of constructing an interrupter for use in Rœntgen-ray work which overcomes the difficulties met in apparatus of other types. There are three features which must be possessed by a successful interrupter; it must be able to break fairly heavy currents up to, say, thirty amperes; it must be capable of being regulated so that the frequency of the break is under control and can be reduced to a fairly low number; and the breaking of the current must be gradual, although the opening of the circuit should be quick. The electrolytic current interrupters satisfy the first two conditions and are excellent devices because of their simplicity, but, unfortunately, they interrupt the current too quickly, and therefore are not entirely satisfactory. On the other hand, certain mechanical interrupters meet the last condition, but are defective in respect to the first two. Other things being equal, the length of a spark-gap varies inversely with the gas pressure. Wolff has shown that the following equation holds: $v=107.2p+79$, in which v is the sparking potential and p the vapor pressure in atmospheres. From this it is seen that by increasing the pressure of the vapor surrounding the spark that the rapidity with which the current is interrupted is brought under control and the length of break required can be varied. This therefore offers an easy solution of the problem. There is no difficulty in constructing the apparatus, because the breaking mechanism only need be enclosed in the pressure chamber, and high pressures are not necessary. It seems probable that the same principle can be employed for constructing an interrupter for use in wireless telegraphy.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), June* 15.

A Gasolene-Electric Motor Car.

A description is given here of an interesting gasolene-electric motor car constructed for the Hungarian government. About 200 of these cars are to be supplied. The car runs on two axles and is equipped with a direct-current generator driven by a four-cylinder gas engine. In this particular car the engine and generator set is placed across the car, though in later designs it will be placed longitudinally. The generator compartment contains all the switch gear and engine accessories. The voltage employed is 550, this being selected to enable the car to run over city electric railway systems without employing the generator set. The controller is a series-parallel device, and there are two motors, one geared to each axle. These motors are of the four-pole type and can be employed for braking, if necessary. The car weighs about eighteen tons, and will carry forty passengers. A car of this type, containing, however, two twenty-kilowatt generator sets in place of the one fifty-kilowatt set now employed, was tested recently at Árad, Hungary, giving the following results: The weight was about eighteen tons. At a speed of thirty-three miles an hour the power required was 20.3 kilowatts. The consumption of gasolene was 8.6 pounds per car-mile. At a speed of twenty-three miles an hour, nineteen kilowatts were required, and the consumption of gasolene was 9.8 pounds per train mile, the motor car in this case drawing a trailer, the total weight being 24.5 tons. During other tests, when the conditions were not quite so favorable, the tractive effort being greater, poorer results were obtained. At a speed of forty miles an hour the weight being eighteen tons, the power consumed was 19.1 kilowatts, and the consumption of gasolene, 8.75 pounds per car mile. During each of these trials a distance of seventy-seven miles was covered, and, in addition, the engine was run for seventy minutes while the car was standing. The trial car was subsequently put into service on the road, and it has made possible a considerable reduction in the force, while still running at a satisfactory profit.—*Abstracted from the Tramway and Railway World (London), June* 7.

A Method of Compounding Direct-Current Electric Stations.

Although the ordinary method of compounding direct-current generators gives fairly satisfactory results, a perfect characteristic is not obtained unless auxiliary appliances are employed. Further, with this method the parallel operation of generators in the same station and of two independent stations is not always easy, for such operation calls for a special adjust-

Digitized by Google

ment of the machines for each condition of running. It is possible to do away with the compound windings, replacing them by a booster, but M. A. Nouguier thinks that a still better way is to place the booster in the exciting circuit of the generators. In this way a much smaller booster is called for than if it were required to carry the whole output of the station, and by a special arrangement it is possible to obtain a straight line characteristic both for the generators and for the station as a whole. This plan also allows simple shunt generators to be installed. The plan consists in placing a resistance in the collector bus-bar, this corresponding to the so-called instrument shunt. Across this shunt are connected the terminals of the field circuit of the booster. The armature of the latter is connected in the exciting circuit of the generators. With such an arrangement and a shunt-wound generator, a characteristic is obtained which resembles that of a compound generator, it being concave toward the load axis. In order to correct for this, the motor driving the booster has series and shunt field windings connected differentially, the series winding being also connected across a shunt inserted in the collector bus-bar. By this means a speed characteristic of the driving motor is obtained which is just the reverse of the compound characteristic of the generator, being convex toward the axis of loads. The curvature of these two lines is, of course, due to the saturation of the iron of the two machines, and when the two curves are properly selected, the change due to saturation is just compensated for by the change in speed of the driving motor, giving a flat compound characteristic of the generator. When more than one generator is to be operated in parallel, a series of parallel shunts is inserted in the collector bus-bar, one for each machine, thus making it possible by cutting out one or more for the voltage of the station to be maintained constant, irrespective of the number of machines in operation. The method makes possible the operation of generators and of stations in parallel, without any special precautions. It merely calls for a booster set, each machine of which is small. It is applicable to stations already erected, and there is no danger of reversing the field of any generator.—*Translated and abstracted from L'Éclairage Électrique (Paris), May* 19.

Modern Tendencies in the Utilization of Power.

An interesting summary of the present situation in the utilization of power is given here by Professor J. J. Flather. Among other significant features of the present tendency in the development of automatic and labor-saving devices are the marked adaptation of compressed air and the application of electric power to machine driving. In the use of compressed air, facility of adaptation to various requirements which are, in many cases, additional to the supply of motive power, is a valuable feature peculiar to this system, and one which is susceptible of extension along many lines. The labor cost in most machine shops and in other works is so much greater than the cost of power that any expedient by which the labor cost may be appreciably reduced is justified, even though the efficiency of the agent itself be low. The introduction of the electric motor in machine shops and factories was at first looked upon with disfavor, but the innovation obtained a foothold, and advantages which were at first unforeseen were found to attend its use, so that it is being very generally adopted for a wide variety of work. A considerable difference of opinion exists as to whether individual motors should be used with each machine, or whether a number of machines should be arranged in a group. There are well-defined conditions to which each system is best adapted, but there are wide limits between which there appears to be no general rule, and both methods are employed. As far as efficiency of transmission is concerned, it is doubtful whether, in a large number of cases, motor-driving is in itself any more efficient than well-arranged engines and shafting. The principal object to be kept in mind is a desired increase in efficiency of the shop plant in turning out its product, with a reduction of the time and labor items, without a special reference to the fuel items involved in power production. An interesting feature of this application has been the demonstration that by means of special tool steels, higher speeds and more rapid work can be utilized than the machine itself will allow. The advantage arising from the use of these appliances has at times led to an injudicious extension, and occasionally one finds tools in use which require more attention than was formerly taken to do the work by hand. It has been proposed to use individual air motors in machine shops, but this use of compressed air seems entirely outside the pale of its legitimate field. The general experience thus far indicates that rotary air motors are not at all economical, and generally are not as satisfactory as electric motors. An interesting phase of the problem is the vast possibilities possessed by the modern combustion engine. While its use as a motor in industrial establishments has been somewhat limited, there is yet a marked tendency to employ the gas engine in manufacturing works, and a consideration of its advantages and cost of operation, together with its thermal efficiency and the possibility of still further improvement, indicates that for a great many purposes both steam engines and electric motors may ultimately be replaced by combustion engines. The high price of gas in this country has been one factor which has retarded the more common use of the gas engine. When it was discovered that blast furnace gases could be readily utilized in combustion engines, a rapid advance followed. The highest thermal efficiency yet at hand in such engines is thirty-eight per cent, which was secured in a two-cycle type of engine; but it remains to be seen whether this type of engine will be satisfactory for small motors. It is possible that the greater complication of details in the two-cycle types, as compared with the simpler four-cycle engine, will cause the latter to continue to give the greater satisfaction, at least for smaller sizes. It is not to be understood that the gas engine will displace either the electric motor or the steam engine. Each has its legitimate sphere of usefulness, but each would be more highly developed as the result of direct competition. Yet the economies already at hand indicate that the field of the gas engine will be extended more and more. The reciprocating steam engine has reached a high state of development, but it is not probable that it has attained its highest degree of perfection. While an economy of less than nine and one-half pounds of steam per horse-power-hour has been obtained, even better results may be expected. But, in any case, and especially with intermittent or variable loads, it is not so much a question of maximum efficiency as it is economy of operation. From this point of view the present activity in the development of the steam turbine is of interest, for with this motor the steam consumption per horse-power varies little from one-third to full load, a feature which predestines the steam turbine to the special field of electric lighting and power generation, where it must inevitably become a formidable rival of the larger-sized, slow-speed reciprocating steam engines. As suggested by Stott, the most economical and reliable plant for large installations is a combination of steam turbines and gas engines. It is doubtful whether such a combination will enable the cost of power to be cut in half as was stated by Stott, but, certainly, marked economies would result from such a combination.—*Abstracted from the* 1906 *Year Book of the Engineers' Society of the University of Minnesota.*

Digitized by Google

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

ORGANIZATION AND CONDUCT OF A NEW BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.

BY M. S. SEELMAN, JR.[1]

I have been recently in a number of cities, not alone of 50,000 and under, but of 100,000 and over, where the central station had not only no organization for securing new and retaining old business, but no sense or appreciation of the lack of it. These companies do no advertising, make no attempt to educate their public to a knowledge of the superior advantages of an electrical service, have no special propositions, employ no canvassers. Some of them do not even follow up the permits for new buildings. They give no suggestion to the customer as to the most economical and effective methods of lighting his home or store or factory—that is left to the wiring contractor, who in all likelihood has an exceedingly primitive and limited idea of illuminative engineering. The attitude of such a central station may be thus expressed: "Here we are. If you really want to buy current from us and are careful in arranging necessary preliminaries and formalities, we will agree to supply it to you." In one city of about 50,000 inhabitants, not one hundred miles from New York, the customer, before being permitted to do business with the central station, must come to the company's office and sign his (or her) name in a big book kept for that purpose.

The business that comes to these central stations drifts in. If the station makes money it is rather in spite of itself than because of itself. And, under the circumstances, sooner or later the municipal ownership propaganda is certain to take strong hold. There is need of stirring and enlightenment. These stations must "awake, gird up their loins and go forth to do battle" for business.

If I were to be asked what the company, awaking from its lethargy and desirous of securing the possible business within its sphere of operation, should first do toward establishing an effective organization, I would say:

Hire a good man; if possible, one familiar with the kind of work he will be called upon to do; a man under forty, if you can; better yet, under thirty-five. If you can secure one with a combination of technical and commercial knowledge, not necessarily an engineer, but a man who has been trained around a central station, knows something about generating and distributing methods and has tackled lighting and power problems before, so much the better. He will have the less to learn and you the less to teach. But, above all, he must have "ginger," he must be a hustler with red blood in his veins, and in his heart the zest for labor and the pride and loyalty of the service. If the time comes when expert or technical knowledge which he lacks is needed, you can buy that for him, but you can not buy the energy, the dash and the vim if it is not there.

There are many such men to be had. Sometimes we find the very man in charge of some smaller central station. A good place to look for him also is among the employés of the larger companies, where the live young man is likely to have had a more comprehensive experience than would have been possible in a smaller station, and still, because of peculiar conditions, to be working for a wage which would make an offer well within your limit personally flattering and financially attractive.

This man should have charge of the organizing and conducting of our new department. Let us consider him as having been installed and call him the general agent.

The first step our general agent shall take is to establish a first-class and highly attractive office and showroom. This should be located on the main street or principal "square" of the town. If the company's offices are already so located he can alter and utilize them—or a portion of them—for the purpose. But if, as is too often the case, the offices are on some side street at a distance from the business centre, or even—as frequently happens—in the generating station itself somewhere on the outskirts of the city, then the general agent must either get the company to move its entire offices, bag and baggage, to a main location or else hire for his department alone a suitable store. I should recommend the former course, so that every time a customer comes in to pay his bill, or anybody enters the office for any purpose, he must necessarily see the exhibit of electrical appliances and utensils. Thus the law of suggestion comes into play and the visitor becomes more or less interested in those things to which we desire to attract his attention.

This new office and showroom must be made bright and attractive. The color scheme should be a creamy white that will reflect the light to the best advantage. The electrical exhibits ought to be as varied and complete as possible. A great many exhibits can be secured at little cost from manufacturers, who will be glad to cooperate with the central station for the advantageous display of their wares.

The windows of this office must be utilized to illustrate different methods of show-window lighting. Arranged on separate switches can be shown exhibits of trough incandescent lighting (as by Frink reflectors), incandescents in combination with cone or holophane reflectors, and Nernst lamps with the special Nernst reflectors. The common method of window lighting by means of projecting incandescents running around the sides of the windows, or by chandeliers, may also be shown, but in this case care must be taken to explain to customers that wherever the object of the lighting is to display the goods, then one of the three first-mentioned systems of reflected light from hidden sources is the more desirable, while the visible lamps, projecting or in chandeliers, may only be used to advantage when the object is not so much to draw attention to the goods as to attract the eye to the window itself, as with a saloon.

In the show window itself should be placed an exhibit of electric fans and heating appliances, such as irons, water

[1] Winner of the $500 prize given by the Cooperative Electrical Development Association, Cleveland, Ohio.

Digitized by Google

and food heaters, coffee percolators, chafing dishes, stoves, toasters and grids, heating pads, curling irons and the like. Adjacent to each appliance place a neatly printed or painted card, naming the article and a definite price for its use, thus:

THIS ELECTRIC IRON
Can be used for one hour
FOR SIX CENTS

If there is room in the window, a sewing machine operated by a motor should be prominently featured and kept running, as a moving object attracts more attention than a still-life exhibit. If you prefer, a buzz saw or a coffee mill might be thus utilized instead of the sewing machine. Two or three handsome reading lamps will add a touch of art and color to the window.

An exhibit of various types of lamps should be installed in the office. These should include arc lamps (one showing the concentric diffuser), one, two and three-glower Nernst lamps (there is a simple but highly artistic five-single-glower Nernst lamp fixture which could well be made a part of this exhibit), Meridian and high-efficiency lamps, Cooper Hewitt tubes, turn-down lamps—such as the Hylo—and attractive and efficient clusters, such as the "Arc-Burst" and the "Pagoda" reflecting arc. Holophane glassware could be shown as an annex to this exhibit.

Two or three types of panel signs, individual letter signs and transparencies should be installed in this showroom if there is space for them; novelties in signs and transparencies could be added from time to time.

The balance of the exhibit should be made as complete and interesting as is possible within a reasonable expense limit. There must be a motor exhibit, of course, and among other appliances that could be given a place in the showroom might be mentioned these:

Electric pump, electric organ-blower, electric forge, electric drills and lathes, electric coffee mill, combination electric meat chopper and coffee mill, electric dough mixer, electric ice-cream freezer, electric vibrators, electric dental machinery, prepayment meters, theatre dimmers, electric vacuum carpet cleaner, motor operating refrigerating machine, motor operating adding machine, the Gray telautograph.

In a prominent place over the desks which his canvassers are to occupy our general agent should have a sign hung, reading:

DON'T TALK VOLTS AND AMPERES TALK DOLLARS AND CENTS

And this brings us to the subject of canvassers. The general agent will, of course, take steps at once toward securing the aides required in his campaign for new business, the principal questions that arise being: how many does he need; in what manner shall he secure them and how much ought he to pay them?

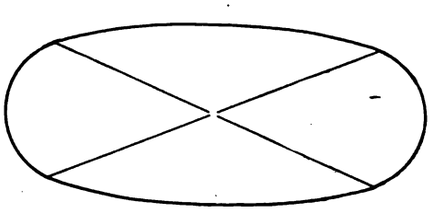
The solution of the first question must be governed to a considerable extent by local conditions—the industrial, commercial and residential nature and status of the town. Roughly speaking, I should say that—other things being equal—a city with 50,000 population or less, which is alive and fairly prosperous, would require one canvasser to about every 12,500 population. This is an elastic rule, however, and must be freely interpreted. For instance, I have in mind a factory town in New England with a population of 100,000, of which 35,000 are mill hands, comparatively few of which would be "prospects." In deciding upon the number of canvassers needed there, that 35,000 would receive but scant consideration. Take it then that we start with one canvasser for every 12,500 population, and these we can lop off or add to as future conditions and contingencies may show to be necessary.

To secure the men we want, we must either again draught from the larger companies or advertise in technical publications. Very likely our general agent knows one or two men of the type he wants who are working for other companies and whose services he can secure. It may be possible to take an employé from some other department of the business and put him to canvassing, but my experience has been that such men are rarely effective and usually unsatisfactory. As a rule, if I had to, I would rather take salesmen from some other line of business and educate them.

As to remuneration, whether straight salary or salary and commission is the best method of paying is a debatable question. I am a firm believer in the latter method as the one most effective for securing new business. Especially is this true in residence districts, where the householder must frequently be interviewed at night, the only time he is to be found at home. The canvasser on straight salary naturally hesitates to give up many of his evenings to this work, but if each call may mean a dollar or two to him, it becomes a different proposition. An equitable arrangement for the payment of canvassers would be, I should say, about $12 per week salary and a commission of two cents per sixteen-candle-power-lamp equivalent for all over 250 equivalents a month the canvasser turns in. In addition the company should pay his carfares and incidentals.

Now then, let us suppose we have gathered our selling force together and have equipped our showroom. We are still not quite ready for business. It is advantageous, I believe, to give the new men the run of the office for a day or two, so that they may become acquainted with the company's physical layout and its installation, metering and service methods. During this time our general agent can have divided the city into districts, one for each of his canvassers. A word about this work of districting.

There are many cities where the business district is largely concentrated in the centre of the town. In places of this kind I believe it an excellent plan—at least to start with—to district along lines starting at a common centre in the business section and radiating outward, thus:



In this way you give each man a portion of business section, of residence locality and probably of power territory. Later on you may find that one of your men is especially effective in residence work, another for business or for power propositions, and it is then easy to redistrict in accordance with the special qualifications of your men. Or, again, later on—to vary the system—occasionally one man may be given one line of business—the printers or the butchers or bakers, or whatever line may be selected—to canvass right straight through, giving a report upon each one interviewed.

Now then, we are pretty nearly ready to canvass. Our general agent gives his men a selling talk—not only to inspire them with enthusiasm, but to give them the last word of information as to how to approach and handle various light and power propositions as they may present themselves, so that the men may be com-

Digitized by Google

petent to advise prospective customers as to matters involved in their installation, such as wiring, selection of lamps and glassware, location of switches and outlets, painting and decorating of houses and stores to produce the best and most economical lighting effects, types of motors in general most suited for special classes of power work, ideas and methods of apportioning the units in a power installation, etc. It is well if these instructions, together with the special propositions offered by the company, be gotten up compactly in small book or pamphlet form and handed to each canvasser. Of course the canvasser must be told to refer at once all propositions that he finds himself unable to adequately or competently handle to the general agent. If he starts such business he is entitled to his commission thereupon, even if the deal has to be consummated by the general agent or some expert or specialist. In connection with this talk of the general agent to his men, it may be said in passing that it is excellent business to secure from time to time and as frequently as possible experts in various lines to address the members of your business department—illuminating engineers, power men, Nernst, meridian and high-efficiency representatives, heating appliance manufacturers and the like. This helps a great deal.

Now to canvass. Some might advise a preliminary canvass to secure names and addresses of prospects, but I believe in digging right in from the start, reaching out after business from the first day. The district agent begins work about 9 A. M. and is instructed to report back about 4.30 or 5 P. M. If this is not practicable on account of distances, then reports can be limited to the morning session, the district agent arriving at the office at eight instead of nine o'clock; but where practicable it is better to have the agent return late in the afternoon so that he may report on his day's business then, giving time for the general agent to go over the reports and prepare his instructions to his men for issue in the morning.

There are a number of systems of keeping track and record of canvassers' work. The card system is probably the best for the city of 50,000 or less. The district agent's daily report of his work he makes out in the form of a card for every one visited, on which card is inscribed name, address, nature of business, date visited, attitude of the visitee, prospects of doing business with him, when to call again, etc. This is not a particularly arduous job for the canvasser, as he is not likely to call upon more than from twelve to twenty people a day.

The general agent must look these daily card reports over carefully before they are alphabetically filed away. He must especially note any difficulties or obstacles encountered by his men, and he himself must bend his best sales efforts on these especially difficult problems and propositions. If a canvasser reports a man as positively out of the prospective class, before the general agent accepts this classification he should either send someone else to see the recalcitrant or go himself. In this way the impossibles can be eliminated and the card catalogue list becomes a list of prospectives.

And this list of "prospects" soon assumes proportions and furnishes the very best possible list for the effective distribution of printed matter.

And this brings us to the important subject of advertising.

I am inclined to believe that newspaper advertising is likely to be more advantageous and profitable in a small city than it is in a big one. There should be more or less of it done in every city, not only because it promotes a desirable feeling of good will between the newspapers and the corporation, but because it certainly has a very real educative value. In the average big city, however, the character of the population is such that out of a circulation of, say, 100,000 that some newspaper may have, only one or two thousand may be possible customers. In advertising the company must pay to reach the 98,000 unprofitable ones along with the 2,000 prospects, and it is, as a general proposition, uneconomical to pay for all this surplus publicity. In the average small city conditions are different. Circulations are not so large nor mediums so numerous, advertising charges are not so heavy and a larger proportion of readers are likely to be prospects. So that, for advertising in the city of 50,000 or less, I would utilize the newspapers to a considerable extent. Take a whole page or a half-page once in a while on some special occasion, such for instance as a reduction in rates or the inauguration of some new policy or special proposition, or a marked addition to station capacity. At other times use an advertisement each week in dailies, not all the year round, but for certain months in the year, pausing now and then to take breath and gather renewed energy for a new campaign. The size of these advertisements should not be fixed hard and fast, but should vary up from a minimum of five inches single column or four inches double, according to the particular message it is desired to convey.

I doubt if a central station in a city of 50,000 or less would support a first-class advertising man, and the other kind is of little use—liable to cost a good deal more than his salary. If your general agent can write a good advertisement—and a good advertisement does not need to be "smart" at all; it is merely the embodiment of a common-sense argument or a special proposition in an attractive form—so much the better. He can do that part of the work to advantage, especially if it is some special proposition or announcement of local interest and value that is being made. For general advertising of educative effect some of the advertising agencies that have made a specialty of electrical work—notably the Curtis Advertising Company, of Detroit, and the C. W. Lee Company, of Newark—get up clever and attractive newspaper advertisements, both text and illustration, and supply them at a price that any central office can afford. Or the general agent can secure samples of the advertisements of the larger companies by writing for them, and many of these can be readily adapted for local use.

The same rule or methods may follow in securing advertising matter for the other and, in my judgment, more valuable system of advertising by letters, circulars, booklets, etc., distributed through the mail. The advertising agencies get up some very excellent and relatively inexpensive general educative matter which is printed with your name and—as far as any one who receives it knows—emanates originally from you. In this category is the "residence number" of the electrical bulletin recently issued by the Curtis company. Letters, circulars, etc., that refer to purely local offers; conditions and announcements must, of course, be gotten up in the home office by the general agent or an assistant, and here again samples of the big companies' advertisements will be of aid, if not to pattern after, at least to suggest ideas and methods of treatment. Another big help is to get a good printer, even if he costs you more. Don't have a poor printer if you can avoid it at any price. The good one is often able to aid you with ideas, suggestions and plans for the effective construction of advertising matter.

(To be concluded.)

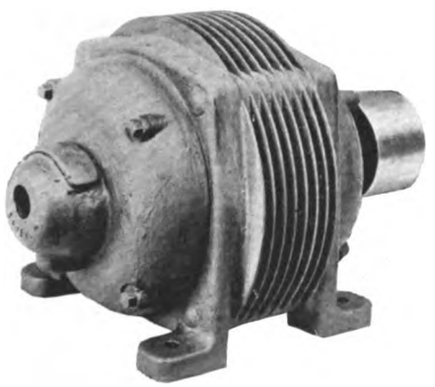
Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Small Riveted Frame Induction Motors.

The General Electric Company is placing on the market a new line of low-powered polyphase induction motors in capacities up to seven and one-half horsepower, which embody several new and interesting features of construction. Some time ago this company began the construction of a skeleton frame type of induction motor in the larger sizes and the success with which these machines have operated has led to the building of the smaller sizes on the same principle. In the older designs of motors it has been customary to build such machines with a solid magnet frame. The new design has proved its superiority, however, and without sacrificing rigidity or strength, much unnecessary material has been eliminated,



TOTALLY ENCLOSED, SIX-AND-ONE-HALF-HORSE-POWER, 110-VOLT, RIVETED-TYPE FRAME INDUCTION MOTOR.

decreasing the weight of the machine and increasing the ventilation and general efficiency.

In the new motors, low temperatures, light weight of active material per horsepower and compactness and rigidity have been embodied by constructing the stator as shown in the illustrations. The cast-iron hoods common in most motors over the stator laminations, are omitted, and the stator punchings are assembled, clamped between cast-iron rings or flanges and permanently secured by bolts riveted at the ends. In the enclosed type, the same principle is followed but additional steel flanges of a larger diameter are heaved into the stator laminations, increasing the radiating surface and thus offsetting to a large degree the smaller amount of ventilation existent with the closed end shields. The resulting stator, while novel in appearance, is very efficient and the reduction in output with the enclosed type of motor is greatly minimized.

Aside from the decreased weight per horse-power, and the compactness and rigidity, the ventilation in the new design is greatly improved due to the direct

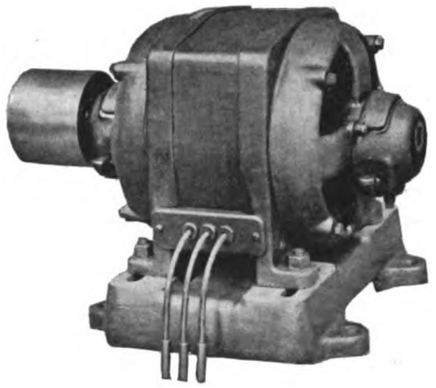
FOUR-HORSE-POWER, 220-VOLT, RIVETED-TYPE FRAME INDUCTION MOTOR.

contact of the laminations with the air, thereby increasing the heat radiation and insuring low operating temperatures at considerable overloads.

The rotor used in both open and enclosed motors is of the squirrel cage, short-circuited type, having no rubbing contacts. This simple and durable revolving element lends itself admirably to motors of small powers since there are no wearing parts and the cost of repairs and operation is practically negligible. Furthermore, these motors can be run in exposed and dusty locations without injury, and the absence of brushes or commutator makes this form of motor absolutely safe in powder, flour or chemical works where elaborate precautions must be exercised against fire.

The qualifications of compactness and good efficiency of the electrical design which adapt these motors to all classes of small power purposes are extended by several mechanical features which make the motor very easy to install. The motors may be used with or without a sub-base and mounted on floor, wall or ceiling, without additional fixtures. By turning the bearing brackets or end shields through ninety or one hundred and eighty degrees relatively to the frame, the bearings are swung into their proper position for any location. When the motors are belted it is desirable to use a sub-base, and such a one is provided with adjusting gear and screw for belt tightening. The same base is used for any position of the motor, and provision is made for distributing the weight evenly on the base in all positions. Another mechanical detail which has received careful attention is the lubrication of the bearings. Large oil wells are cast in the bearing brackets, and provided with oil gauges and drain cocks. Copious lubrication is provided by oil rings.

In operating these motors the starting torque is greater than is usually met with in squirrel-cage type of induction motor, and the starting current is comparatively small. It is generally advisable, however,



FOUR-HORSE-POWER, RIVETED-TYPE FRAME INDUCTION MOTOR.

to reduce the starting current in the seven and one-half horse-power motors and the General Electric Company makes a compensator of a simple and durable design suited for this purpose. The motors may, however, be started by connecting the stator in Y and changing the delta when the motor reaches normal speed. This change is easily made by a six terminal lead board and a double throw switch. While equivalent to using a sixty-per-cent tap compensator and considerably cheaper, this method of starting is less flexible since only one starting voltage can be obtained.

The standard motors described in the foregoing are made for both moderate and slow speed, the former being generally provided with pulleys for a belt drive, though with a slight modification they are also suitable for direct connection or for gearing.

The light weight per horse-power due

Digitized by Google

to the riveted form of construction, adapts the motor to many special applications where a heavier, bulkier machine could not be used. The General Electric Company also makes special forms of this new type motor, as shown in the illustrations; a vertical motor for direct connection to a pump and a motor with fan blade mounting.

All motors are manufactured for standard commercial voltages and frequencies for two or three-phase alternating-current circuits and are guaranteed to carry their load continuously, with a temperature rise above the surrounding air not exceeding forty degrees centigrade, and a twenty-five-per-cent overload for two hours with a temperature rise not exceeding fifty-five degrees centigrade.

Central Station Advertising at the National Electric Light Association Convention.

The accompanying illustration gives a fairly good idea of the central station advertising display made by the Curtis Advertising Company, Detroit, Mich., at the exhibition on Young's Pier, in connection with the twenty-ninth convention of the National Electric Light Association, at Atlantic City, N. J., June 5 to 8. This exhibit included posters, postal cards, folders, bulletins, magazines and follow-up systems,

AN EXHIBIT OF CENTRAL STATION ADVERTISING MATTER AT THE NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION, ATLANTIC CITY, N. J., JUNE 5-8.

all of which are applicable to syndicated central station advertising. The exhibit attracted a great deal of attention, and the company announces that the central station men showed a keen interest in this subject.

The Exhibit Plant of the Automatic Refrigerating Company.

One of the most interesting booths at the recent exhibition held in conjunction with the convention of the National Electric Light Association at Atlantic City, N. J., was that of the Automatic Refrigerating Company, Hartford, Ct. During the four days of the convention this company, represented by three refrigerating engineers, demonstrated to the public the practicability of thermostatically controlled automatic refrigerating appa-

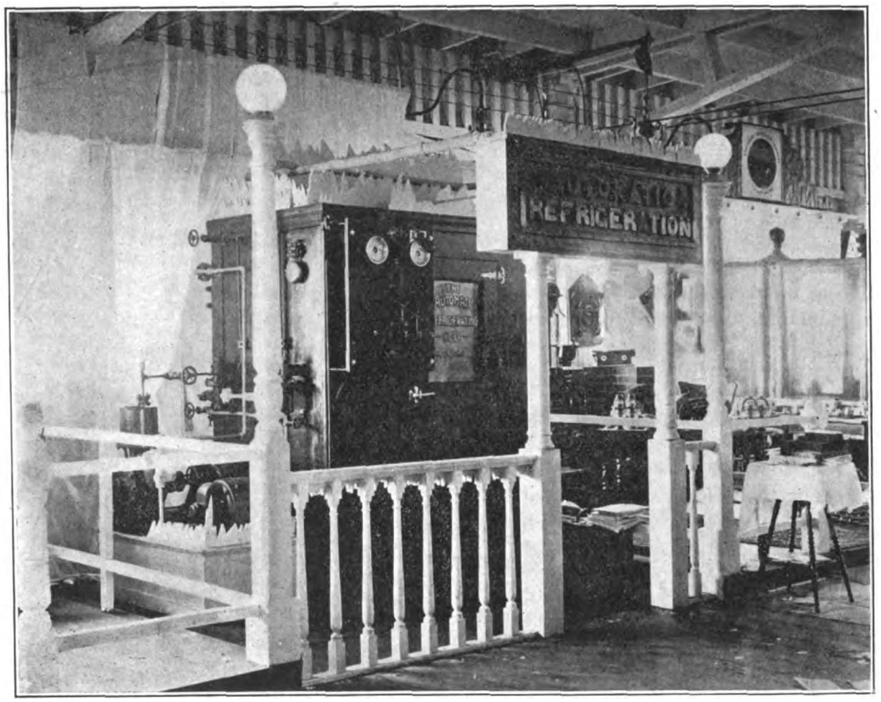


EXHIBIT OF THE AUTOMATIC REFRIGERATING COMPANY AT THE CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION, ATLANTIC CITY, N. J., JUNE 5-8.

ratus. The exhibition plant, which had not previously been assembled in its entirety, was one of the company's standard one-horse-power motor-operated systems, connected to a small insulated cooler. The appearance of the whole system, which was put in practical operation within two days after its arrival at Atlantic City, inspired considerable confidence in its mechanical characteristics, and its perfect automatic operation proved its efficiency for the work for which it was designed.

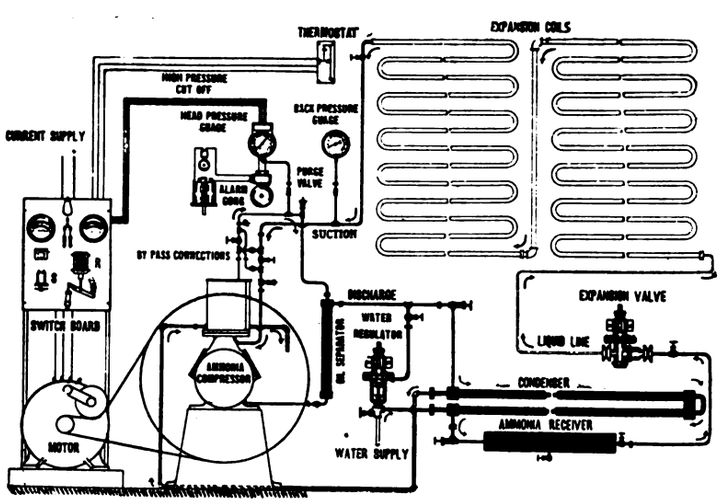
The accompanying illustrations indicate the arrangement of the various elements of the system, and give a good idea of the appearance of the exhibit as arranged at Atlantic City. The frost on the lettering surrounding the exhibit was maintained by the direct expansion of ammonia in a small coil of pipe behind the letters. The small cold-storage box, which was also cooled by direct expansion, was provided with a glass door, through which the frosted pipe, as well as the controlling thermostat, could be seen from the outside. This box was maintained at a temperature of from forty to forty-two degrees Fahrenheit, the control of the temperature being effected by a special thermostat designed by the company for cold-storage use. This thermostat carries a small current of electricity necessary to

Digitized by Google

operate the motor-starting device on the switchboard.

Several of the features of this system attracted a good deal of practical attention, particularly the construction and operation of the automatic expansion valve, the automatic water-regulating valve, and the high-pressure safety cutoff.

The automatic expansion valve is a special patented form of pressure-reducing valve of such design that the slightest change of pressure within the expansion coils instantly effects an increase or a decrease in the amount of anhydrous ammonia allowed to pass the valve and expand into the cells in the cold-storage compartments. This increase or decrease in pressure, as the case may be, quickly restores the back pressure to the point for which the valve has been set. This, it is claimed, allows the highest possible back pressure, consistent with the lowest temperature required, to be maintained at all times and consequently causes the compressor to operate under the conditions most conducive to maximum efficiency.



COMPLETE AUTOMATIC REFRIGERATING SYSTEM.

These automatic valves are protected against the possibility of stoppage from scale or dirt by an extremely fine steel gauze strainer inserted in the liquid line ahead of the valve. It is claimed by the manufacturers that these valves having once been adjusted need not be touched for an indefinite period. For the sake of a slight increase in economy, however, it is recommended that on account of the difference between the conditions of load in the summer and winter, the expansion valve in the ordinary plant be adjusted twice a year, once in the spring and once in the fall.

A second valve, similar in construction to the automatic ammonia expansion valve, throttles the flow of condenser cooling water to the actual requirements and shuts off the supply entirely when the head pressure drops after the compressor has been stopped. It will be noted that the ammonia expansion valve is regulated by the back pressure, the feed through same being reduced as the back pressure is increased, while the water-regulating valve is regulated by the head pressure, the feed through it being increased as the head pressure is increased.

The question that naturally arises in this connection is what would happen if the water supply should fail so that the automatic water-regulating valve would be unable to supply the required amount to the condenser.

This emergency has not been overlooked, for just above the head-pressure gauge is arranged a small automatic switch which the company calls a "high-pressure safety cutoff." The function of this switch is to shut down the compressor in case the condenser pressure should become abnormal, and to start it again as soon as the pressure should again be restored to normal. Mechanically this is effected in much the same way as the starting and stopping is controlled by the thermostat, the pressure instead of the temperature operating the motor-starting apparatus.

Referring to the diagram herewith the modus operandi is as follows: starting with the "expansion coils" where the liquid ammonia is evaporated and in consequence produces a cooling effect on the surrounding atmosphere, the vapor passes to the "compressor," which discharges it into the "condenser," from which it flows, in the liquid form, to the "ammonia receiver." Between the compressor and the condenser the high-pressure gas is passed through an "oil separator" which separates out any entraned oil picked up in its passsage through the compressor. From the "ammonia receiver," which forms a reservoir, the liquid ammonia passes to the "automatic expansion valve," the function of which has already been explained, after which the above cycle is again traversed.

The circuit of the cooling water is first through the "automatic water-regulating valve," the "condenser" and the "compressor jacket," after which it passes to the sewer, or if of value to a storage tank.

The principal advantages claimed for the "automatic system" are superior efficiency because of the automatic parts, which also places mechanical refrigeration within reach of the man whose small ice consumption will not warrant the expense of engineers, the saving of whose services, by the use of automatic devices, the Automatic Refrigerating Company claims to have demonstrated to be eminently practical.

The Automatic Refrigerating Company's exhibit was in charge of F. E. Matthews, manager, assisted by its Boston representative, Eugene Carpenter, and Expert Engineer A. Michael.

Railway Equipment for the United Railroads of San Francisco.

For the equipment of its new rolling stock, made necessary by the recent fire, the United Railroads of San Francisco has placed large orders with the General Electric Company for various types of railway motors. These include twenty-five four-motor, GE-80 (40-horse-power) equipments; fifteen four-motor, GE-90 (50-horse-power) equipments, and ten four-motor, GE-73 (75-horse-power) equipments. All these equipments will be supplied with the flexible Sprague-General Electric system of multiple-unit control. The GE-80 (40-horse-power) motor is being widely adopted in railway work, many other companies having adopted this motor. It is the most suitable size for city work, and the special M.C.B. oil bearing design has proven extremely popular. The United Traction Company, of Albany, N. Y., has recently ordered twenty-five four-motor equipments of this type and the Philadelphia Rapid Transit Company, 100 four-motor equipments. In several instances, the GE-80 is being substituted on cars already using a less efficient motor. Thirty-six equipments of four motors each were recently ordered by the St. Louis Railway Company, supplanting motors of another type.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

DIRECT CABLE LINE TO JAPAN—Greetings have been exchanged between President Roosevelt and the Emperor of Japan, over the American cable connecting the island of Guam and Japan, which was recently completed. President Roosevelt's message, expressing the good will of the American people and himself, was sent on June 25. The Japanese emperor's reply reached Washington on June 26.

NEW YORKERS TO DEVELOP MAINE WATER POWERS—Arthur E. Leach, a New York banker, has purchased for a New York syndicate a majority of the stock of the Consolidated Electric Light Company of Maine, and has also secured from George A. Fernald & Company, Boston brokers, owners of a controlling interest in the Portland Electric Light Company, an option on that company. The deal involves $1,000,000 and contemplates development of water power on the Saco and Penobscot rivers, whereby electric light and power may be furnished to many cities and towns in western Maine.

THE HOME TELEPHONE COMPANY OF RHODE ISLAND—A company known as the Home Telephone Company of Rhode Island is seeking to obtain a franchise to do a telephone business in Providence, R. I. The company was incorporated several years ago and has obtained franchises for several of the smaller places in Rhode Island, but, up to the present time, has gone no further. It is capitalized at $2,500,000, and has an authorized issue of bonds of $1,500,000. The company undertakes, if it obtains a franchise, to give a free service to its subscribers until 5,000 stations are in operation.

ALLIS-CHALMERS COMPANY BOND ISSUE—A special meeting of the stockholders of the Allis-Chalmers Company has been called, to be held at 15 Exchange place, Jersey City, N. J., on Monday, July 16, to take action upon two resolutions adopted by the board of directors at a meeting held on June 25. One resolution authorized the issue of bonds for an aggregate sum not exceeding $15,000,000, to be secured by mortgage, lien or pledge upon the real estate and manufacturing plants of the company. The other resolution authorized and approved a conditional contract between the company and Messrs. Shearson, Hammill & Company, acting on behalf of a syndicate, for the acquisition of as much of $12,000,000 worth of the bonds as may not be taken by the stockholders.

THE STONE & WEBSTER ENGINEERING CORPORATION—It is announced that an engineering and constructing company with a paid-in cash capital of $250,000 has been organized by Stone & Webster, Boston, Mass., under Massachusetts laws, to take over the engineering part of its business, the firm of Stone & Webster devoting itself to financial affairs and the management and development of the numerous properties which it operates. The new company proposes to undertake engineering and construction work in connection with electric railway, lighting, gas and water-power undertakings, electrification of steam roads, etc., throughout the country. All the stock of the company has been taken by Stone and Webster and their associates. The officers of the corporation are: president, Russell Robb; vice-president and general manager, Dwight P. Robinson; treasurer, Howard L. Rogers.

MEMPHIS STOCKHOLDERS OBJECT TO MERGER—At a meeting, held in Louisville, Ky., of the owners of stock, preferred and common, in the Memphis Street Railway Company, the secretary of the meeting was instructed to address a protest to Isidor Newman & Son against the reported plan of the firm to form a holding company to control the Memphis Street Railway, the Little Rock Railway and Light Company, the Knoxville Railway and Light Company, the Birmingham Railway, Light and Power Company, the Nashville Railway and Light Company and the Houston Lighting and Power Company. The protest says: "We have purchased the securities of the Memphis Street Railway upon our faith of the future growth and prosperity of that city, and do not care to have it linked with other properties concerning which we know little and in which we have no interest. We sincerely trust that you will leave the Memphis property out of your proposed plans."

NORTHERN OHIO TRACTION—The Northern Ohio Traction and Light Company, according to advices from Cleveland, will soon take over the Canton-Akron system. The former's stock will be increased for the purpose and the latter's bonds will be guaranteed, its preferred stock being retired and its common exchanged for that of the Northern Ohio. When the transaction is completed the Northern Ohio Traction's capital stock will be $10,000,000, its outstanding bonds, $900,000, and its earnings this year about $1,700,000. The Northern Ohio Traction owns the interurban line from Cleveland to Akron and Barberton and the city lines and lighting plants of Akron and Barberton, with a line to Kent and Ravenna. The Canton-Akron system includes the line from Canton to Akron, with the city lines of Canton and Massillon and the new interurban line from Canton to New Philadelphia and the Tuscarawas Traction Company, altogether about eighty-seven miles. The Canton-Akron has outstanding $2,000,000 bonds and about $1,800,000 stock. This will give a through route, Cleveland to Canton.

ANOTHER EXTENSIVE TRACTION MERGER—The incorporation of the Indiana, Columbus & Eastern Traction Company recently, with a capitalization of $12,000,000, marks the beginning of one of the largest electric traction consolidations which has yet taken place in the West. The company is one of the Widener-Elkins creations and will take over all the traction lines in Ohio which have been held by the Ohio syndicate of which W. Kelsey Schoepf, of Cincinnati, is chairman, and J. H. McGowan, of Indianapolis, chairman of the Indiana syndicate, is vice-chairman. The Indiana, Columbus & Eastern will take over the Columbus, London & Springfield, operating between Columbus and Dayton; the Columbus, Grove City & Southwestern, operating between Columbus and Morgan's Station; the Dayton, Springfield & Urbana, operating between Dayton and Urbana; the Dayton & Western, operating between Dayton, Ohio, and Richmond, Ind.; that part of the Dayton & Muncie operating between Greenville, Ohio, and Union City, Ind.; the Dayton & Northern and the Columbus & Lake Michigan from Defiance to Lima. It will also build a new line from Bellefontaine to Lima to connect with the Lima & Toledo, now under construction, and will lease the lines of the Columbus, Newark & Zanesville Traction Company, operating between Columbus and Zanesville. The capital stock of the latter company has been increased to $6,500,000, and it has bought the Columbus, Buckeye Lake & Newark and the Zanesville city lines. The consolidated company will operate more electric mileage than any other single corporation in the country, having under its immediate control over 500 miles of interurban lines. It will cover all of central and western Ohio and by connection with the lines of the Indiana syndicate will be enabled to operate through cars from Zanesville to Terre Haute, Ind., a distance of over 300 miles. The principal cities which it will connect are Cincinnati, Toledo, Cleveland, Columbus, Indianapolis, Muncie, Ind.; Zanesville, Ohio; Dayton, Ohio, and Newark, Ohio. The Columbus, Newark & Zanesville will issue $5,000,000 of bonds to care for underlying issues and to provide for improvements and extensions, and the Indiana, Columbus & Eastern will have an authorized bond issue of $12,000,000, of which, however, but a part will be now issued. All of the roads will be put in the best possible shape and high-speed passenger and express cars will be run. The company expects to compete with the steam roads in all kinds of traffic, and already has secured sites in Dayton and Columbus for large interurban passenger and freight union stations. The station to be built in Columbus will cost in the neighborhood of $1,000,000.

Digitized by Google

PERSONAL MENTION.

MR. EDWARD M. TAYLOR, who has been in charge of the traffic department of the Lynchburg (Va.) exchange of the Southern Bell Telephone Company, has been appointed manager of the Lynchburg district, in place of D. F. Turnbull, who has been promoted to a position at Birmingham, Ala.

PROFESSOR GEORGE I. ROCKWOOD has been appointed to the professorship of steam engineering in the Worcester Polytechnic Institute, Worcester, Mass. Professor Rockwood is a graduate of the Worcester Polytechnic Institute, class of 1888, and is one of the leading authorities in this country on the subject of steam engineering.

MR. LOUIS STUART THURSTON, who has been identified with the Cincinnati office of the General Electric Company, was married on June 26 to Miss Annie Louise Smith, of Delaware, Ohio. Mr. Thurston is a New York man and a graduate of the engineering department of Columbia College, and he has been active in electrical engineering in the middle West during the last few years.

MR. WALTER CLARKE DEAN has opened offices in the Bank of Commerce Building, Norfolk, Va., and will represent the C & C Electric Company. Mr. Dean is a graduate of the Massachusetts Institute of Technology, and has had considerable experience in the equipment of the Norfolk Navy Yard, where he has made a specialty of variable-speed motors for driving machine tools.

NEW PUBLICATIONS.

PROCEEDINGS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION—The book of proceedings of the Atlantic City convention of the National Electric Light Association will probably be distributed about the first of November. For those who wish to receive at once the papers read at the meeting, a number of sets are available at a price barely sufficient to cover the cost of printing and distribution, namely, $1.25 for the papers and $1.25 for the question box.

THE TRUE RAILROAD SITUATION IN MASSACHUSETTS AND THE INTERURBAN ELECTRIC RAILROAD—Mr. John H. Bickford has published, in pamphlet form, the information which was presented by him and others to the Massachusetts railroad and street railway committees. The subject is taken up under several headings, including a discussion of the state policy with respect to railroads, the relation of present classes of carriers to each other and to the public, the physical limitations of each class and their inability to meet the growing demands of the public for better facilities, and the electric railroad on private right of way. The whole forms an interesting study of the present situation in Massachusetts.

DIRECTORY OF DIRECTORS IN THE CITY OF NEW YORK—The 1906 edition of the "Directory of Directors in the City of New York," published by the Audit Company, of New York, 43 Cedar street, New York city, is ready for distribution. This book is of great value as a reference, and bears the unmistakable stamp of accuracy and authenticity. The first part contains a complete alphabetical list of directors and trustees having New York city addresses, followed by the names of the companies with which each is connected. The name of the firm or company with which each director is most closely associated is given in all cases where facts were obtainable, on the same line with the name and address. The second part of the book—the appendix—contains selected lists of corporations in banking, insurance, transportation, manufacturing and other lines of business, alphabetically arranged, accompanied in each case by the names of the company's principal officers and all its directors or trustees. The book forms a comprehensive directory of all the large business interests in New York city, containing practically all the addresses desired by business men. The 1906 edition is printed from new type, is nicely arranged, very easy to read, and is handsomely bound in red cloth covers.

ELECTRICAL SECURITIES.

Liquidation continued in the stock market during the past week, due largely to the uncertainties of the money market, resulting in net declines throughout nearly the entire list. While the call money rate has been nothing unusual for this period of the year, time money has hardened perceptibly, rates for periods carrying over the year advancing to five and three-quarters and six per cent, and, in cases of mixed collateral, to seven per cent. The bank statement, while favorable, was somewhat disappointing, in view of the large dividend and interest disbursements to be made. Another factor has been the recent ruling, to the effect that there shall be a charge of $2 on every 100 shares of stock sold in New York state, regardless of its par value, which has had a tendency to restrict sales of securities having a par value of less than $100, notably in the cases of Reading and Pennsylvania. Crop reports have been generally favorable, one estimate placing the probable wheat crop at a new high record total. The iron and steel industries are also in a prosperous condition.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 30.

New York:	*Closing.*
Allis-Chalmers common	17¾
Allis-Chalmers preferred	96½
Brooklyn Rapid Transit	75⅛
Consolidated Gas	138⅝
General Electric	161¼
Interborough-Metropolitan common	36¼
Interborough-Metropolitan preferred	74
Kings County Electric	165
Mackay Companies (Postal Telegraph and Cables) common	70
Mackay Companies (Postal Telegraph and Cables) preferred	71
Manhattan Elevated	147
Metropolitan Street Railway (ex dividend)	106
New York & New Jersey Telephone	121
Western Union Telegraph	91¼
Westinghouse Manufacturing Company	152½

The income statement of the Interborough Rapid Transit Company for the year ended March 31, 1906, follows: earnings from operation, $18,954,273; operating expenses, $8,357,084; net earnings, $10,597,189; other income, $748,972; gross income, $11,346,161; interest, rentals, etc., $8,461,978; net income, $2,884,183; dividends (8 per cent on $35,000,000), $2,800,000, leaving a surplus of $84,183 for the year, which added to the previous surplus, $2,012,365, makes the total $2,096,548.

The directors of the New York & New Jersey Telephone Company have declared the regular quarterly dividend of 1½ per cent. The annual rate paid by the company, however, is 7 per cent, because for several years an extra dividend of 1 per cent has been declared in January. The dividend is payable on July 16 to stockholders of record on July 5.

Boston:	*Closing.*
American Telephone and Telegraph	134
Edison Electric Illuminating	241
Massachusetts Electric	68¼
New England Telephone	130
Western Telephone and Telegraph preferred	91
Philadelphia:	*Closing.*
Electric Company of America	11½
Electric Storage Battery common	69
Electric Storage Battery preferred	69
Philadelphia Electric	8
Philadelphia Rapid Transit	24½
United Gas Improvement	81½
Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	142
Metropolitan Elevated preferred	66
National Carbon common	82
National Carbon preferred	117
Union Traction common	4
Union Traction preferred	14

The postponed annual meeting of the Chicago Edison Company was held on June 26, and the retiring directors were reelected. Nothing was done toward a consolidation of the Edison and Commonwealth companies. The Edison report shows about 9.04 per cent earned on the stock, compared with a little less than 8.6 per cent a year ago. The Commonwealth earned 2.86 per cent on its stock, against 2.83 a year ago. The Chicago Edison has announced to customers a reduction of 11 per cent in rates, commencing July 1.

Digitized by Google

OBITUARY NOTICES.

DR. JOHN A. TANNER, JR., died at Boston, Mass., June 21. He was for many years a surgeon in the United States navy, but had been in private practice since his retirement in 1887. While in the service he made many electrical investigations on cables and on insulating materials, and also designed electrical apparatus for the government use.

MR. HARRY BOTTOMLEY died at Knutsford, England, on Saturday, June 16. Mr. Bottomley was born in Belfast, Ireland, thirty-two years ago. For the last three years he had been assistant treasurer of the English branch of the Westinghouse Electric and Manufacturing Company. He was a brother of John B. Bottomley, vice-president of the Marconi Wireless Telegraph Company.

MR. CHARLES EASTMAN TRIPLER died on Wednesday, June 20, at Liberty, N. Y., after an illness of several months. Mr. Tripler was born in New York city in 1849, and while attending private schools showed an aptitude for mechanics and chemisty. When he was twenty-three years old he constructed a naphtha condensing engine, and then devoted himself for several years to experimenting with chemicals. In 1890 he discovered a means of liquefying air, and two years later succeeded in producing liquid oxygen and nitrogen at a cost of five cents an ounce. A stock company capitalized at $20,000,000 was formed to put the method into commercial use, and all sorts of claims were made for the product. The company was never a financial success.

MR. LOUIS CASSIER, proprietor of *Cassier's Magazine* and the *Electrical Age*, was killed in the railway accident at Salisbury, England, on Sunday, July 1. Mr. Cassier was born in Boston, Mass., forty-four years ago, and did his first magazine work with the *Musical Courier*, of New York city. Later he was connected with the New York advertising office of the *Illustrated London News*, and in 1891 started *Cassier's Magazine*. A few years ago he bought the *Electrical Age* and reorganized its management, becoming president of the company. He went abroad in 1894 and started *Cassier's Magazine*, of London, and since then has divided his time between New York and London. Mr. Cassier was a member of the Reform, Automobile and Camera clubs, the Municipal Art Society and the American Society of Mechanical Engineers. He is survived by his wife, who was Miss Agnes Nichols, of Trumbull, Ct., where Mr. Cassier had a country home.

MR. CHARLES C. NEWTON, president and treasurer of the Newton Machine Tool Works, Incorporated, Philadelphia, Pa., died at Bremen, Germany, on Wednesday, June 13. Mr. Newton had not been in good health for some time past, and had gone to Europe to seek relief at the baths at Bad, Nauheim, Germany, but was too ill to continue his journey after his arrival at Bremen. Mr. Newton was held in high esteem by all who knew him, owing to his unswerving honesty and integrity, coupled with his exceptional ability as a designer of machine tools. Charles C. Newton was born February 9, 1846, at Cambridge, Washington county, N. Y. At the age of nineteen he indentured himself as an apprentice to the Brooks Locomotive Works, Dunkirk, N. Y. After finishing his apprenticeship and working in various shops, Mr. Newton returned to Dunkirk in 1875 and in partnership with J. D. Cox manufactured twist drills, reamers, cutters, etc., removing to Cleveland, Ohio, in 1876, to broaden the scope of their work, operating under the firm name of Newton & Cox. In 1880 Mr. Newton sold out his interests to Mr. Cox, who formed out of the old firm the Cleveland Twist Drill Company. Going to Philadelphia, Mr. Newton laid the foundation for the present Newton Machine Tool Works, Incorporated, in a little shop on Callowhill street, with only himself and an assistant as the working staff. In the fall of 1886 he built a new shop to accommodate the increased demand for his material, and in August, 1895, the first part of the present shop was erected. Mr. Newton was the sole proprietor of the works until July 14, 1897, when articles of incorporation were taken out, the firm being the Newton Machine Tool Works, Incorporated, with Mr. Newton as president and treasurer. Mr. Newton was a member of the Engineers' Club, American Society of Mechanical Engineers, the Art Club, of Philadelphia, and the Athletic Club, of Philadelphia.

ELECTRIC LIGHTING.

BRONSON, MICH.—The electric light plant which was recently destroyed by fire will be rebuilt at once.

McGRAW, N. Y.—The contract for lighting the streets of McGraw for one year has been let to the Cortland & Homer Electric Company.

MILWAUKEE, WIS.—The village of West Milwaukee has awarded the contract for its street lighting to the Milwaukee Electric Railway and Light Company at $84 per light, to burn all night.

DUQUOIN, ILL.—The Duquoin city council has granted a waterworks and electric light franchise to D. E. Nottley, of Pittsburg, and E. C. Parker, of St. Louis. Work on the installation of the electric light system will begin at once.

LEXINGTON, VA.—Robert E. Hutton, general manager for the Lexington Light and Power Company, has placed orders for the necessary machinery and equipment for the improvement of the plant. The new equipment is expected to arrive by August 1, and will be installed by the early fall.

NIAGARA FALLS, ONTARIO—At the annual meeting of the shareholders of the Canadian Niagara Power Company the following directors were elected: W. H. Beatty, W. H. Brouse and Wallace Nesbitt, of Toronto; De Lancey Rankine, of Niagara Falls, N. Y., and A. Monroe Grier, of Niagara Falls, Ontario.

SLATINGTON, PA.—At the annual meeting of the stockholders of the Citizens' Electric Light, Heating and Power Company the old board of directors was reelected for the ensuing year as follows: Fred Horlacher, E. D. Peters and Charles Benner, Jr., of Slatington, and Robert E. Wright and Hugh E. Crilly, of Allentown.

WILKESBARRE, PA.—There is a movement on foot among the merchants of Wilkesbarre to organize a new light company. Some of the leading merchants and largest consumers of light have subscribed for stock in the new corporation, which will be capitalized at $250,000, and have signed contracts to use the light for a period of five years.

HUNTSVILLE, ALA.—The Muscle Shoals Power and Development Company has been incorporated in Colbert county for the purpose of developing power from Muscle Shoals in the Tennessee river. The incorporators are: S. J. Kernachan, W. J. Kernachan, G. B. Shea and J. R. Coleman. The company will build an electric power-house near the shoals.

TECUMSEH, NEB.—The outcome of the movement started by the Commercial Club for better electric lighting service has been the appointment of a committee by Mayor H. T. Ward to go to Seward and investigate the conditions there, where, as in Tecumseh, municipal ownership prevails. If conditions warrant, the city council will call a special election for the purpose of voting $10,000 for the proposed improvement.

SPOKANE, WASH.—It is said that the Madison River Power Company, at Twin Bridges, Mont., is contemplating the building of another large power plant on the Madison river to furnish more electric power for Butte mines and smelters, the plant now in operation in the Madison cañon being inadequate to the demands for electric power. A party of surveyors is now in the upper Madison valley for the purpose of making surveys.

BURLINGTON, PA.—Ownership by the city of its own lighting system is again agitated, and a special committee appointed by the common council to enquire into the matter has reported in favor of municipal ownership. Council has deferred action on the report until a further investigation is made by the committee to ascertain whether or not the city can legally furnish lights for other than public use. The report of the committee shows that the city is paying yearly for arc lights $90 each and for incandescent lights $21.50.

BELLEVILLE, ILL.—The property of the Belleville Gas and Electric Light Company, in Belleville, has been sold to a syndicate of Chicago capitalists, headed by K. A. Ames, the consideration being $500,000. Harry Kircher will be retained as manager, it is stated, and very few, if any, changes will be made. The company was reorganized about four years ago with Judge R. D. W. Holder, Attorney L. D. Turner and ex-Mayor M. M. Stephens, of East St. Louis, as principal stockholders. They invested about $350,000 at that time.

Digitized by Google

TELEPHONE AND TELEGRAPH.

RICHMOND, VA.—The Southern Bell Telephone Company will expend $400,000 in improving its service in Richmond.

NEWARK, N. J.—Plans are being prepared for a two-story exchange building at Haddonfield, N. J., for the Delaware & Atlantic Telephone Company.

DUNKIRK, N. Y.—The Bell Telephone Company is to expend $30,000 in improvements in Bradford this summer. A new $10,000 exchange will be built.

AUBURN, N. Y.—The certificate of the increase of the capital stock of the Southern Cayuga Telephone Company from $15,000 to $30,000 has been filed in the county clerk's office.

ALBANY, N. Y.—The Bell Telephone Company has filed with the secretary of state a certificate to the effect that the Wyoming & Cattaraugus Telephone Company has been merged with it.

MALAGA, WASH.—The Columbia River Lumber Company, of Wenatchee, is building a telephone line from Malaga to Laurel hill. Poles are also being cut for a telephone line for the Stemilt valley and Laurel hill.

CHARLOTTE, N. C.—Three new circuits north *via* Greensboro will shortly be run by the construction department of the Southern Bell Telephone and Telegraph Company out of Charlotte. There are in operation now eight circuits.

REDLANDS, CAL.—The Coachella Valley Home Telephone Company is the name of a recently organized company which will have for its object the connecting of towns through Coachella valley, the lines extending from Mecca to Indio. The officers of the company are: president, J. D. Turnbull; vice-president, F. E. Dudley; treasurer, C. C. Abbey; secretary, K. C. Wells.

ANAHEIM, CAL.—The Valley Home Telephone Company will establish a system covering all of northern Orange county, comprising the cities and the districts of Anaheim, Fullerton, Placentia, Buena Park, La Habra, the Fullerton oil fields, Garden Grove, West Anaheim, Brookshurt, Yorba, Benedict, Miraflores and Claire. Arrangements have been made to connect with the Home Telephone Company. About $125,000 will be expended on the system.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company opened its new St. Paul exchange on the night of Saturday, June 16. The company has had no St. Paul exchange since the fire in February, 1904, when its central exchange was destroyed. The opening of the new exchange involved the changing of about 16,000 telephone numbers. The new exchange is located on the ninth floor of the Chesapeake & Potomac company's new building on Light street.

SACRAMENTO, CAL.—The Pacific States Telephone Company is to erect a six-story building on the site of its former building at 140 New Montgomery street. The frame is to be of the steel-cage construction and the foundations and floors of reinforced concrete. The inner walls will be of fireproof material and the outside decorations will be of pressed brick, terra cotta and copper. Metal sashes are to be used for the wired-glass windows, which will be rendered doubly fireproof by rolling iron shutters. The whole building will be in Italian renaissance style. The cost is estimated at $300,000, and the time for construction at twelve months.

ALLENTOWN, PA.—The Consolidated Telephone Company has concluded a deal, by which it leases for a term of 999 years the Easton & Bethlehem Telephone Company's lines. This line was started about five years ago. The company later failed and was reorganized by a company, of which W. A. Wilbur is the president, and J. Davis Brodhead, secretary. It takes in all of the Bethlehems, Easton, Phillipsburg, Alpha, Martin's Creek, Freemansburg and surrounding territory, with a total pole mileage of about 500 miles and 1,400 subscribers. The company also purchased outright the Honesdale Telephone Company, which operates a line from Hawley to Carbondale, a distance of thirty-two miles and has about 400 subscribers. The Consolidated also purchased the Berwind Telephone Company, which operates a line from Lime Ridge to Nanticoke, about twenty-five miles, with important long-distance connections and about 500 subscribers. The Consolidated company will immediately commence developing and extending these lines. All of them will be connected with the Allentown exchange thus affording direct communication from that city.

ELECTRIC RAILWAYS.

GOSHEN, IND.—Wakarusa has voted a $7,000 subsidy to the Fort Wayne & South Bend electric line. Nappanee voted $8,000.

SHARON, PA.—Announcement is made that the interurban trolley line between New Castle and Meadville will be built this year.

ASHLAND, KY.—The Ashland Interurban Railway Company has been incorporated to build an electric traction road in Ashland, and extending to Russell, opposite Ironton. Later the road will be extended to Greenup, Ky. The company will also furnish electric current for commercial purposes.

LIMA, OHIO—The Widener-Elkins syndicate has acquired control, by lease, of the Dayton & Western traction line, extending from Dayton to Richmond, Ind. By the arrangement six per cent per annum will be paid on the $850,000 preferred stock and on the $450,000 common stock. This makes an annual rental of $78,000.

BALTIMORE, MD.—The United Railways and Electric Company is having surveys made from Towson to Lutherville with the view of constructing an electric line. This route has been practically mapped out, and in a short time, it is thought, bids for the construction will be invited. The purpose is ultimately to extend to Cockeysville.

INDIANAPOLIS, IND.—The Electrical Installation Company, of Chicago, and the Allis-Chalmers Company, of Milwaukee, which have the entire contract for building and equipping the Indianapolis, Newcastle & Toledo Electric Railway Company, have sublet the contract for grading, ballasting and track-laying to J. T. Adams, of Columbus, Ohio, and S. E. Seagraves, of Toledo, Ohio. Grading is to be started at once.

MANITOWOC, WIS.—The Fox River Valley Railway Company, organized a year ago to construct an interurban between Sheboygan and Kaukauna, has increased its capital from $25,000 to $200,000. It is proposed to construct the line from Manitowoc to Sheboygan at once, and then extend to Kaukauna next year. The company has floated $400,000 of its bond issue, it is said, and there is assurance that the road will be built.

NORTH YAKIMA, WASH.—A movement is on foot to organize a syndicate of business men to build and operate an electric railway system for the city of North Yakima, and connecting with other parts of the valley. The business men who will enter the scheme will put up $100,000 and all needed above that amount will be raised by mortgages on the plant. The citizens propose to build with the idea of turning the system over to the city at some future time.

KANSAS CITY, MO.—D. B. Holmes and other Kansas City men are named as incorporators in a company that proposes to build an electric line between Joplin, Mo., and Pittsburg, Kas. The company recently filed articles of association in Joplin. The company proposes to operate a city service in Joplin and an interurban service between Joplin and Pittsburg. Some of the other Kansas City men in the company are: H. C. Page, G. W. Carpenter and John S. Southerland.

LAPORTE, IND.—The survey for the construction of an electric railway to connect South Bend and Chicago *via* Michigan City and Gary, and a connecting link in the system which is to be operated between Cleveland and Chicago, has been completed. The statement is authorized that construction work, part of which is under way, is to be pushed with all possible speed, the financing of the road having been arranged. This is the line in which the Hanna syndicate, composed principally of Cleveland capitalists, is interested.

AKRON, OHIO—The Mandelbaum-Pomeroy syndicate has awarded the contract for the construction of the electric line between Mansfield and Seville to the Cleveland Construction Company. The work is to be completed early in 1907. This line will supply the missing link connecting the Ohio Central Traction line, uniting Bucyrus, Galion, Crestline and Mansfield with Cleveland, and connecting with the Cleveland & Southwestern line at Seville. It will also give those towns direct connection with Akron, when the Northern Ohio Traction and Light Company extends its Wadsworth line to Seville.

Digitized by Google

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1503 describes and illustrates the Allis-Chalmers Reliance-Corliss engine of the direct-connected type.

THE BLISS ELECTRIC CAR LIGHTING COMPANY, Milwaukee, Wis., in bulletin No. 80, describes the vestibule-type coupler with automatic jumper used with the Bliss system.

THE CALCULAGRAPH COMPANY, 1444 Jewelers' Building, New York city, is distributing a neat souvenir in the form of a facsimile of a calculagraph record card used by the Japanese Porcelain Company, of Noritaka, Japan.

THE FARR TELEPHONE AND CONSTRUCTION SUPPLY COMPANY, 118-120 West Jackson boulevard, Chicago, Ill., will be pleased to send catalogue No. 19 to any one interested in telephone apparatus and telephone line supplies.

THE DEAN ELECTRIC COMPANY, Elyria, Ohio, has ready for distribution bulletin No. 102, describing common battery telephones. In addition to the text and the illustrations of the telephone apparatus there are a number of very clear diagrams of connections.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has published a neat folder descriptive of Jeffrey flexible wire-rope conveyers. The company also makes chain and rubber-belt conveying machinery, and will be pleased to send catalogues and full information upon request.

W. R. OSTRANDER & COMPANY, 22 Dey street, New York city, will be pleased to send literature describing the "Morse" adjustable fixtures for use in factories, shops, schools and draughting rooms, incandescent lamp replacers and cleaners, and the "Connecticut" coil current indicator and coil switches.

THE AMERICAN ELECTRIC SIGN COMPANY, 41-45 Van Buren street, Chicago, Ill., is distributing a large poster illustrating various forms of telephone signs. The company is the manufacturer of electric advertising and commercial signs, flashlight signs and board signs. The electric signs are wired complete with rubber-covered and braided wire of proper carrying capacity.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., will be pleased to send to any one interested, upon request, a reprint of the speech delivered by the Hon. John A. Walker, vice-president and general manager of the company, before the members of the Boost Club, New York, May 10, entitled "A Concise History of Lead Pencil Making."

THE LOMBARD GOVERNOR COMPANY, Ashland, Mass., has ready for distribution bulletin No. 106, illustrating and describing its type "Q" governor. This is the latest design the company has put on the market. Some sixty of these machines are now in use, and their performance is fully up to the company's expectations. The company states that this type shows a distinctly better regulation than its types "B" and "D," which have always been highly regarded.

THE POWER AND MINING MACHINERY COMPANY, Milwaukee, Wis., will shortly have ready for distribution catalogue No. 6, descriptive of machinery for roasting, smelting and refining copper and silver-lead ores. This catalogue will contain about 176 pages, six by nine inches, amply illustrated, and will give information of interest to the practical mining and smelting man. It will be ready for distribution about the middle of July, and will be sent to any one interested upon request.

GILLETTE, VIBBER & COMPANY, New London, Ct., is making a specialty of the "G. V." pipe-cap for covering the outdoor end of service pipe carrying any number of wires. These pipe-caps are made in eight sizes, from one-half inch to three inches. They can be applied without interrupting the service, can be used on either threaded or plain pipe, are equipped with brass screws, and can be used for any number of wires, including cables. The company will be pleased to send samples and literature upon request.

THE ABNER DOBLE COMPANY, San Francisco, Cal., has relocated its offices at its former site, Fremont and Howard streets. The company is one of the first to resume operations in the burned district, and has taken contracts for a large amount of work in addition to the orders on hand previous to the fire. Work is progressing rapidly on the company's new shops and warehouses in the Potrero district, at Seventh and Hubbell streets. Temporary pattern and forge shops are already in operation on the new site.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has ready for distribution special bulletin No. 7,049, giving the range of capacities of different types of alternating and direct-current motors for all classes of service. The literature in this pamphlet is so arranged as to make a convenient reference to this apparatus. The company in circular No. 1129 and circular No. 1134 describes and illustrates, respectively, the No. 119 railway motor for direct-current service, and electrical and mechanical brakes for Westinghouse type "K" motors.

THE MARINE ENGINE AND MACHINE COMPANY, 126 Liberty street, New York city, has been awarded the contract by the Department of Water Supply, Gas and Electricity, of the city of New York, for two 5,000,000-gallon pumping engines for the Canarsie pumping station, borough of Brooklyn. These engines will be of the horizontal triple-expansion crank and flywheel type, with a guaranteed duty of 150 foot-pounds per thousand pounds of dry steam, and similar to the two engines now being built by the company for the New Lots pumping station of the borough of Brooklyn.

THE DE LA VERGNE MACHINE COMPANY, New York, N. Y., reports the following recent sales of the "Hornsby-Akroyd" crude and fuel oil engines: the Fulton Bag and Cotton Mills, Atlanta, Ga., fifty-horse-power engine to drive general machinery. F. P. Pfleghar & Son, New Haven, Ct., 125-horse-power engine, direct-connected to generator. Wissahickon Electric Company, Fort Washington, Pa., fifty-horse-power engine. Iola-Aurora Production Company, Iola, Kan., twenty-horse-power engine for driving general machinery. Marconi Wireless Telegraph Company of America, New York city, seven-horse-power engine.

THE ELECTRIC CABLE COMPANY, 17 Battery place, New York city, has secured orders from the American Railways Company, Altoona, Pa., and from the Taluca Light and Power Company, Taluca, Tex., for "Voltax" compounds, to be used in both cases for insulating purposes. The Public Service Corporation, of Aurora, Ill., has also recently placed a large order for "Voltax," and orders have been secured from the Brass Goods Manufacturing Company, of Brooklyn, N. Y., for waterproofing concrete floors, and the Paul Smith's Hotel Company will use "Voltax" as a waterproofing compound on telegraph and trolley poles and fence posts on its property in the Adirondacks.

NEW MANUFACTURING COMPANIES.

LANSING, MICH.—The Sharon-Quinlaren Electrical Company, of Detroit, has been incorporated with a capital of $1,000.

COLUMBUS, OHIO—The Cleveland Gas and Electric Fixtures Company, Cleveland, has been incorporated with a capital of $250,000 by B. G. Tremaine, W. C. Hine, R. W. Hine, H. A. Tremaine and J. R. Crouse.

SALT LAKE CITY, UTAH—Articles of incorporation of the Davis County Plumbing and Electrical Supply Company have been filed in the office of the secretary of state. $5,000. Incorporators: J. H. Robinson, of Farmington; Dan Muir, of Woods Cross, and David Stoker, of Bountiful.

AUGUSTA, ME.—The Consolidated Railway Electric Lighting and Equipment Company has been organized at Augusta for the purpose of manufacturing and dealing in machinery for generating, heating, ventilating and power, and for other purposes, with $16,000,000 capital stock, of which nothing is paid in. The president and treasurer is I. L. Fairbanks, of Augusta.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 2. NEW YORK, SATURDAY, JULY 14, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. L. W. MARSHALL, Manager
BOSTON OFFICE: Delta Bldg., 10 Post Office Square, M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad St., London, E. C., HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.
Copyright, 1906, by Electrical Review Publishing Co.
Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

CONTENTS.

EDITORIAL:
Electric Power in the South . . . 37
Greenwich Observatory in Trouble . . . 38
The Three-Phase Locomotives for the Simplon Tunnel . . . 38
A Safe Noise Maker . . . 39
Magnetic Surveys of the Oceans . . . 39
The Simplon Tunnel Electric Locomotives, by B. F. Hirschauer . . . 40
Street Railway Association of the State of New York . . . 43
A Method of Starting Gas Engines . . . 47
Electricity in Elevator Service . . . 47
The National Electrical Contractors' Association . . . 48
An Investigation of the Steam Turbine . . . 51
Report on the Peabody (Mass.) Municipal Light Plant . . . 52
The Electrical Plant of the Canadian Niagara Power Company, by H. W. Buck . . . 53
The Faraday Society . . . 57
Economical Lubrication of Large Power Plants, by W. M. Davis . . . 58
Electrical Notes from Europe . . . 59
The Denver "Welcome" Arch . . . 61
Electricity: The Power Behind the South, by W. S. Lee, Jr. . . . 62
Professional Ethics, by Rossiter W. Raymond . . . 64
Iron and Steel Institute . . . 66
BOOK REVIEWS . . . 66
ELECTRICAL PATENTS . . . 67
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 68
Underground Telegraph Wires in England . . . 69
Train Service for Simplon Tunnel . . . 69
METHODS OF GETTING NEW BUSINESS: "Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under" (Concluded), by M. S. Seelman, Jr. . . . 70
INDUSTRIAL SECTION:
New Hubbell Candelabra Socket . . . 73
A New Water-Wheel Governor . . . 73
The "G. V." Pipe Cap . . . 73
Effect of Load-Factor on Fuel Consumption of Diesel Engines . . . 73
Yale & Towne Portable Electric Hoists . . . 74
New Outdoor Lighting Specialties . . . 75
Electrical Machinery in South America . . . 76
"Keough" Cord-Grips . . . 76
Second Annual Conference of the Franklin Electric Manufacturing Company . . . 76
Production of Asbestos in 1905 . . . 76
New Line of Stanley-G. I. Arc Lamps . . . 77
CURRENT ELECTRICAL NEWS . . . 78

ELECTRIC POWER IN THE SOUTH.

At a recent meeting of the American Cotton Manufacturers' Association, at Asheville, N. C., an instructive paper was read by W. S. Lee, Jr., chief engineer of the Southern Power Company. The paper dealt with the importance of electric power to the manufacturers of the South. A striking phase of this problem has been the apparent neglect of the many and important water powers in that section up to this time. This is explained not only by the fact that the South has been an agricultural rather than a manufacturing section, but because, when the railroads were being built there, there were practically no factories to influence the location of the lines, so that they were built merely with respect to the best location from the railroad engineer's viewpoint, which was along the highlands, and not in the valleys. This, as was pointed out, is diametrically opposite to the condition in New England, where the factories were well developed before the railroads were built, and the latter were forced to seek the mills; while, in the South, the factories were built after the railroads, and had to go to the latter. The result of this has been that the mills in New England were built where power is cheap, and cheap transportation was brought to them; while, in the other section, the mills sought the railroads, and, as a consequence, could not take advantage of the available water powers.

The condition has been changed now by the application of the electric drive, which, by means of a station placed at the water power, supplies cheap power to the mills already located on high and healthy ground close to the railroads. This new development has thus given the Southern mills an additional advantage over those in New England, besides that of being in the cotton country; and if full benefit be taken of these opportunities, and if the labor problems do not upset the forecasts, it is difficult, as Mr. Lee believes, to see what is to prevent that section of the country from becoming the main cotton-manufacturing centre of the world.

With such opportunities the manufacturers and engineers of the South have great responsibilities put upon them. If this development is to be carried out with the fullest success, many things must be borne in mind. A large water power is a valuable asset, but it can only be made to pay if the power produced from it can be sold. There must be a market or a fair prospect of creating one before the owners are justified in developing their property. On the other hand, the ability to secure cheap power gives one district a decided advantage over another not so favorably situated; yet it must not be forgotten that in most manufacturing processes the mere cost of power is a minor item. The great success of the electric drive can not be attributed to this feature alone. It is the other benefits accruing from its use which have put it in the lead. These water powers must therefore be developed intelligently and with a view to inducing manufacturers to build near them. Moreover, as undoubtedly a good deal of the capital required for this work must be drawn from other parts of the country, there should be no over-hasty running into hydroelectric construction. Such a policy would merely defeat its own ends by rendering capital suspicious. It is much better to go slowly, developing first at those points where there is already a market, and not rushing heedlessly into a hydroelectric boom.

There are a number of other problems now presented to the South which are related to this development. One is the preservation of the waterfalls by stopping the destruction of the

Digitized by Google

Southern forests. In some sections the danger of this destruction is already understood, but there should be a greater effort to impress the public with the importance of this matter. Then, too, the Southern states should provide better facilities for training their engineers. While at the present time there are a number of schools in the South where a good electrical training can be had, in most of the colleges the courses offered in electrical engineering, judging from the catalogue descriptions, are far from adequate. While it is true that the determined student can get his education by going to other states, there are many who are not able to do this, and there should be no such necessity. There is not the same neglect in other branches of technical instruction, and if, as has been predicted, electricity is to be the power behind the South, the colleges should see to it that properly trained men are provided to bring about this much-to-be-desired result.

GREENWICH OBSERVATORY IN TROUBLE.

A surprising situation has developed recently at Greenwich Observatory, England, which is, without question, one of the most important astronomical stations of the world, due to the putting in service near it by the London County Council of its new power station. The station is located exactly on the meridian, about a mile south of the observatory, and although it at present has but a small part of its complement, the entire equipment will have an output of over 50,000 horse-power. Already, some disturbance has resulted from the operation of certain generating units, and the observatory authorities have brought the matter before Parliament, as they fear that when all the machinery is in place and running, their instruments will become useless.

The surprising feature of this situation is that apparently no steps have been taken before to protect the observatory. Application for authority to build the power-house was made about four years ago, and when it was granted, other departments of the government, as well as private interests, were safeguarded; yet the observatory, the one institution most likely to be affected, seems to have been overlooked, and apparently its officers did not realize what was being done. Now they find not only that there is some vibration, but that the two large chimneys of the power-house, coming in the meridian, may possibly interfere with the observation of transits, not only on account of the chimneys themselves, but because of the hot gases which will pour out of them.

When this matter was up before Parliament a number of eminent statesmen and scientists spoke about the situation. Some suggested the substitution of steam turbines for the reciprocating engines; others suggested cutting down the height of the chimneys; but no definite conclusion was reached. It is probable that a commission, representing both the government and the London County Council, will examine the conditions thoroughly. In the meantime, careful studies are being made of the station to see if it can be rearranged so as to do away with the vibration. What the outcome will be can not be said definitely, but even though the power-house represents at the present time a value of about $2,500,000, it is hardly probable that for this sum the disabling of the observatory will be allowed; and yet, under the conditions, it does not seem fair that the taxpayers of London county should be made to pay for the negligence of a department of the government.

THE THREE-PHASE LOCOMOTIVES FOR THE SIMPLON TUNNEL.

The most recent application of the three-phase motor to electric railway operation is that which has been made in the Simplon tunnel. These locomotives, which were designed and built by Brown, Boveri & Company, Baden, Switzerland, are described on another page of this issue by Mr. B. F. Hirschauer. They were originally intended for the famous Valtellina road, but, on account of the recent completion of the tunnel, they were transferred there in order to begin the electrical movement of the trains. A short time ago it was reported in the daily papers that some difficulty has been encountered in using these locomotives in the tunnel on account of the hot, humid atmosphere, but it is hardly probable that this is serious, as the motors can be protected, or at least rendered sufficiently moisture-proof to do away with the trouble.

The equipment of the locomotive consists of two motors, as against the four used on the latest American types. Further, since these motors are of the induction type, they both must run at the same speed. It is therefore necessary to gear them together, otherwise the load upon them might be badly unbalanced; in fact, a serious unbalancing is likely to occur, due to a slight difference in the diameter of the driving wheels, if some coupling arrangement be not adopted. The motors are not geared to the axles. A system of side bars is employed, which is simply a flexible coupling, enabling the motors to move relatively to the axles.

The American locomotive most interesting to compare with this polyphase machine is that described by B. G. Lamme as the type selected for the New York, New Haven & Hartford Railroad. This is a single-phase locomotive, equipped with four gearless motors, spring-suspended from the driving wheel. The latter locomotive is designed to be used with 11,000 volts on the trolley. It calls for two single-phase transformers. The Simplon locomotives are intended for 3,000 volts only, and require a complement of three single-phase or one polyphase transformer. The four motors of the New Haven locomotive are rated at 200 horse-power each, but they can easily be overloaded so as to develop 1,000 horse-power. The Simplon motors are rated at 450 horse-power each, making a total of 900, but they also can be greatly overloaded. The American machine makes use of a multiple unit-control system, enabling two or more locomotives to be coupled together so as to obtain any desired tractive effort. This can not be done with the Simplon type.

It is probable that the Simplon tunnel offers unusually favorable conditions for the use of the three-phase type of locomotive, which is most suitable for fairly long runs with few stops. The type does not involve the use of commutators, the reliability of which in heavy alternating-current service is still doubted in

Digitized by Google

some quarters. Another characteristic of the polyphase type of locomotive is the limited speed range. There are but two economical speeds which are obtained by commutating the motors. The single-phase type has a variable speed characteristic, but is designed to develop forty-five miles per hour as a maximum. The speeds of the Simplon tunnel locomotive are twenty-five and forty miles an hour.

Mr. Hirschauer says that the Simplon motors weigh a little less than twelve tons each, and that they can develop a maximum output of 1,150 horse-power, which makes them the lightest motors for their size which have yet been constructed. This method of rating hardly seems fair, for it is probable that the output mentioned is that which the motor will develop just before dropping its load. It corresponds to what is almost a 100-per-cent overload from the normal rating. The motors could not, of course, be operated at any such load. It is possible that the single-phase motors, tested in the same way, would develop nearly as great an output per pound as the polyphase machine.

The total weight of the Simplon locomotive is said to be sixty-eight tons. It is intended to handle trains weighing from 200 to 250 tons. The weight of the New Haven locomotive has not been given, but it is to handle trains of approximately the same weight. The work of the two locomotives will therefore not be very different, considering only the single-phase machine as used for through service, and a more satisfactory comparison can be made when data secured from regular service are at hand.

A SAFE NOISE MAKER.

In commenting upon the reports of Fourth of July accidents, which, while possibly not as large as in previous years, still leave a great deal to be desired, our esteemed contemporary, the New York *Times,* says: "It would really seem that in the present state of science and art of chemistry the ingenuity of its professors and practitioners ought to be equal to arranging for some kind of noise which would not have too lethal consequences to persons or too destructive consequences to persons and property."

The opportunity here pointed out for a useful invention has already been seized upon in one instance, at least, and a safe noise maker has been constructed by the distinguished head of the physical department of one of our leading universities. This apparatus, which was described in this journal something less than a year ago, is a gas cannon, so-called because the explosive mixture is in gaseous form. It consists merely of a small toy cannon, a small acetylene generator and a couple of dry batteries for ignition purposes. By pressing a key the cannon is charged with a mixture of acetylene and air, and a touch upon a second key ignites the charge, producing a loud, sharp report. The cannon can be fired as rapidly as the gas will flow into it, at least as often as thirty times a minute, which should be frequent enough for any one. It is perfectly safe, for the hand can be held in front of the cannon mouth during a discharge without receiving any injury, and slight fabrics or tissue paper do not take fire when held in the flash, as the latter is almost instantaneous. If a louder noise is desired, a cork may be inserted, which then becomes a harmless projectile. The only drawback to the device is the first cost, but as this is not more than $5, it is probable that, bang for bang, it furnishes noise as cheaply as any other device, due weight being given to the size of the bang. If still bigger bangs are sought, any ingenious boy can add a horn to his cannon, or by firing it into the mouth of a barrel, he could raise a racket louder than the bolts of heaven. This noise maker has been for sale for nearly a year, but probably it is not widely known and therefore has been little used.

MAGNETIC SURVEYS OF THE OCEANS.

A very interesting article is contributed by Dr. L. A. Bauer to *Terrestrial Magnetism and Atmospheric Electricity* for June, in which he discusses the need for systematic magnetic surveys, and points out some of the important results accomplished by the survey which is now being made of the Pacific ocean, funds for which were provided by the Carnegie Institution. A brief summary of these results is given on another page of this issue. It is in such uses of the generous fund under the control of this institution that the greatest scientific good may be accomplished. Similar surveys on land are not so difficult, and they fall more properly in the work of the scientific departments supported by the various governments; but, as pointed out by Dr. Bauer, while thorough surveys are needed on land, it is on the water area that the need is greatest. The necessity for such surveys need hardly be urged when one's attention is called to the lack of reliable data, but the mere plotting of more accurate magnetic charts will be but a portion of the results accomplished.

As yet no satisfactory theory has been proposed to explain the earth's magnetism, and it is almost hopeless to expect to solve the greater problems pertaining to this until we have more complete knowledge of it. For instance, careful calculations made several years ago, and based upon the best data available, seemed to indicate to Dr. Bauer that the earth is losing its magnetism. There is no way of proving or disproving this phenomenon except by careful and thorough surveys. The indicated rate of shrinkage is so large that, if it exist and continue at the same rate, the earth will lose half of its present amount of magnetism in 1,660 years—a rather startling suggestion.

Another important problem is to establish some connection or to prove the entire independence of atmospheric electric currents and the earth's magnetism. Studies of the latter seem to point to the existence of a system of electric currents passing from the air into the earth, and in the other direction, but the values deduced for these currents do not agree with those observed by students of the atmosphere. Here again only more complete studies, both of the earth and the air, will lead to a definite conclusion.

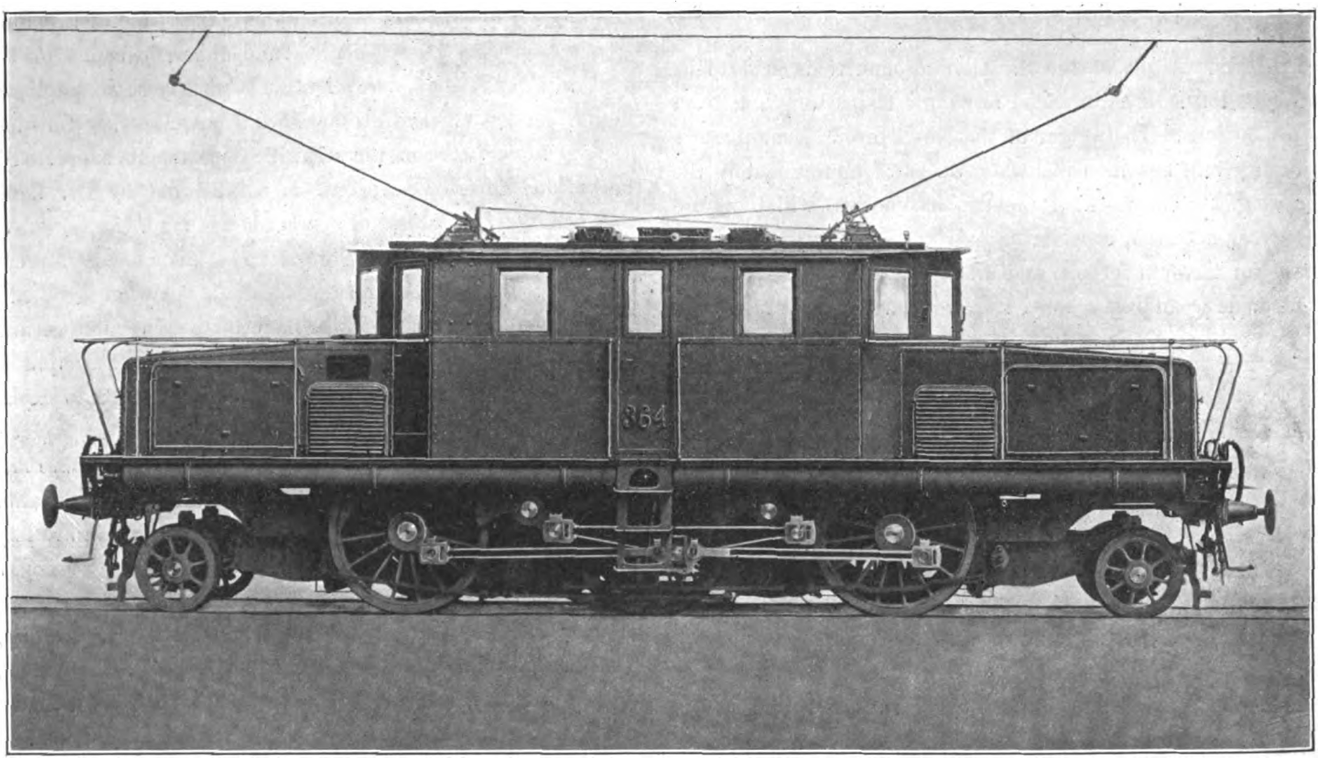
The work already accomplished by the Galilee, the ship chartered by the institution, is only preliminary, but important conclusions have been reached, those of the greatest value probably being the demonstration that her equipment is thoroughly adapted to the purpose for which it is intended. We may therefore look forward to a most satisfactory survey, not only of the Pacific, but of the other oceans.

Digitized by Google

The Simplon Tunnel Electric Locomotives.

By B. F. Hirschauer.

THE new electric locomotives which have been built in order to carry the traffic of the Simplon tunnel are of especial interest as showing the latest progress in the way of designing a locomotive for running upon high voltage three-phase current. In the present description are given the main lines of construction which have been followed, with special reference to the novel features which are to be found in this case. There are also a number of views of the locomotive and motor, which show the general design. These locomotives have been built in Switzerland, at the works of Brown, Boveri et Cie., of Baden, who have furnished the writer with the following information.



THREE-PHASE LOCOMOTIVE TO BE USED IN THE SIMPLON TUNNEL.

Several years ago the Italian railroad system known as the Rete Adriatica established a concourse for the new electric locomotives which were to be used on the Lecco-Colico-Chiavenna railroad. This concourse was laid out under the following specifications.

The locomotives are to consist of a frame which contains the main part of the electrical apparatus, and is supported upon two trucks. The latter have two axles each. Upon the frame is placed the upper body or housing of the locomotive, which is arranged so as to hold the remainder of the electrical outfit. The locomotive body is required to be built of such a shape as to give an easy and safe passage between it and the cars which are coupled to it at the ends. They are to be built according to the standard gauge of the Italian railroads, taking into account the contact shoes for the third rail. The maximum weight allowed upon each of the driving axles is not to be greater than fifteen tons.

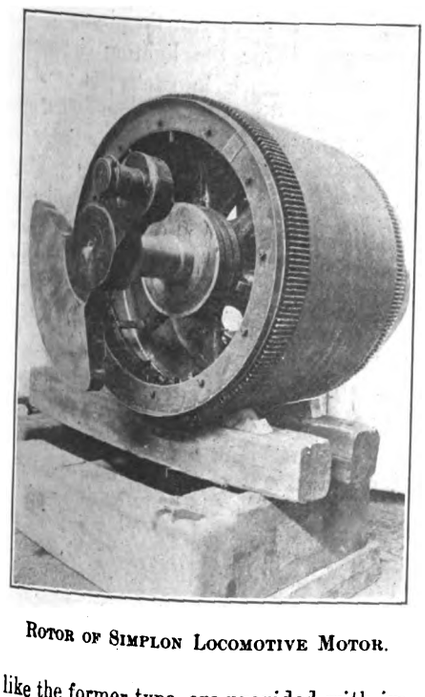
The distance between the wheel centres of each of the bogies is fixed at a minimum of seven feet six inches, while the two inner axles are not to be less than nine feet eight inches distance apart. These latter axles are used as driving axles, and the wheel diameter is limited between four feet eight inches and five feet seven inches. For the transmission of the movement from motor to driving wheel the use of gearing has been excluded, and an especially solid construction is required for the motor support so that there shall be no movement either of the fixed or the rotating part of the motor, even should one of the springs be broken.

As regards the speed and the weight of the locomotive, it was found desirable to fix these points after the following conditions, which are based on previous experience. The locomotives are to be designed so as to allow two normal running speeds, which are to be obtained by the proper switching of the circuits. The power which is to be used in this case is 3,000-volt, three-phase current at fifteen cycles. Proper switching devices are to be supplied for cutting the high-tension current entirely off the motors when desired. The two standard speeds for running the locomotives have been fixed at twenty to twenty-five miles an hour for the first speed and from thirty-five to forty miles an hour for the second. The tractive effort of the locomotive at the normal speed is to be at least 6.6 tons at the wheel periphery for the slow speed and forty tons for the high speed. To allow for the proper starting of the locomotives, they are required to take a total load of 440 tons, including the weight of the locomotive, up a straight track having less than 1 : 1,000 grade, bringing the train from a position of rest up to the speed of twenty miles an hour in not more than fifty-five seconds. Again, a lighter train, weighing 280 tons along with the locomotive, is to be brought from rest up to a speed of

Digitized by Google

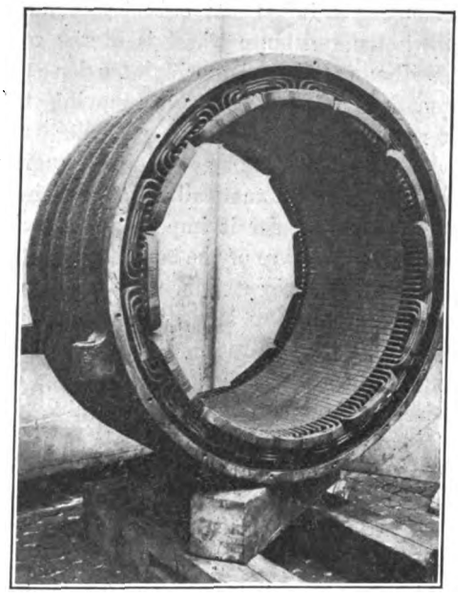
thirty-five miles an hour within 110 seconds, with the same conditions of track. In this number of seconds is included the time which is required for switching over from the slow speed to the high speed of the motor. These conditions must hold good even should the pressure of the line fall as low as 2,700 volts, and should it rise twenty per cent above the normal, the 280-ton train is to be brought with safety to the twenty-mile speed. The motors, resistance and the other electrical apparatus must be designed so that a load of 440 tons running upon a track with curves of 580 feet maximum radius and grades of three per cent following each other three times at least in a two-minute interval, can be brought from rest up to a speed of twenty miles an hour without any damage or overheating of the apparatus.

The new three-phase locomotives were designed according to the above conditions by the Brown-Boveri company, using the formerly constructed Valtellina locomotive as a model. This latter is a four-axle locomotive, and while keeping some of its features, it was desired to improve it considerably, especially from a mechanical standpoint. The main improvement which we find in the new locomotive over the old type consists in a change in the design of the frame. In place of using two half-locomotives coupled together, which showed some weak points in running, there is now a single and very solid frame mounted upon two trucks, each having two axles. The new locomotives,



ROTOR OF SIMPLON LOCOMOTIVE MOTOR.

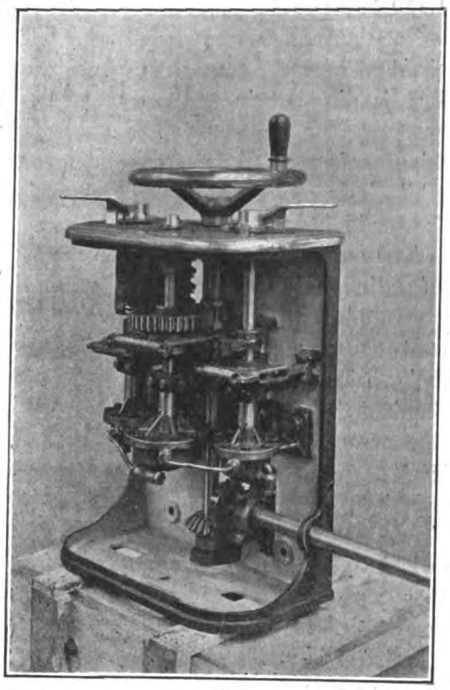
like the former type, are provided with improved apparatus for giving the two standard running speeds. At the same time the efficiency of the motors and the tractive effort have been increased in the new type. On account of the disadvantages arising from the use of three-phase motors mounted direct upon the driving axles, the Brown-Boveri company has designed a five-axle, two-truck locomotive, with two three-phase motors placed between the driving axles, in the inner space between the two trucks. The motors are coupled to the driving wheels by a driving bar, and at the same time the motor casing is utilized to form part of the locomotive frame. The method of driving will be observed in the view which shows the elevation of the locomotive. The two motor shafts are connected by cranks to a common driving bar which runs across between them. From the middle of this driving bar pass two side bars which are connected on either side with one of the driving wheels of each truck.



STATOR OF SIMPLON LOCOMOTIVE MOTOR.

These locomotives had been constructed with a view of using them upon the Valtelline electric railroad, but before they left the factory it was desired to change their destination and to use them for the Simplon tunnel, so that they could be put in operation in the early part of the year. At the request of the Brown-Boveri firm, the Italian government decided to employ the locomotives for the latter purpose.

The principal dimensions of the Simplon locomotive are as follows. Distance between outer driving wheels, sixteen feet six inches. Centre to centre of axles in each truck, eight feet four inches. Length of the locomotive between buffers, forty-one feet eight inches. Diameter of driving wheels, five feet six inches. Diameter of outer wheels, two feet ten inches. Total weight of locomotive, sixty-eight tons, of which the mechanical part is thirty-seven tons and the electrical outfit thirty-one tons. Weight on drivers, forty-six tons. Capacity of the two motors in



CONTROLLER FOR SIMPLON LOCOMOTIVE.

normal running, 900 horse-power. Maximum capacity, 2,300 horse-power. Weight of each motor with driving bar and counterweight, 11.8 tons. Normal speeds, forty and twenty miles an hour. Tractive effort at the high speed, normal 3.8 tons; maximum, ten tons. At the slow speed, 6.6 and 15.4 tons.

It is to be remarked as regards the weight of the motor, 11.8 tons, that for the maximum capacity of 1,150 horse-power which it will yield, this is undoubtedly the lowest weight which has yet been obtained for this capacity. This reduction in the weight of the motor has been brought about by the choice of the system of electrical connections, which avoids the method of series coupling used in the old locomotives of the Valtellina system. In this way a gain over the former type of motors of 2.8 tons per motor is effected.

The design of the new three-phase motors will be observed in the present engravings, which show the different details of construction. The two standard speeds of twenty and forty miles an hour for the locomotive are obtained by a new system of coupling the stator windings so as to form sixteen or eight poles. In this way a change in the speed from 112 to 224 revolutions per minute is made. The normal capacity of the motor when in regular use on the road is put at 390 horse-power at the twenty-mile speed and

Digitized by Google

450 horse-power at the forty-mile speed, using a tension of 2,700 to 3,000 volts at the terminals, working at fifteen cycles. Tests which have been made upon the new motor show that it can be run as high as 1,150 horse-power for short periods, and on a continuous running it will yield about 575 horse-power. The phase coupling is different in the case of the two speeds. For the slow speed the stator winding is coupled on the delta system, while it is connected on the star system for the high speed.

The outer field casting of the motor is of cylindrical form. It is built of cast steel and has a set of strengthening webs cast on the outer surface. Ventilating holes bring a good air circulation into the laminated iron. The revolving part of the motor is also well cooled on the interior. It is wound for six phases, of which three phases form one group, and it is designed so that the change in phase which is given to the stator produces a corresponding change in the rotor automatically, so that a separate switching of the latter is unnecessary.

The main controlling apparatus of the locomotive, which is shown in one of the views, has been well designed, and is of very simple and substantial form. It uses compressed air for operating the reversing switch and the pole-changing switch. A rod-and-gear-transmission device is used to connect it with the rheostat. The hand-lever of the reversing switch has three stop-points, forward, reverse and a middle point, in which case the lever is raised. In the forward and reverse points the air pressure is sent to the pneumatic switch, which is placed in the high-tension chamber, and by means of a piston device the latter switch operates the connections of the circuits for either direction of running. The pneumatic pole-changing switch is operated in a similar way. On the controller the lever for working it is provided with only two points, corresponding to the two speeds of the motor.

The main hand-wheel, which is placed between the two above-mentioned levers on the main controller, serves to operate the main rheostat of the locomotive for starting up the motors and for otherwise controlling the power of the latter. There are fourteen stop-points for the hand-wheel, corresponding to thirteen working points on the rheostat and one position where the rheostat is cut out. On the first of the working points, the rheostat is also cut out of circuit, but in this case the current is sent into the stator of the motor, as then the air-pressure is sent into the pole-changing switch and operates the latter. Then follows the normal working of the motor, using the slow-speed point on the pole-changing switch. To change over to the high speed, the resistance wheel of the main controller is brought back to the zero point, as before. The switching from slow to high speed and the short-circuiting of the rheostat is regulated by watching the ammeter reading. The switching can also be carried out by commencing with the pole-changing switch placed at the high-speed point, but there is then only one round of the controller, that is to say, thirteen points instead of two rounds of twenty-six points as in the former case. Cutting down the speed and stopping the motors is accomplished by bringing the controller back to the zero point, which cuts off the current by means of the pole-changing switch. An interlocking system is used on the controller, so that the reversing and pole-changing switches can only be operated when the resistance wheel is at the zero position and there is no high-tension current on the switch. By removing the reversing lever of the controller the valves of the reversing and pole-changing switches are automatically closed. These precautions render it impossible to make a false manoeuvre of the controller.

The emergency switch, which is shown in one of the views, is placed in the middle of the locomotive roof. It consists of an upper part containing the switching device, while the lower part, forming the oil-box, can be removed. It is operated either by hand or automatically in connection with the air-brakes, but not in the normal working of the latter, and also in case of short-circuit. The motorman can work this switch by means of a cord, if need be. It is also connected with the main controller by a pneumatic device, so that the emergency switch can only be closed when the controller is at the zero point.

A trolley is mounted at each end of the roof and works against the overhead wire. It is of a new design. For each trolley are provided two cutoff switches for the line. These are used to cut out one of the trolleys should there be a fault in the insulation, in which case the locomotive is run with the other trolley, either forward or backward. These switches are operated from a hand-lever placed on the roof, and a pneumatic locking device is used so that the handle can only be placed in the cutout position when the trolley is resting against the overhead wire.

A special housing or box is provided to contain all the high-tension apparatus of the locomotive, the reversing switch, pole-changer, ammeter switch, voltmeter transformer and fuses, the latter being placed in a separate box. The apparatus for each motor is placed separately, so as to allow of running with one motor alone. A single oil case contains both the reversing switch and the pole-changer, along with the piston apparatus for operating each of them from the controller. In order to prevent danger the high-tension box is closed by a special form of lock, and the latter is connected by a pneumatic device with the trolley-base. To open the box the trolley must be brought down from the wire, cutting off current from the high-tension apparatus.

For each of the motors is provided a separate rheostat of similar form. The rheostat is made up of wire-wound iron frames. Each rheostat has six separate frames, which can be easily removed, or two frames per phase. The frame is divided into thirteen sections in each case, and at the top is a set of removable contacts, so that any faults can be easily located. Regulation is carried out by carbon and copper brushes, which are operated by a chain transmission from the rod coming from the controller. To cool the rheostat, two air-fans are used, which are driven each by a three-horse-power motor. These motors are connected with the windings of the main motors, and diminish in speed until they come to a stop when the main motor is running entirely in synchronism.

In the motorman's cabin are placed a set of seven-kilowatt oil-transformers, which are used to run the air-compressor motors and for the lighting circuits at 110 volts. Each locomotive is provided with two automatic air-compressors, one of which is used for the Westinghouse brakes, and the other for the acoustic signals, the sand boxes and for the pneumatic control of the electric devices, as we have just seen. Either one of the compressors can serve for all the work if required.

As regards the design of the trolleys, it is to be remarked that the lower part has the form of a long parallelogram, which can be raised and lowered by air-pressure. The upper arm which carries the trolley contact is made very short and light. It has a limited swing on either side, and when used on the ordinary overhead line (at twenty feet above rail level), it works without having to move the main frame. The latter comes into play in the tunnels, where the wire is but fourteen feet above rail level, and in this case the air-pressure cylinder lowers the trolley arm. When needed, a small hand-pump supplies the air for starting up, and afterward the compressors come into action.

Digitized by Google

Street Railway Association of the State of New York.

Discussion of the Use of Hydroelectric Power at the Annual Meeting, Saratoga, June 26, 27.

AT THE twenty-fourth annual meeting of the Street Railway Association of the State of New York, held in Saratoga on June 26 and 27, there was an active discussion on hydroelectric power for electric railways. At this meeting were read the three papers on this topic presented by S. B. Storer, C. E. Parsons and G. A. Harvey, abstracts of which are given below. The extensive development of water power, both at Niagara falls and in the upper Hudson valley, has led hydroelectric companies to seek a market among the electric railways throughout central New York, and the discussion between the representatives of the supplying and consuming companies brought out some interesting differences of opinion as to the proper basis of charging.

CONTRACTING FOR USE OF HYDROELECTRIC POWER ON RAILWAY SYSTEMS.

BY G. A. HARVEY.

The effect of load-factor on cost of power is thoroughly understood where steam plants are concerned, but it might be supposed in the case of hydraulic power, where no furnaces have to be banked and inefficiency at light loads becomes unimportant, that the conditions would be different. Hydraulic turbines of modern design, however, usually have such characteristics that their overload capacity is very slight, and it therefore becomes necessary, if peak-loads are to be handled, to provide extra machinery to take care of these. With no provision for peaks it is still necessary to hold at least one generating unit in reserve, and a margin of capacity must be left unused in the operating turbines for gate travel in regulation, and to allow for partial clogging of distributors by refuse which accidentally enters the penstocks. As the water is available and costs no more if used to the full capacity of the plant, it is plain that the power-selling company will strive vigorously for a uniform load as high as is practicable for the installed machinery to carry. This results in making peaks a prohibitive element to power deals where the hydraulic plant has been some time in the field and has been able to discriminate in the choice of its customers.

The foregoing is not intended to convey the idea that railways can not contract advantageously for hydroelectric power. The typical street-railway load necessarily has prominent peaks, and, if these can not be smoothed down by adjustments of service, it is still possible, where a fair price is asked for the water power, to carry the heaviest part of the all-day load by means of this and the remainder by steam engines, gas engines or storage batteries, or combinations of engines and batteries.

If it is possible to make contracts for full-power requirements, it is usual for power companies to place some penalty rate on the peak-power or to arrange the terms of charge so that there are distinct advantages to the purchaser in keeping the load-line as nearly straight as possible. The most common method is to sell a solid block of "firm" power, which can be used at a load-factor of seventy per cent to eighty per cent or better, charging the minimum flat rate for this, and providing power above the firm amount on a kilowatt-hour basis at rates gradually increasing with the height of the peaks.

A very fair method of billing for power is on a sliding rate depending on the monthly load-factor. The maximum two-minute peaks are recorded in kilowatts each day and averaged for the month. The total number of kilowatt-hours for the month, divided by the kilowatt of this average peak times the number of hours in the month, represents the monthly load-factor. The charge for the month is then made up as follows: a definite service charge plus (load-factor times a fixed amount) times average daily maximum kilowatts. A moderate penalty for peaks is thus included, and the customer pays, according to the load-factor, as nearly for what he consumes as can be expected. This method of charging is now being offered extensively by one of the companies which is about to do business over a large portion of New York state. In effect it corresponds very closely with a flat-rate charge, but gives the purchaser a slightly less cost per kilowatt-hour at low load-factors.

If power companies can not entertain peak propositions at all, or if they place prohibitive rates thereon, the purchaser must then provide the steam plant or storage battery, or both, to care for a part of the load. In this case the hydroelectric power purchased should form the solid twenty-four-hour base of the area enclosed by the total load-curve, and should extend up to such height as to cover a chart area bounded at the top by a line closely corresponding with the base of the average daily fifteen-hour load-line (fifteen-hour load-peak). The purchaser should be allowed, without charge, swings of about ten per cent above the firm line of purchased power, provided the kilowatt-hours used above the line do not exceed those unused below it.

Very careful consideration must be given to proportioning the division of load to water power and steam power. It is hardly possible to evolve an exact formula for the location of the firm line of purchased power, and if one were worked out the weekly variations of load conditions would probably make its accuracy look doubtful. A safe point for this line is at such height that the fifteen-hour daily use of purchased power will be fairly close to it at all times. It is important, in starting to make this adjustment, to know the cost of steam power per kilowatt-hour at various load-factors under local conditions.

The possibility of power interruptions should be recognized in agreements and have penalties placed upon them. An interruption of six minutes is of comparatively small consequence to the railway and might be ignored if not repeated too frequently. Interruptions due to lightning, mistakes in switching, cable burn-outs, etc., are bound to occur, and six minutes is a reasonable allowance for testing cables and lines and returning power. Longer interruptions should entail forfeitures by the power company, increasing considerably in amount as the length of interruption increases.

In cases where steam plants are already in service on railway systems when the companies commence buying additional power, the interest, depreciation, etc., on these plants, although charged to total cost of power, should not enter into the cost of steam-generated power when balancing up the amount of this to be used in conjunction with the purchased power. The steam plant fixed charges continue, regardless of the power turned out, and only the actual operating expenses (coal, labor, etc.) should be figured against the steam power in this case. If the steam plant is installed, either at or after the time of contracting to buy power, the fixed charges might be considered as against "peak-power," but it does not alter the case materially in proportioning the

Digitized by Google

amount of steam power to be used. Operating cost per kilowatt-hour at various load-factors and the normal capacity and dependable overload capacity of the individual power station units are the governing features.

THE SALE AND MEASUREMENT OF ELECTRIC POWER.

BY S. B. STORER.

Since the day when the first commercial electric light entered the field of artificial illuminants, there have been endeavors to find an equitable way of charging for energy supplied in the form of electricity. The fact of the matter is that neither the straight flat rate nor the straight kilowatt-hour rate is equitable except when applied in connection with a definite load-factor—and even then it may not be entirely so, due to uncertainty as to the number of hours per day that full-load conditions prevail, with corresponding high efficiency, and to the hours during which operation continues at light loads with resultant low efficiency.

It is fully recognized now, however, that the load-factor is the root of the trouble, and unless a system of charging gives due consideration to it there will always be inequality of rates and dissatisfaction on the part of the power company or of its customers, or of both.

With the hydroelectric plant the cost per horse-power per year is almost constant, regardless of whether supplied one hour per day or twenty-four hours per day. Repairs are about the only variable, and they may be considered as increasing in direct proportion to the load-factor. Labor, oil, waste, etc., are nearly the same, irrespective of the proportion of light loads to full load.

With the steam plant, on the contrary, the items of coal, labor, etc., increase rapidly with the load-factor, and hence the cost per horse-power per year increases in almost the same proportion.

If we take up the case of a hydroelectric plant and transmission system with a wholesale cost of $30 per horse-power per year, and attempt to make a flat rate to all consumers, we quickly find there is little demand for power, as nearly every consumer has an intermittent load, or, in other words, a low load-factor, and can not afford to pay or will not pay the price it is necessary to ask for flat-rate twenty-four-hour power. It then becomes incumbent on the power company to devise a system of charging that will not only enable it to market its output, but to do so at prices that will secure a net revenue for the power equal to $30 per horse-power-year, besides an additional amount sufficient to cover the cost of retailing or distributing it, and further to enable it to sell at rates low enough to be attractive to consumers.

In the proposed system everything is sold on a maximum-demand basis, with the rate per horse-power per year varying between fixed limits in accordance with the consumer's load-factor. The load-factor is computed on the basis of a twenty-four-hour day; the kilowatt-hour consumption per day, divided by twenty-four, being taken as the average demand. The maximum demand is taken as being the highest rate of consumption for any one minute during the day.

Assuming that a manufacturer has made a contract to buy 400 horse-power for the operation of his factory, and that the rate per horse-power-year varies between the limits of $16 and $43, depending on the load-factor, the determination of his rate per horse-power per year for any given month would be as follows:

If the kilowatt-hours consumed during a thirty-day month are 43,200, then the average demand for power is 43,200 divided by 720 (the number of hours in the month), equal to sixty kilowatts or eighty horse-power. Assuming further that his maximum demand each day was just 400 horse-power, then, of course, his average maximum demand for the month will be the same amount, and the load-factor is eighty divided by 400 = 0.2, or, as commonly expressed, twenty per cent.

If the rate per horse-power-year varies between $16 and $43, it will be evident that the variable quantity is the difference between $16 and $43, or $27. The rate is therefore equal to the minimum rate ($16) plus the load-factor (0.2) times the variable ($27). Two-tenths of $27 is $5.40, so the rate per horse-power per year for that month will be $16 plus $5.40 equals $21.40. The total charge for the month would therefore be 400 times $21.40 divided by twelve, or $713.33. This is equal to 1.65 cents per kilowatt-hour. If his use of the power had been such as to give a load-factor of thirty per cent, the rate per horse-power per year would have increased to $24.10, but the equivalent cost per kilowatt-hour would have decreased to 1.24 cents—a reduction of almost twenty-five per cent in cost per kilowatt-hour due to increasing the load-factor to thirty per cent.

This may readily be put in the form of an equation which, if the desired rate per horse-power per year is R
the minimum rate limit is A
the maximum rate limit is B
and the load-factor is L
is expressed by $R = A + L\ (B-A)$.

This method is much more equitable than that sometimes used, of selling all the power on a kilowatt-hour basis with a guarantee from the consumer of a specified load-factor. A better way of charging—certainly a much more equitable way—would be to sell the power on a maximum-demand basis with the rate varying between the limits of, say, $18 and $38 per horse-power-year. With this way of charging there is a continual inducement held out to the consumer to increase his load-factor. The power company would probably also increase its profits somewhat by the increase in load-factor, but only to a comparatively small extent.

With such a system of charging established, having for its basis the load-factor of the consumer, the question immediately arising will be as to the manner in which the limiting values per horse-power per year are established, with power companies of different capacities to supply demands of all kinds and sizes.

Referring to the assumed case of a hydroelectric plant and transmission line wherein the wholesale cost is $30 per horse-power per year, and further assuming that the rated capacity of the system as a whole is 10,000 horse-power, we then have a basis with which to start. If power is to be furnished to consumers having a load-factor of approximately 100 per cent and sold on a straight flat rate per horse-power per year, then the cost of retailing the power in small amounts will increase the cost as the amounts decrease.

If, however, the consumers operate at a low load-factor, the power company may "oversell" its plant to an extent directly dependent on the relation between the capacity of its plant and the amount of firm power sold to each one. As a matter of actual practice the ratio is about three to one.

The same system may also be applied to steam plants if consideration is given to the range in cost due to change in load-factor. Greater leeway as to permissible intermittent demands could also be given, due to steam engines being capable of temporary overloads to a much greater extent than are water-wheels. The general principles underlying all power plants of whatever type are, however, the same; and one system of sale and measurement of their output, giving due considerations to

Digitized by Google

local conditions, would, if universally used, do much to establish a better relationship between producer and consumer —if, as in the one proposed, it is founded on equity.

SALE OF WATER POWER FROM THE POWER COMPANY'S POINT OF VIEW.

BY C. E. PARSONS.

There are three important factors which have to be considered in determining the cost of hydroelectric power for a railway system: the first cost of the power plant and distributing system, the amount of power to be delivered, and the load-factor.

There is no reason to expect a railway manager to consider a proposition for power unless there is a saving over the cost of operation by steam, and the stumbling block in the way of a contract is usually the amount of this saving. The railway companies as a rule are not thoroughly conversant with the first cost of a plant and distributing system, and do not realize the magnitude of the interest and maintenance charges.

One of the largest items in the cost of a system for supplying power is the substation and apparatus. The total cost of the distributing system, including transmission lines and substations, is about equal to the cost of the generating stations.

The second item to be considered in determining the cost of hydroelectric power is the total number of kilowatt-hours required. It is self-evident that an average load of 2,000 kilowatts is more to be desired than a load of 500 kilowatts, as the fixed charges and operating expenses of the distributing system in either case are practically the same. This is not exactly true in regard to the interest on copper and distributing apparatus, but this item is small compared with the operating expense and depreciation on lines, etc.

The load-factor is the third and most important item in determining the cost of power, load-factor being the ratio of average to maximum load. It is evident that when the load-factor is near 100 per cent all of the machinery is in operation on all parts of the system, and the transmission lines are carrying their full load; the entire investment will have an earning power, and the charges will be a minimum per kilowatt-hour. This is an ideal condition, and one which can not be realized. Nevertheless, it has to be used as a basis to work from in determining the cost with various load-factors. If a plant is built for supplying power for a railway only, the cost per kilowatt-hour will be higher than where power is also supplied to factories and for lighting purposes. In a large mixed system consideration must be given to the loads which are on at a time when the railway demand is low and when the machines set aside for railway purposes can be used for partially carrying other loads. The value which is to be given to these separate loads must vary according to the character of the load and the time of year.

There are two methods which may be considered in making contracts for railway energy. One is the flat rate per horse-power per year, based on the maximum demand; the other method is on the kilowatt-hour basis. In either case a fixed amount of power as the maximum load is agreed upon, and momentary overloads of five per cent or ten per cent are allowed.

With the flat-rate method the power company is not interested in the load-factor, and the burden falls on the railway company. The only way for the railway company to take advantage of the cheaper hydroelectric power is by the use of storage batteries or by the operation of an auxiliary plant to carry peak loads.

With the second method of charging on the kilowatt-hour basis the power company must be protected by a minimum monthly payment. This minimum payment must be determined by the average load-factor. The load-factor, therefore, is the basis for determining the cost with the kilowatt-hour method.

The items to be considered in fixing the cost to the railway company per horse-power per year are the fixed charges, consisting of interest, depreciation, taxes and insurance; the cost of manufacture, consisting of labor, repairs and supplies; the cost of distribution; and the cost of management. There should then be added a reasonable dividend on the stock. The sum of these items, less the dividend, divided by the average amount of power which can be supplied at the distributing stations throughout the year, determines the cost per horse-power per year to the power company. This cost with large customers determines the price which they are to pay for energy. If, now, the power company is to be subject to the loss of income due to apparatus being idle for a part of the time, on account of low load-factor, the railway company's cost per kilowatt-hour must be correspondingly increased.

The gist of the matter is that with the flat-rate method, in order to obtain the benefit of the cheaper power, the railway company must make an investment in either a storage battery or an auxiliary power plant and bear the interest and depreciation of the same; while with the kilowatt-hour method the rate to the railway company is higher, but the power company bears the interest and depreciation of the apparatus which is idle part of the time, but which must be maintained in readiness to supply the maximum demand. In the kilowatt-hour method consideration should be given to the factory and lighting loads whose peaks do not overlap the railway load. In this manner the load-factor on each individual machine is increased and the railway company derives the benefit of this greater load-factor. In other words, the railway load-factor may be forty-five per cent, but by means of the loads which can be carried on the plant the average load-factor on the machines supplying the railway company, which are usually running in parallel with some of the other machines, can be built up to say seventy per cent. This load-factor of seventy per cent is used instead of forty-five per cent in determining the cost of the power for the railway company.

To analyze the methods of determining the cost, a concrete example will be given. The figures used are for comparison only and do not represent conditions of operations.

The maximum railway load is 3,000 kilowatts, or 4,000 horse-power, and the load-factor is forty-five per cent. Considering the fixed charges and cost of operation, it is determined that the value of the power at the railway company's substation is $100 per horse-power per year. The cost to the railway company with the flat-rate method will, therefore, be $400,000 per year, or, if the full amount of power could be taken for twenty-four hours per day every day in the year, the cost would be $.0153 per kilowatt-hour. With a load-factor of forty-five per cent the average power would be 1,350 kilowatts, or 1,800 horse-power, and the cost would therefore be, with no storage battery on the system, $.0338 per kilowatt-hour. The cost to the railway company is therefore $100 per horse-power per year, based on the maximum amount of power used, and the cost based on the average of 1,800 horse-power used is $222 per horse-power per year. On account of the great cost per horse-power per year based on the energy actually used, the railway company is compelled to install a storage battery and decrease the maximum demand. The maximum demand will therefore be 1,350 kilowatts, the average load, plus a battery loss of approximately 350 kilowatts, making the maximum demand on the power company 1,700

Digitized by Google

kilowatts, or 2,260 horse-power. The cost to the railway company for the hydroelectric power will therefore be 2,260 horse-power times $100, or $226,000 per year. To get the total cost for power there must be added the interest and depreciation of the storage batteries, which will amount approximately, on a comparative basis, to $30,000 per year, making the total cost to the railway company $256,000.

With the kilowatt-hour method the value of the power at the distributing station is the same, or $100 per horse-power per year, or $.0153 per kilowatt-hour. Instead of using the load-factor of forty-five per cent in determining the cost to the railway company, the railway company is given the benefit of the average combined load-factor of the generating plant. This load-factor is seventy per cent, and the cost to the railway company is $142 per horse-power per year for power actually used, or $.021 per kilowatt-hour. The total cost, therefore, to the railway company is 1,800 horse-power times $142, or $255,600 per year.

The power company must have a minimum guaranteed monthly payment based on the maintenance of the load-factor by the railway company. The power company is also protected by the maximum demand which can not be exceeded, and is assured of a stipulated income; so that if the railway company's load-factor drops below whatever amount is stated in the contract, the railway company will be the loser by reason of paying for power which it has not used. Thus the railway company derives the benefit of the larger combined load-factor of the plant in determining the cost per kilowatt-hour, but is obligated, by reason of the minimum payment, to keep its load-factor within reasonable limits.

It is evident that the actual cost in either case is approximately the same, but with the flat-rate method the railway company has to make a larger investment in order to take advantage of the hydroelectric power.

In opening the discussion, G. A. Harvey, of Buffalo, presented several curves; one showed an example of economical location of the "firm" line, and the other two gave the cost of power for various load-factors, figured from data given in Mr. Storer's paper.

W. W. Cole, of Elmira, referring to Mr. Storer's paper, pointed out that the cost per horse-power per year increases rapidly with the load-factor. In Mr. Parsons's paper the author says: "The load-factor is the third and most important item in determining the cost of power." The same thing applies to the steam station apparatus. The steam apparatus is working on the point of economy when it is carrying a normal rated load, but when used for carrying peaks there is put upon it the kind of load which is most expensive. Unless a storage battery is installed to carry a given load beyond the normal load, the cost per kilowatt-hour of these peaks will be brought up to about twenty cents.

The question of determining just what can be carried is difficult. For instance, on a station carrying 5,000 kilowatts, there may be a firm load of anywhere from 3,000 kilowatts to 3,500 kilowatts, but a storage battery would have to be used in conjunction. The peaks of about 500 kilowatts run from one-half hour to an hour a day. In carrying such a load on an auxiliary steam plant it would be necessary to charge up to say twenty cents per kilowatt-hour for the peak power. On many roads in the summer months, where there is a pleasure ground, it is sometimes necessary to start off thirty to forty cars in half an hour. Yet this peak period may come on only twice in twenty-four hours. With an electric light plant there are many large office-building loads coming on for about an hour a day. Still the company must pay for the twenty-four hours on account of that hour when the load runs above the firm-load line.

W. J. Harvie, of Utica, said his company purchased hydroelectric power on the kilowatt-hour basis and from its standpoint this method seems all right.

T. W. Wilson, of Buffalo, agreed with Mr. Harvie on the way to pay for power. When a company can get down to a kilowatt-hour basis it knows what its power is going to cost. Mr. Harvie had figured it out for the Buffalo proposition, and found it very much more expensive to buy power based on peaks.

J. H. Pardee, of Canandaigua, asked what was the difference between one-minute and two-minute peaks, that is, whether the two-minute peak could be allowed with safety by the power company instead of a one-minute peak. It appeared to the speaker that a two-minute peak could be allowed as well as the shorter one, as the difference to the railroad company seemed to be much more important than to the power company. For instance, in the plant described by Mr. Parsons the turbines have considerable overload capacity. It is quite unusual that the turbines should be rated so much higher than the generators. In the case of Mr. Parsons's plant, a two-minute peak should be no hardship at all. If the machines had no overload capacity it would be more of a hardship.

Mr. Storer said, in reference to one or two-minute peaks, that in connection with the system of charging explained in his paper, if a two-minute peak is used it would mean that the probability of peaks overlapping on different railway or other loads is increased just double. The power company could not oversell its plant with two-minute or longer peaks as easily as it could with one-minute peaks. The speaker had found in the negotiations he had had with power customers that they all look at their individual conditions and try to get a time limit on their peaks long enough to take in their maximum demand. For example, one customer had a load to carry up a hill which would mean a fifteen-minute peak. The customer thought the company ought to sell him power on a fifteen-minute peak. It does not make any difference what the peaks are, the income must be a certain amount, and if the load-factor is based on a one-minute peak to determine the cost per kilowatt-hour, it all comes to the same cost per kilowatt-hour, because the kilowatts consumed on a five-minute peak are more than on a one-minute peak. As far as the question of selling power on a kilowatt-hour basis pure and simple with a guaranteed load-factor is concerned, the consumer runs against the same thing as on the maximum-demand basis. From the Niagara, Lockport & Ontario Power Company's standpoint, that company considers it much more to the consumer's advantage to be permitted to take these peaks and pay for them only when they occur, rather than have the circuit-breakers throw off the entire load and interrupt the service, if only for a few minutes. According to Mr. Cole's remarks on peak loads, he counts the load he gets in the summer time for the park service as put on as an addition over the firm-load line. On top of that he puts the lighting load from buildings and some other kind of power service. The chances are that in Mr. Cole's particular case the park load in summer will come at a time after the ten-hour factory load is off. It will also come when the lighting load in offices is not a factor. Therefore, taken as a whole, the same law of probability would enter in that case. The point of measurement being the same for all these different usages, the total peak would be very much reduced below the individual peaks of each class of service supplied by

Digitized by Google

the buying company. Therefore the retail company could oversell this purchased block of power in the same way that a power company can oversell the capacity of its plant.

C. L. Allen, of Utica, said that approximately seventeen per cent of the gross receipts of the electric railways in the state of New York is paid out for power, according to the report of the New York State Railroad Commissioners. The Superintendent of Public Works, in his annual report four years ago, called attention to the fact that the state of New York, aside from Niagara falls, had more undeveloped water power than any other state in the nation. It seems to have taken us a long time to discover that hydraulic plants are available as a source of cheap power. It also seems to be a fact that when a traction and power company begin to negotiate they start from a common point but proceed in opposite directions. The question of whether hydroelectric power is the right thing for a traction company to use depends, first, upon the price and, secondly, upon the quality of the service. If the price and service are as good as with a steam plant, there is no doubt that the traction interests are suffering by not purchasing hydroelectric power. Whether such power service will prove satisfactory or not depends a great deal upon the form of contract. In the past five years the Utica & Mohawk Valley Railroad Company has had three forms of contract, two unsatisfactory and the third satisfactory. It has been operating under the latter since July 1, 1905, and it has proved mutually satisfactory. The first contract was for block or firm power, to be paid for at so much per horse-power per year, measured by a horse-power meter. The maximum demand for the month was to be regarded as seventy-five per cent of the average maximum demand, and was to be paid for at the rate of $25 per horse-power. All power in excess of this seventy-five per cent was to be paid for at the rate of $33 per horse-power per year. That was not satisfactory either to the railway company or to the power company, and was repudiated by both. As an arbitrated agreement, the railway company purchased power for two years on the kilowatt-hour basis, the railway company having no power plant that it could use. The price in that contract was so high that instead of paying 16.66 per cent of the gross receipts for power, the railway company paid 32.8 per cent for two years. The present contract is not wholly a kilowatt-hour contract. The railway guarantees a minimum load per month, and if the total kilowatts used in one month do not clear a certain amount, the railway company must pay the minimum anyway. There has been but one month when the total kilowatts used have fallen below the minimum. The quality of service that has been received in the past year has been satisfactory in every way. The contract, besides being a hydroelectric contract, embodies two other features which have not been spoken of. As a supplementary contract, there is a steam-power plant which the power company maintains and agrees to have ready on thirty minutes' notice; the other is the penalty feature. But the railway has never yet penalized the power company.

Mr. Wilson said the International Railway has two forms for contracting for hydroelectric power. It pays a certain price in Buffalo for 7,000 horse-power firm, and at another rate for the peak loads during the summer. In winter the peaks are carried by a steam plant. On the interurban section a sliding firm line is used, excess loads being paid for by the kilowatt-hour.

Oren Root, of New York, said, in reply to a question, that the price of power in New York city is about $.006 per kilowatt-hour.

J. H. Pardee, of Canandaigua, said he had found that the charge frequently made by hydroelectric stations for "readiness to serve" amounted to about eighty per cent of supplying the peak loads from a steam plant.

A Method of Starting Gas Engines.

An ingenious method of starting gas engines has been devised by Louis Renault, of Billancourt, France. The device is primarily an ignition magneto driven by means of a friction coupling, but it is arranged so that when the engine is standing the coupling is free. The engine is arranged so that it is full of gas whenever it is stopped, the admission valve being held open. To start it it is only necessary to throw a lever, which turns the magneto over, producing a spark in the cylinder, thus starting the engine, and throwing the magneto into gear with the friction clutch. If desirable the magneto may remain in gear with the engine and a supplementary device employed for the starting-spark.

Electricity in Elevator Service.

In order to get definite information as to the relative merits of electric and hydraulic elevators, S. M. Bushnell has collected records of the operating costs of a large number of elevators in the city of Chicago, Ill. These elevators are, for the most part, of moderate size, running from five to twenty-five horse-power. The records show an approximate efficiency on the part of the electric elevator about twice that of the hydraulic elevator using electric pumps. Figures given for five office buildings indicate that the energy consumed by the electric elevators is from 2.19 to 3.45 kilowatt-hours per car mile. These data are the result of a careful record of many trips made at various times during a year. They check closely with data obtained in similar service in other cities. There were found in Chicago four hydraulic elevators operated by means of electric pumps, and the energy consumed by these averaged over six kilowatt-hours per car-mile. These figures also agree fairly well with similar service in other cities. As it requires nearly a kilowatt per horse-power to run the pumps, the average result is found to be reduced to about six kilowatt-hours per car-mile when allowance is made for the motor losses. Much has been said regarding the relative mechanical efficiency of hydraulic elevators as compared with other types. Some have claimed a mechanical efficiency for the hydraulic machine of over seventy-five per cent. However, the owner of a building does not care particularly about the efficiency of his elevator, as what he wishes is a machine which requires the least amount of energy to operate it. Figuring in this way, it is found that the net commercial efficiency of the most modern elevators runs far below the figures mentioned. Assume an electric elevator of the drum type operated in a modern tall office building, and let it carry on an average six persons from the top to the bottom of the run. This is probably a favorable assumption. On this basis it is found that the actual efficiency as a transporting device is about thirty-three and one-third per cent. Figured in the same way, the efficiency of the hydraulic elevator will be about one-half this, or sixteen and two-thirds per cent. It is very probable that the greater number of electric elevator installations are operating to-day at an efficiency of not over twenty per cent, and hydraulic elevators at about ten per cent. Evidently, in spite of the great advance which has been made in elevator work, there is opportunity for still further improvement.—*Cassier's Magazine, July.*

Digitized by Google

The National Electrical Contractors' Association.

Sixth Annual Convention, to Be Held at Cleveland, Ohio, July 18, 19 and 20.

THE sixth annual convention of the National Electrical Contractors' Association will be held at Cleveland, Ohio, July 18, 19 and 20. The Hollenden Hotel has been selected as headquarters. Through the efforts of Alexander Henderson, master of transportation, a rate of a fare and a third has been secured from the Central Passenger Association, the Trunk Line Association, the Western Passenger Association, the New England Passenger Association and the Southwestern Excursion Bureau. For the convenience of passengers from New York and adjacent points, arrangements have been made with the New York Central & Hudson River Railroad for a special Pullman equipment, to leave the Grand Central station, New York city, on July 17 at 5.29 P. M. The train is due to arrive in Cleveland on July 18 at 6.55 A. M.

Passengers from points south and east who desire to avail themselves of the lake trip may secure at Cleveland for the return journey transportation *via* the Cleveland & Buffalo line, whose steamers run daily between Cleveland and Buffalo. Passengers desiring to visit Niagara Falls on the return journey may do so by depositing their return tickets with the agent of the line over which their tickets read, immediately on arrival at Buffalo.

The National Electrical Contractors' Association was organized in Buffalo, N. Y., July 17, 1901. The meeting for this purpose was called by the United Electrical Contractors' Association of New York State. The association movement was first started by the formation of local associations in different cities in New York state. In August, 1899, these local organizations formed the United Electrical Contractors' Association of New York State. This organization met with strong support and proved such a factor in developing the opportunities of the electrical contractors that it was decided to issue a call for a meeting of contractors from all parts of the country. This call resulted in the formation of the association in Buffalo, as above mentioned. The Buffalo meeting was largely attended, and the national association was inaugurated with considerable enthusiasm. The organization has steadily gained, both in numbers and in power. The membership list includes contractors from all parts of the United States, and is thoroughly representative of the electrical contracting business. In connection with this association a monthly paper, called *The National Electrical Contractor,* is issued. This paper is not in any way a technical journal, but is devoted entirely to the interests of the electrical contractor.

Much good can be accomplished by the getting together of the men who represent large expenditures of capital and the handling of large numbers of laboring men. The object of the association is to formulate plans for the equitable carrying out of business in every section of the country.

The present officers of the association are:

President—James R. Strong, New York, N. Y.

First vice-president—W. I. Gray, Minneapolis, Minn.

Second vice-president—Walter C. McIntire, Philadelphia, Pa.

Third vice-president—F. E. Newbery, St. Louis, Mo.

Treasurer—John R. Galloway, Washington, D. C.

Secretary—W. H. Morton, Utica, N. Y.

Sergeant-at-arms—J. C. Sterns, Buffalo, N. Y.

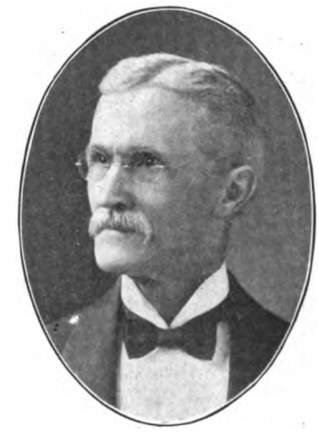
The directors are as follows:

Arkansas—T. B. Martin, Jr.; Connecticut—E. N. Baldwin; District of Columbia—Cyrus Mantz; Illinois—Arthur Frantzen; Indiana—G. M. Sanborn; Iowa—Edward Kunkle; Maryland—H. K. McCay; Massachusetts—Seth B. Wetherbee; Michigan—F. J. Miner; Minnesota—L. L. Sanford; Missouri—W. A. Corrao; New Jersey—Paul H. Jaehnig; New York—J. R. Strong, M. L. Barnes, James Hilton; Ohio—E. M. Lawton; Pennsylvania—E. R. Keller; Rhode Island—S. A. Potter; Wisconsin—George F. Rohn.

JAMES R. STRONG, PRESIDENT.

W. I. GRAY, FIRST VICE-PRESIDENT.

F. E. NEWBERY, THIRD VICE-PRESIDENT.



JOHN R. GALLOWAY, TREASURER.

Quite recently an enquiry was raised as to the future opportunities for development of the electrical contractors of the United States. We are happy in being able to present herewith the views of a number of prominent electrical contractors concerning this important organization.

James R. Strong, president of the association, writes as follows:

"So far as the needs of electrical contractors are concerned, I think that their chief interest at this time is to devise means whereby the different lines of business can be separated, so that the manufacturers and wholesalers shall not con-

Digitized by Google

tinue to be competitors of the contractors, who are the legitimate retailers.

"You have, no doubt, seen considerable similar discussion on this subject within the last few months, and I feel that your valuable paper can confer a great benefit upon the electrical trade at large by urging some classification of the different kinds of business, so that the above-named competition may be done away with."

F. E. Newbery, third vice-president, writes:

"Reviewing the history of the evolution of the electrical contractor, one finds the progress made in the electrical industry has necessitated the employment of considerably more men in carrying out the installation work than were available for the purpose, the immediate result of this being the introduction of not a few more or less unfit, both as to technical education and in practical work.

town or community, considered, no doubt, to be the best there is in his line, judged as he would be, by the best standards obtainable in the somewhat restricted field in which he is carrying on his business. This contractor himself knows, however, or very quickly finds out, when he comes in contact with the electrical engineers and contractors of the larger cities, that the rapid progress, year by year, makes it necessary for him to brush up against those who are up to date. This opportunity is afforded him by an association.

"The social features of an association should not be overlooked either. It is far pleasanter to feel that one's competitor is a friend; one would always rather lose to a friend than to an enemy. After all, one has only a life to live, so let us try to make it as pleasant for one another as possible."

John R. Galloway, treasurer, writes:

"The needs of the electrical contractor

"The interpretation of the underwriters' rules should be uniform throughout the country. This will be of benefit to the contractor, wireman, customer and the inspection departments as well, and result in saving much expense to the contractor and much annoyance and inconvenience to the customer.

"A law requiring all contractors to be licensed should be in force in every state in the Union. Such laws can only serve the purpose of protecting the public and the conscientious contractor."

W. H. Morton, secretary, writes:

"The principal needs of the electrical contractors at this time are better conditions in the retail trade, uniform and reasonable inspection of work, license laws safeguarding the public from irresponsible and unskilled workmen.

"The conditions of the retail trade are such that at the present time the manufacturer, jobber, contractor and some of

W. H. Morton, Secretary.

T. B. Martin, Jr., Director for Arkansas.

G. M. Sanborn, Director for Indiana.

Seth B. Wetherbee, Director for Massachusetts.

"This condition of things naturally, in course of time, would right itself, as, in fact, it has been doing very rapidly the last few years. In the meantime, however, it behooves the electrical contractor himself to see to it that men of the proper material are educated up to the standard of requirements to-day. The electrical engineer and contractor nowadays must essentially have a thorough technical education and also a practical experience in some of the many important branches of the industry, in order to properly carry out the important engineering problems continually confronting him. To this end it will be readily seen that an association of electrical contractors can be a great help, both in the exchange of practical experiences and in the promulgation of new ideas.

"As an example, one might assume the case of an electrical contractor, in a small

are better conditions in the retail trade; license laws for the better protection of the contractor and general public from incompetent and unskilled workmen; uniform interpretation of the underwriters' rules and rigid inspection of concealed work.

"The conditions of trade at this time are very unsatisfactory. Manufacturers, jobbers, contractors and, in some cases, the central stations compete for the same business. The central stations' business is to sell current, and they should advance every possible means to encourage the use of electrical devices, and leave the sale of all current-consuming devices to the retailer or contractor.

"Rigid inspection of all electrical work is of the greatest importance, and the enforcement of the rules will be a great benefit to those contractors who endeavor to execute good and honest work.

the central stations are competing for the consumer's business.

"While this is due to the phenomenally rapid growth of the business, it is a condition that is contrary to all established laws of trade.

"The manufacturer should distribute through the jobber, the jobber through the contractor or retailer, and the contractor sell the goods to the consumer direct.

"The central station is in the business to sell its current, and while it is entirely within its province to do everything possible to stimulate the use of current-consuming devices, it should not sell such devices in competition with the retailer.

"Inspection of electrical work is of vital importance to all contractors, and a rigid enforcement of the rules is a benefit to contractors endeavoring to do good work.

"It is necessary, however, that the interpretation of the rules throughout the

Digitized by Google

country should be uniform both on account of the contractor and the wireman.

"The rules as laid down by the National Electrical Code cover practically all conditions met with in actual practice, and they are fairly clear and distinct.

"The interpretation of the rules, however, varies greatly in different sections of the country, causing misunderstandings that result in expense to the contractors and inconvenience to their customers.

"Laws requiring contractors to be licensed are important to both the trade and the public.

"While electrical work properly put in is absolutely safe, improperly installed it becomes a menace to both life and property.

"A law requiring all contractors to be licensed should be in force in every state, and such a law should embody the following conditions:

"Each contractor applying for a license should be examined as to his ability to properly install electrical work.

"Each contractor should be required to pay a yearly license fee and to furnish a bond in a good-sized amount conditional on the proper installation of his work.

"It should make it a misdemeanor for any one not holding a license to install electrical work.

"Such a law would be a protection to life and property through its preventing the installation of unsafe electrical work and would not work any hardship on any one who was capable of properly installing electrical material.

"This National Electrical Contractors' Association is endeavoring to bring about a better condition in the business along all of the above-mentioned lines and should have the cooperation of all those interested in the improvement of the electrical business."

William A. Corrao, director for Missouri, thinks that the contractors need to get together, and that if more of them could attend the annual conventions and hear the experiences of the different members from every part of the country, the association would be three times as large as it is. He believes the convention is the greatest educator that the contractor could have.

M. L. Barnes, director for New York, writes as follows:

"The greatest need of the electrical contractor to-day is thorough organization. A business that has reached such vast proportions in such a time has hardly given those who have engaged in electrical construction and installation time to think of the results that would accrue by being able to obtain ideas from others in the improvement and safety of their work. Being but in its infancy and new devices being constantly introduced, the electrician can scarcely afford to keep within himself, but should aim to be in touch with these improvements and broaden out, with these conditions. There seems no better way than to throw aside the narrow-mindedness that has pervaded the profession, meet the competitor on a friendly and equal footing in an association having as its basis the fostering of trade, to reform abuses, to settle differences between its members and to promote more friendly intercourse among the craft.

"Could those who are still unattached to local, state or national electrical contractors' associations realize what changes have come as the result of organization, in trade and labor conditions, betterment of underwriters' rules and consequent improvement in installations, broadening of mind and education of the once narrow-minded contractor, he would lose no time in becoming a member of these organizations. Starting from a small local organization in western New York, interest in its object was created throughout the state, resulting in the formation of additional locals and then all united in forming a state association. Observing the broadening influences of this formation, New York state took the initiative of a still broader scope of improvement by the organization of a national body. This has grown to such proportions that to-day it stands among the foremost trade organizations in point of influence, purchasing power and personal standing in the United States. It has brought out ability and executive powers of many men that might have lain hidden in their narrow minds, but for their coming together with their fellow craftsmen. The electrical contractor who wants to enlarge, to keep in touch with conditions and improve his calling, should become allied with these organizations and he would find the money expended to be meagre to the benefits derived."

F. J. Miner, Director for Michigan.

William A. Corrao, Director for Missouri.

Paul H. Jaehnig, Director for New Jersey.

Paul H. Jaehnig, director for New Jersey, writes as follows:

"Of the three classes engaged in the electrical business to-day, the manufacturer, the jobber and the contractor, it seems to me the contractor occupies a peculiar and yet very important position. He stands directly between the producer and consumer, and consequently is a factor in the field that can not be ignored by the other two classes. In other words, the contractor is as essential to the welfare of the manufacturer and jobber as they are to his welfare. Unfortunately, the manufacturer, and more particularly the jobber, have been slow to recognize this fact, with the result that the relations between the three classes are somewhat strained. This should not be so, as there surely must be some common

Digitized by Google

ground on which these three classes can meet and agree. Each class occupies a position that is well defined, and if each were willing to confine itself exclusively to the limitations of its class, an understanding could be arrived at in short order.

"The keynote of the whole situation is cooperation—the get-together and stand-together idea, for their mutual interests. By a concentration of effort to promote the industry in all its diversified branches, on the part of the three classes, the electrical business will develop beyond our most sanguine expectations.

"Another need of the electrical contractors to-day is to promote sociability among themselves; to have them meet and become acquainted with each other. This is a pressing need, aside from its social features, as by this means they can meet and discuss topics for their common good."

between the jobber and the retailer. The character and personnel of the contractors are rapidly improving. Instead of being bell-hangers and locksmiths as they largely were in the olden days, they are now largely composed of electrical engineers and practical as well as theoretical men. The necessity for risky credit extension has therefore passed, and the contractors in line with improved relations with the jobber and manufacturers should insist upon a new standard being maintained. But most of all the contractor must understand that only by organization and community of interest these great improvements can be brought about, and those contractors not now associated with a single central body such as the National Electrical Contractors' Association should realize that they are standing in their own light and the light of progress by so doing."

An Investigation of the Steam Turbine.

The following paragraphs, abstracted from the report presented by the committee for the investigation of the steam turbine, W. C. L. Eglin, chairman, at the recent Atlantic City (N. J.) convention of the National Electric Light Association, are interesting as showing the status of this important prime mover at the present time.

A visit was made to the Lynn works of the General Electric Company on Tuesday, April 3. The committee was received by Richard H. Rice, with whom the various features of the Curtis turbine were discussed with particular reference to changes in design from the time of the last visit of the committee to the Lynn works. The committee was shown through the works. The most important feature is the large increase in the number of the smaller sizes of turbines now being built, sizes from twenty-five to 300 kilowatts of the horizontal Curtis type. A number of these turbines were being controlled by a mechanical valve mechanism of a new type, being developed specially for this class of turbine. There was a very noticeable increase in the number of turbines being manufactured in sizes up to 1,500 kilowatts, as well as the smaller types.

The works of the General Electric Company at Schenectady were visited. During the inspection of the works a number of improvements in the mechanical construction were noted. The larger wheels in some cases are being made from steel plates or boiler plates, two plates being bolted to a spider, the spider being placed between the plates and the buckets riveted at the outer edge with the flange of the bucket sections on the inside of the wheel; the two sets of buckets are so arranged that they have a smooth external surface reducing the friction of the wheel.

The committee discussed with the engineers of the General Electric Company, both at Lynn and Schenectady, the various features of the Curtis turbine, and particularly such parts as had required special attention during the past year in regular operation. These were taken up in detail in the report.

The total number of turbines of the Curtis type manufactured by the General Electric Company shipped or on order is 592 units, an aggregate of 580,325 kilowatts. Of these, 385 units are of 500 kilowatts or larger.

The committee visited the works of the Westinghouse Machine Company, Pittsburg, on Friday, April 6, and discussed with Messrs. Sniffin and West the various changes and the progress made in their steam turbine during the past year.

Mr. Sniffin reports that during the past year they have had very successful results from their turbines and he has sent letters to all of the users of their turbines requesting information concerning their

M. L. Barnes, Director for New York.

James Hilton, Director for New York.

E. M. Lawton, Director for Ohio.

J. C. Sterns, Sergeant-at-Arms.

E. M. Lawton, director for Ohio, writes:

"The most prominent idea is that of the contractor's relation to the consumer. The contractor must be recognized as the retailer, and the jobber and the manufacturers must learn this sooner or later. The time is past when the manufacturer is compelled to take his product to the consumer direct. His business should be done with the jobber who is the wholesaler, and by the same line of progression the contractor, as the retailer, should buy from the jobber, and receive protection with the consumer.

"Probably the next important reform should be along the line of commercial credit. In the inception of an electrical industry, the manufacturers and jobbers are oftentimes compelled to lend financial aid to men who have since developed into successful contractors. In no other business have there been such glaring departures on the matter of extension of credit as there have been along this line

Digitized by Google

operation. Copies of these letters were sent to the committee, and examination shows that practically very little trouble has developed in the regular operation of the turbines. The Westinghouse company now has in operation 144 units, or a capacity of 122,270 kilowatts. It has shipped or on order 130 units, equivalent in capacity to 200,250 kilowatts, making a total number of 274 units, an equivalent capacity of 322,520 kilowatts.

The most noticeable feature in inspecting the shop was the number of large turbines now being built, and the appearance of the shop indicated that steam turbines were very decidedly the largest percentage of the output of the shop.

The double-flow turbines have been very materially changed in both design and construction. The first stage consists of an impulse wheel with two sets of buckets, steam being admitted through three nozzles, two arranged at the top and one at the bottom of the casing. The steam after leaving the impulse wheel passes on to a series of Parsons blading. After passing through a second stage, assuming that the impulse wheel is the first stage, the steam is divided, continuing in the same direction through the blading, the balance being carried through openings in the cylinder to which the blades are attached to the opposite end to another set of Parsons blading and in this way balancing the thrust. The advantages claimed for this machine are that it obviates the necessity of the use of large balancing pistons and it materially shortens the length and reduces the diameter, making the machine more compact; for these reasons the design particularly lends itself to the larger sizes.

The committee visited the works of the Allis-Chalmers Company, in Milwaukee, Wis., Saturday, April 7, and was received by Messrs. Doran and Rotter, and later met the engineers connected with various departments of the turbines designed by the company. The first visit was to the works of the company at West Allis. In the engine shop a 1,500-kilowatt turbine had been opened up for inspection. The principal difference between this type of turbine and the Parsons turbine is in the mechanical construction, balancing pistons, blading, the governing device, and some other details are given in an appended manufacturer's description.

After a very careful examination of all parts of this machine the committee visited the Reliance works in Milwaukee, where the blading work is done.

Previous to our visit to the works we had examined an Allis-Chalmers turbine at Utica. This turbine had not been in operation for three weeks, and, although cold, was started and full load put on it in less than ten minutes. The load was afterward increased to fifty per cent overload, and the operation was apparently very satisfactory.

I. E. Moultrop, one of the members of the committee, visited Europe early this spring to investigate the turbine experiences in England and on the Continent. His report is appended, together with a brief description of some of the turbine stations visited.

It will be noted in the very large list of turbines now installed that they are being manufactured in large numbers and that three large manufacturing companies are devoting a large part of their works to the manufacture of steam turbines. There are also some other companies engaged in experimental development. These, however, have not reached a point of commercial importance in the larger-sized turbines for us to be able to express any satisfactory opinions.

Mr. Moultrop says in part:

There can be no doubt as to the status of the turbine as a prime mover in the generation of electrical energy by use of steam, for all of the recently designed stations which were visited were equipped with turbines, and some of the older stations, built originally with engine-driven units, are being increased in capacity by the installation of turbine units. The only observed instance in which this is not true is that of the Metropolitan station in Paris, where the station is being completed by the installation of one large engine-driven unit. This station was originally designed for, and about seven-eighths equipped with, engines, and doubtless the design of the station and the local conditions would, in this instance, make the installation of a turbine very inconvenient. It is rather interesting to note that in interviews with the leading engineers no question was ever raised as to the comparative merits of engines and turbines for electric light plants.

The horizontal-shaft type of turbine is practically the only one used, and from the European engineer's viewpoint, it fills their requirements much better than a vertical-shaft machine could possibly do.

The regulation of the turbine is almost invariably accomplished by means of a governor controlling one valve in the steam-supply pipe, the steam being either throttled or admitted in puffs. The majority of the manufacturers use the latter arrangement. None of the manufacturers is attempting to regulate by cutting in or out a series of nozzles and this portion of the turbine construction is therefore very simple and positive. Close regulation is very easily obtained and turbine-driven alternators of different sizes were seen working in parallel; also working in parallel with engine-driven units and apparently without setting up cross-currents sufficient to be at all troublesome.

There seems to have been very little progress made in the matter of steam consumption of turbines during the past year. The best record of economy appears to be that of the Brown-Boveri 5,000-kilowatt machine installed in Frankfort a year or more ago. Apparently, the manufacturers have given more attention in the past year to the matters of standardization and of continuity of service than to economy requirements. Direct-current turbine-driven generators are now being built as large as 2,000 kilowatts which give very good results.

Report on the Peabody (Mass.) Municipal Light Plant.

A report has been presented to the electric light committee of Peabody, Mass., upon the municipal plant of that town. This was prepared by the Electrical Auditing Company, Old South Building, Boston, Mass. The report discusses the present condition of the plant, and suggests two plans for improvement.

The present nominal output of the plant is 600,000 kilowatt-hours per year, while the report is based upon a maximum output of about three times this. To obtain this output and to modernize the plant will require an investment, according to the report, of $56,000 in electrical apparatus at the station. In addition to this there will be required transformers and new lines which will cost $22,000, making a total of $78,000 for the entire remodeling. If such changes are made it is estimated that the cost of power delivered at the switchboard will be 2.29 cents per kilowatt-hour.

If, however, instead of remodeling the plant, the municipal authorities decide to purchase power from outside companies, they could obtain this at 2.13 cents per kilowatt-hour. The municipality would still have to install the transformers and the new lines at an expense of $22,000, but, allowing for this, it is estimated that the actual cost of current generated in a remodeled station would be 2.16 cents per kilowatt-hour, leaving a slight difference still in favor of purchased power.

The report states that the cost of power in the present station is 3.69 cents per kilowatt-hour, a figure agreeing closely with the one reached by the manager of the plant.

Digitized by Google

The Electrical Plant of the Canadian Niagara Power Company.

By H. W. Buck.[1]

THE plant of the Canadian Niagara Power Company was the first of the power-houses on the Canadian side of the falls to be designed and to have construction work begun upon it. As soon as the decision was made to go ahead with this development the question was raised as to whether the plan should be identical with those of its allied company, the Niagara Falls Power Company, on the American side, or whether engineering advances had taken place since their completion sufficient to justify changes and improvements. In general it was decided to adopt the same system of development, but certain essential changes were introduced:

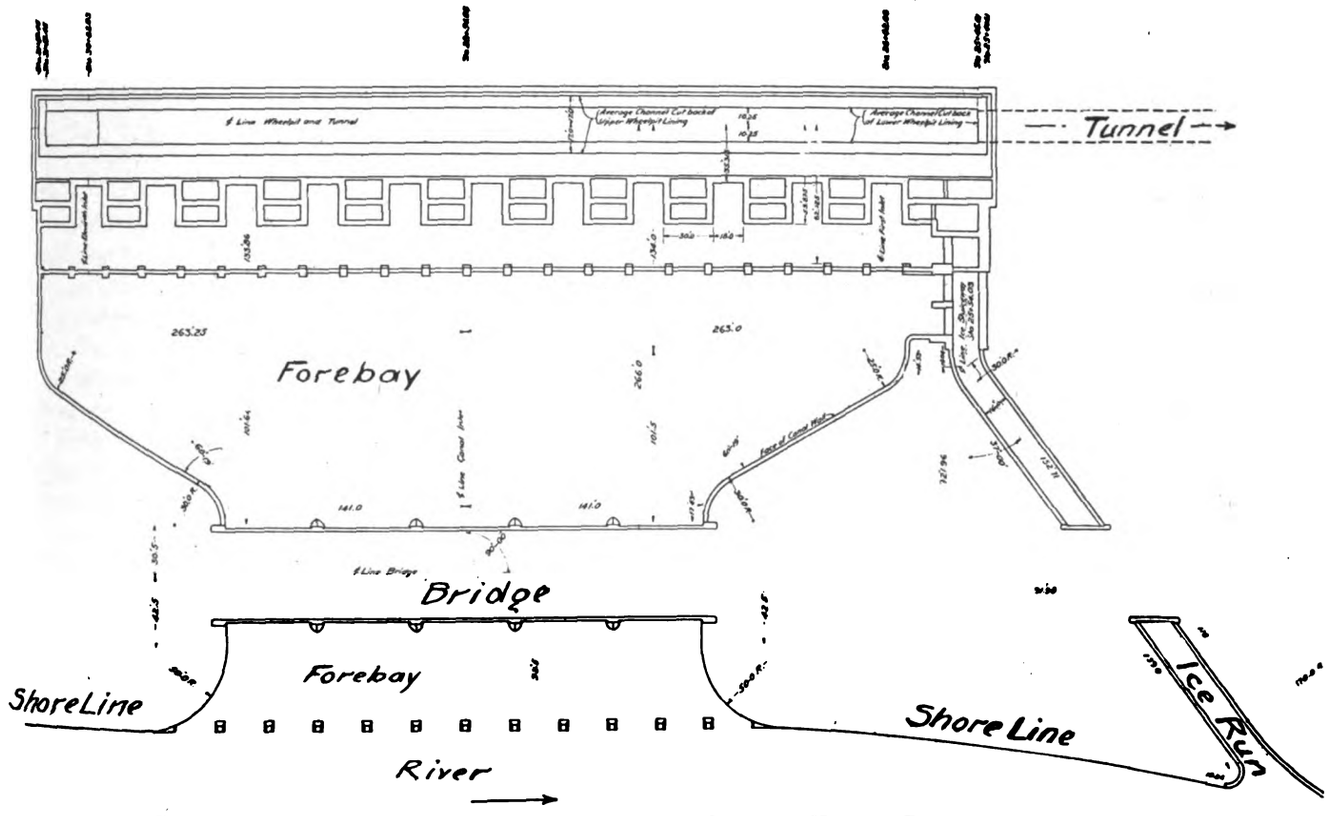


FIG. 1.—GENERAL PLAN OF THE DEVELOPMENT OF THE CANADIAN NIAGARA POWER COMPANY'S PLANT.

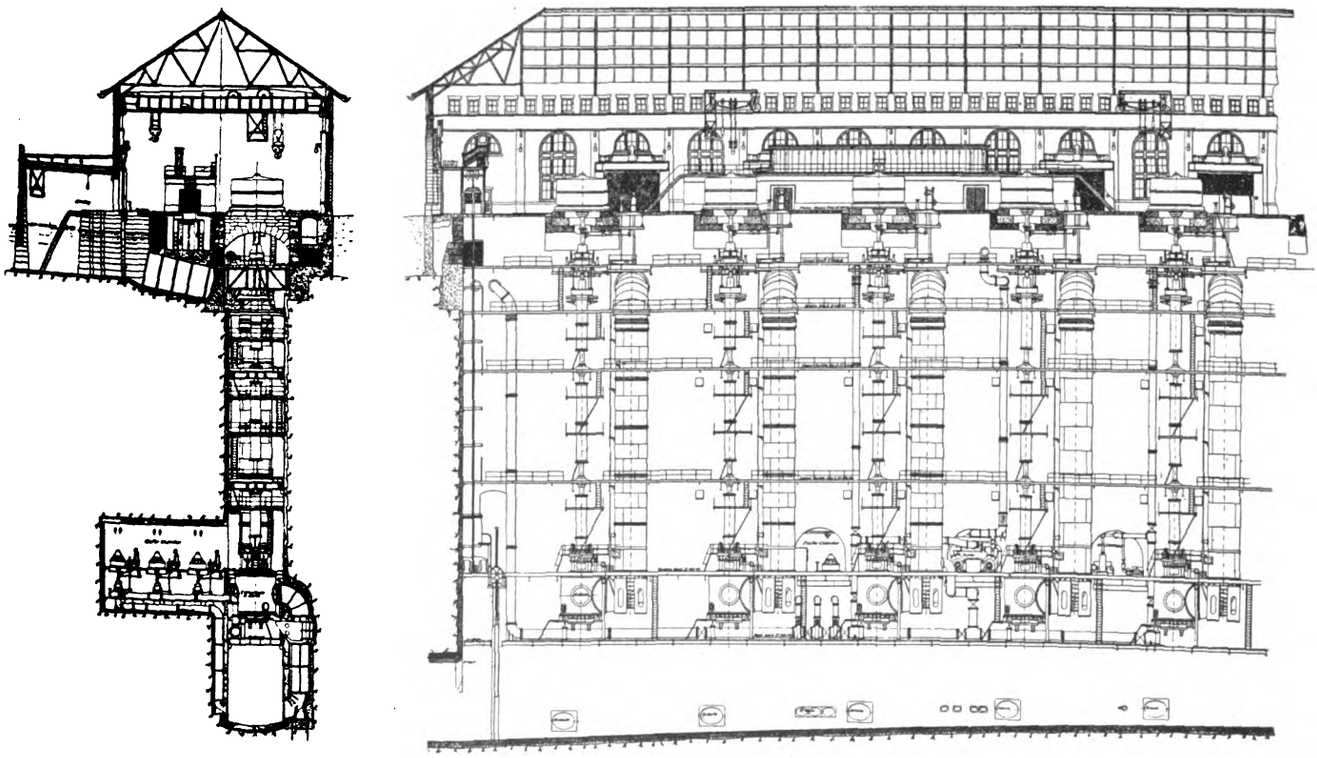


FIG. 2.—SECTIONS OF POWER-HOUSE AND WHEEL PIT, CANADIAN NIAGARA POWER COMPANY.

[1] Paper presented at a meeting of the Canadian Electrical Association, Ontario, June 19, 20, 21.

Digitized by Google

(1) Generating units of 10,000 horse-power instead of 5,000 horse-power, were adopted.

(2) Generated voltage was raised to 12,000 volts.

(3) Generators were wound for three-phase instead of two-phase.

When the 10,000-horse-power generators were ordered for this development they constituted the record to date for capacity, and were for a short time the "largest in the world," but, like all records in electrical work, it was of short duration. At present there are a number of machines in operation somewhat larger than these in rating, and others are being seriously considered for certain installations which will be nearly twice as large.

It was decided to change from 5,000 horse-power to 10,000 horse-power for the generating units:

(1) To reduce the length of the wheel pit, power-house, forebay, etc., and consequently to reduce their cost of construction.

(2) To reduce the cost per horse-power of the generators, water wheels, etc.

(3 The load of the Niagara Falls Power Company and its ally, the Canadian Niagara Power Company, had become so large that a unit of 10,000 horse-power could be installed without having such unit represent too large a proportion of the total load, from the standpoint of convenience and flexibility of operation.

The decision to have the generators wound for 12,000 volts was made to effect economies in station wiring and in the system of underground distribution necessary to transmit the power from the power-house outside the limits of the Victoria park. The particular voltage of 12,000 was selected as being the highest which at that time was considered reasonably safe for underground service, and also because the Niagara Falls Power Company had already adopted this as a transformed voltage for the transmission of power to some of its local customers.

Three-phase was taken instead of the two-phase winding of the American machines on account of the simplification of switches, wiring, etc., and also to effect the saving of twenty-five per cent in transmission copper.

HYDRAULIC MACHINERY.

The general hydraulic construction of this plant is very similar to that of the American plant, which is too well known to engineers to require detailed description here. Fig. 1 shows a general plan of the development. Fig. 2 shows sections of the power-house and wheel pit, together with their equipment.

The turbines were all designed by Escher, Wyss & Cie., and the first three were built at Zurich. The last two were built from the same designs by the I. P. Morris Company, of Philadelphia. The turbines are of the Francis type, inward discharge, with draft tubes led to the bottom of the wheel pit, as shown in Fig. 2. A regulating gate is installed at the end of the wheel pit to maintain the level of the tail water at a sufficient height at all loads to cover the mouths of the draft tubes. This regulating gate is operated by an eighty-five-horse-power direct-current motor, hand-controlled. The weight of the rotating machinery is carried by an oil thrust bearing under the dynamos, and also by an hydraulic piston at the bottom of the turbine. The turbines give an output of about 12,000 horse-power at full-gate opening at a head of approximately 135 feet.

ELECTRIC GENERATORS.

The generators are of the internal revolving field type with twelve poles giving twenty-five cycles at 250 revolutions per minute. The efficiency at full load is about ninety-eight per cent, and the regulation on full non-inductive load about eight per cent. The generators were built by the General Electric Company, a large part of the assembly work being carried out in the power-house. The armatures are con-

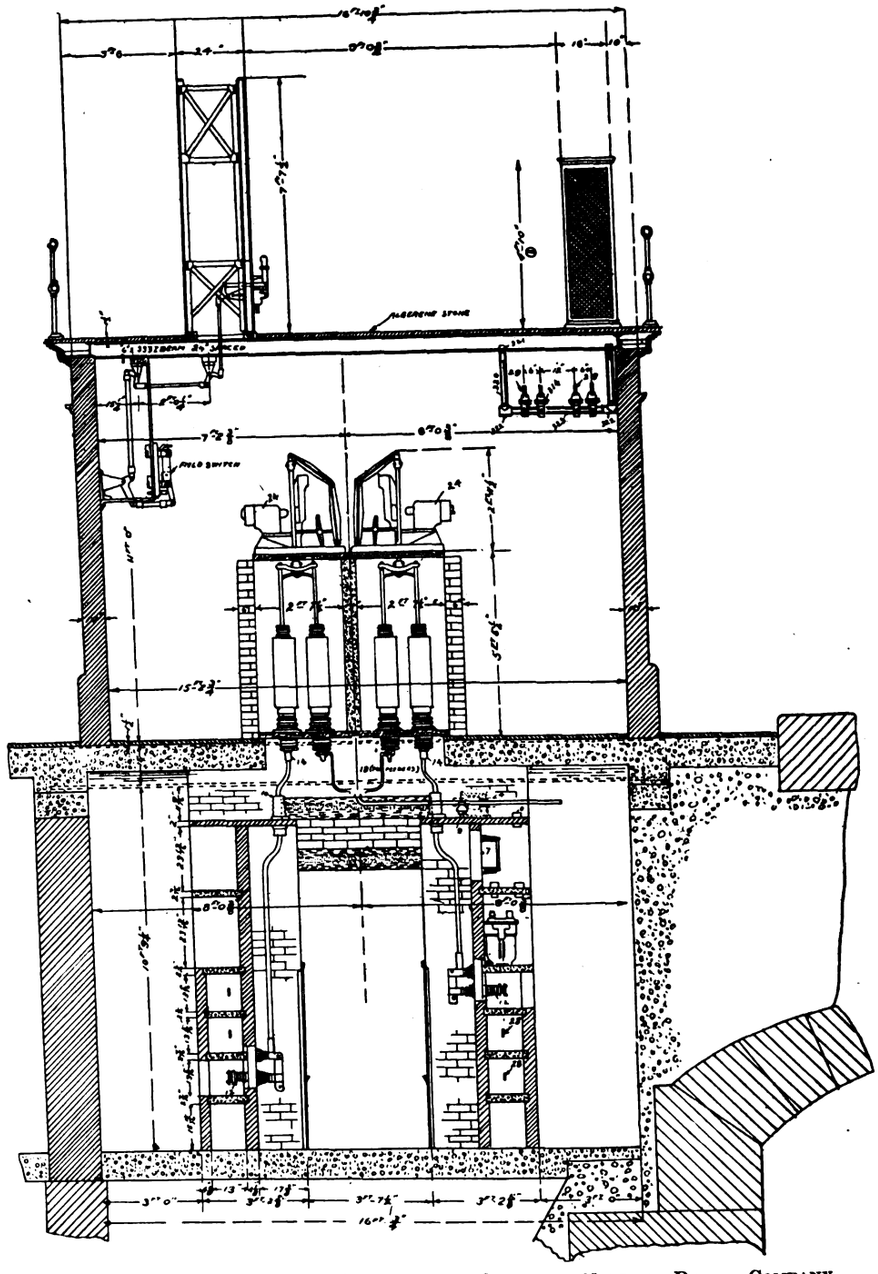


FIG. 3.—SECTION THROUGH SWITCHBOARD, CANADIAN NIAGARA POWER COMPANY.

Digitized by Google

nected Y, and the neutral is brought out so that it can be grounded if desired.

SWITCHBOARD.

From the generators the current is led through varnished cambric insulated cables to double-throw selector oil switches, and thence to the bus-bars, of which there are four sets. The oil switches are electrically operated by relay switches placed on the main switchboard panels. Fig. 3 shows a general section through the switchboard gallery, and indicates the relation between controlling panels, oil switches, bus-bars, etc. Fig. 4 shows a photograph of the controlling and instrument board. This operating board consists of five generator panels, twenty feeder panels, ten recording wattmeter panels, and three bus-bar interconnecting panels. Each panel is distinct, and contains no instruments or switches except those belonging to the particular feeder or generator in question. In this regard it is different from most of the switchboard arrangements adopted in modern plants. The so-called "bench-board" system of operation usually installed economizes space, but it has certain disadvantages. The concentration of instruments and relays necessitated in this construction may cause considerable confusion at times of emergency. If instrument needles suddenly begin to slam around on their scales it is somewhat difficult to make a prompt and correct association in a bench-board installation between the instruments and the relay switches involved, which are usually on slabs separate from the instruments. With the panel construction adopted in this plant, possibly more space is occupied by the board itself, but operating simplicity and directness results. Each panel contains within its limits all the instruments and switches involved in any operation which the attendant has to make, and consequently there is a minimum liability to confusion and mistake. The separate panel construction also permits the separation of control wires, which become so congested in the bench-board arrangement. In case of an accident in the power-house there is consequently less likelihood of a complete crippling of the control system.

The present equipment of the power-house comprises five machines, and this group and its switchboard is considered as a complete plant. When the power-house structure is extended to its full length six more 10,000-horse-power units will be installed, having an entirely separate switchboard, separate exciter plant, etc. This separation is made for the reason that 50,000 horse-power is believed to be as large a block of power as should be under the control of a single switchboard and its attendant.

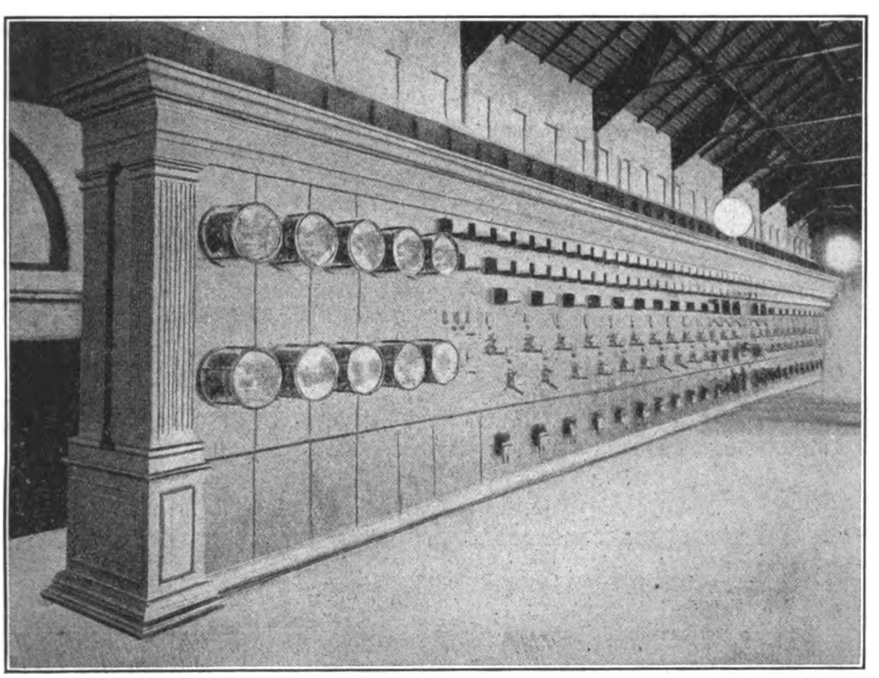


FIG. 4.—CONTROLLING AND INSTRUMENT BOARD, CANADIAN NIAGARA POWER COMPANY.

EXCITER PLANT.

The exciter plant is located in a compartment near the bottom of the wheel pit at the turbine deck level. There are three 200-kilowatt, 125-volt, direct-current generators, each connected to an independent turbine. Any two of these units will carry the entire direct-current load of the power-house. There are two sets of exciter bus-bars, one of which operates the generator fields and the other the direct-current power system, including motors and arc lights. The current is carried up the pit to the main floor of the power-house through a system of vertical copper bars supported every ten feet.

UNDERGROUND CABLE SYSTEM.

All the power from the power-house is transmitted underground by means of 000 B. & S. paper insulated triplex lead covered cables. The feeders are divided into two groups. One set leads from the north

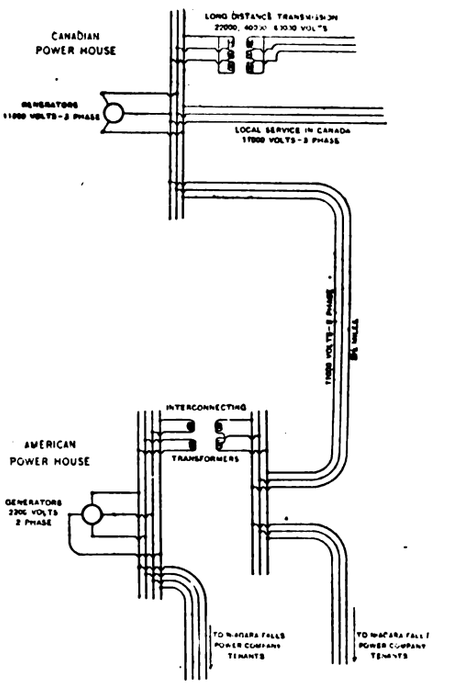


FIG. 5.—METHOD OF INTERCONNECTING SYSTEMS OF THE CANADIAN NIAGARA POWER COMPANY AND THE NIAGARA FALLS POWER COMPANY.

end of the power-house through Victoria park and across the arch bridge to the plants of the Niagara Falls Power Company, with which they are interconnected. The other group runs south up the high bank above the power-house to the transformer house there located.

The conduits are constructed in four groups of eight ducts each. The groups are segregated in order to separate the cables in the manholes, and consequently to reduce to a minimum the risk of damage from short-circuit and also to prevent overheating of the cables in the ducts, the separation of the groups facilitating the conduction of heat in the ground. In no case is the group wider than two ducts, so that every duct has the ground in contact at least on one face. The cables are rated at a maximum of 4,000 horse-power each at 12,000 volts. This rating corresponds to about a forty-degree centigrade rise in copper temperature when all the cables in the group are in service at full

Digitized by Google

load. The manholes are all made double with a concrete fire wall between the two halves, so that in case of a destructive manhole short-circuit, not more than one-half the feeders could be involved. Fig. 5 shows the method of interconnecting the three-phase, 12,000-volt, Canadian system with the 2,400-volt, two-phase system of the Niagara Falls Power Company through Scott connected transformers. The two systems are constantly in operation in parallel through this connection, and no trouble is experienced from pumping or in controlling the distribution of load.

building is divided into three sections. The east bay contains all the 12,000 switches and bus-bars, the central bay contains only the step-up transformers, and the west bay the 60,000 volt-switching apparatus. The transformers are of the oil type, water cooled. The water supply is insured by a storage standpipe adjacent to the transformer house, which has sufficient capacity to operate the transformers for forty-eight hours in case of a water-works shutdown.

The arrangement of windings on the 1,250-kilowatt transformers is somewhat unusual. The transformers are construct-

of power to several small consumers in the city of Niagara Falls, Ont., to whom it would be unsuitable to deliver power at as high a voltage as 12,000 volts. This distribution at 2,400 volts is by an overhead line.

All the high-tension wiring in the transformer house is insulated for the highest voltage, 62,500 volts, and the conductors are of sufficient current-carrying capacity for operation at full output at the lowest transformer voltage, viz.: 24,000 volts.

BUFFALO TRANSMISSION LINE.

The output from this transformer house

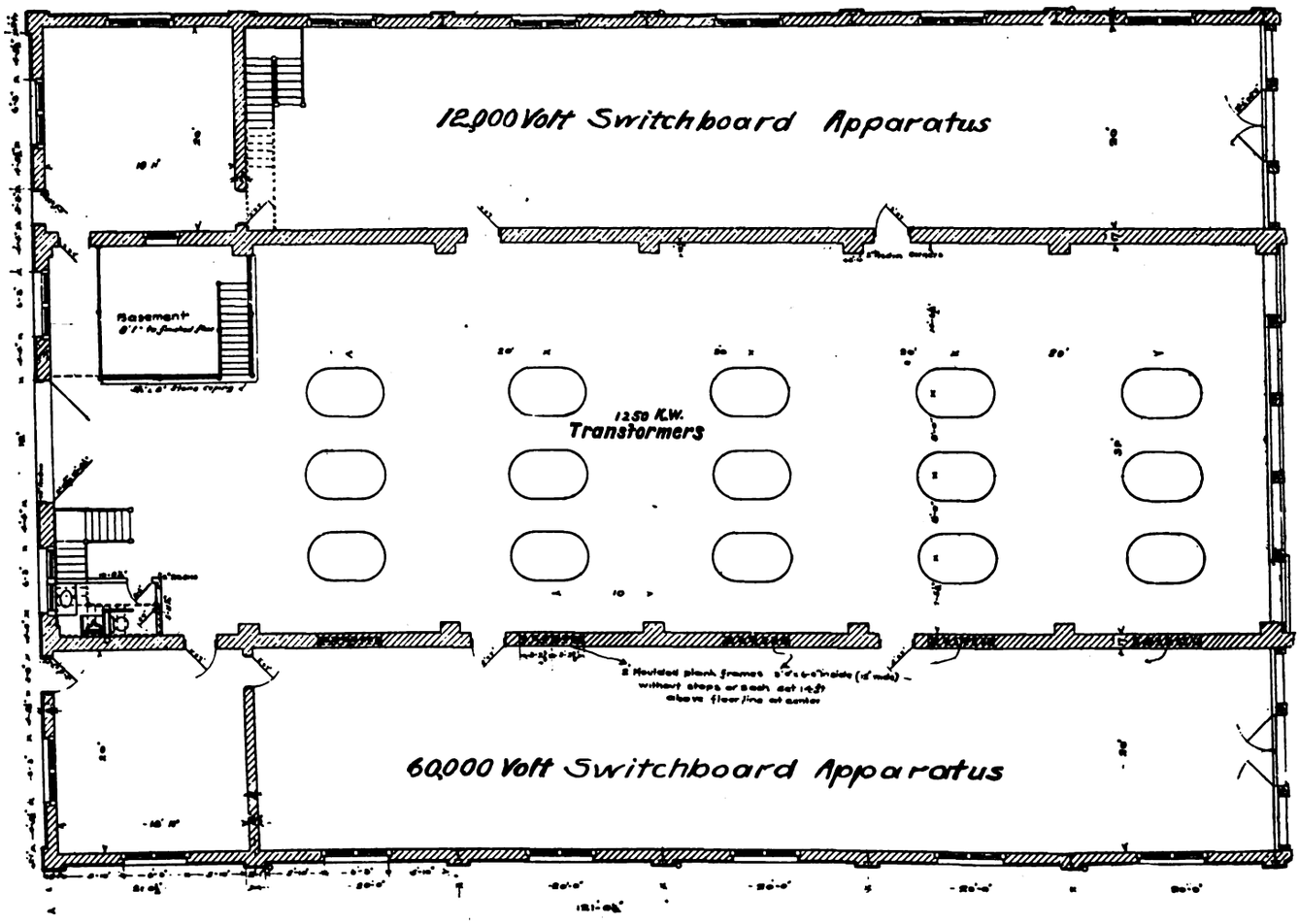


FIG. 6.—GENERAL ARRANGEMENT OF TRANSFORMER HOUSE, CANADIAN NIAGARA POWER COMPANY.

TRANSFORMER HOUSE.

Fig. 6 shows the general arrangement of the transformer house and its equipment. The installation comprises twelve 1,250-kilowatt transformers, each bank therefore requiring one-half the output of a generator at the power-house. Transformers of comparatively small size were installed for reasons of flexibility of operation. The very large transformer units now being used in some plants cost considerably less per kilowatt, but the large size of units makes it difficult to isolate circuits and bus-bar sections so necessary at times in the operation of a plant. The

ed with five similar coils, two of which constitute one winding and three the other winding, either of which set can be used interchangeably as primary or secondary. By the various combinations of coils, as indicated below, any of the following voltage ratios can be obtained with the full copper efficiency of each coil:

12,000 volts △ to 24,000 volts △
12,000 volts △ to 36,000 volts △
12,000 volts △ to 41,500 volts Y
12,000 volts △ to 62,500 volts Y

The west bay of the building also contains 3,000 horse-power in air-blast transformers, which lower the generated voltage from 12,000 to 2,400 for distribution

will be used partially for transmission at 24,000 volts to Fort Erie, and thence across the Niagara river to Buffalo, the distance being about fifteen miles. There are some engineering features connected with this work which may be of interest.

The transmission line is built on a private right of way thirty feet wide extending from the transformer house to the river front at Fort Erie. There will be two pole lines on this right of way each carrying two circuits. The circuits have a nominal rating of 12,500 horse-power each at 24,000 volts, making 50,000 horse-

Digitized by Google

power total for the transmission. The poles consist of two four-inch wrought-iron pipes jointed together at the centre by a malleable casting which has four struts projecting radially at ninety-degree angles. Truss rods secured at the top and bottom of the poles pass over the ends of these struts, which, when tightened up, stiffen the jointed pipe. The function of this central tubular member is to resist downward compression only. The horizontal stresses on the pole are resisted by four guy rods anchored in the ground with concrete guy stubs. There is one of these guys in each quadrant around the pole. The poles are forty feet in height, and are placed apart at distances ranging from 250 to 300 feet. Fig. 7 shows a map of the transmission line right of way.

connection to a local substation for the supply of power to that municipality. The line then rises from the standard forty-foot elevation to a tower eighty feet high, erected about 4,200 feet from the Canadian shore line of the Niagara river. Thence the line rises again by a single span of 1,200 feet to a tower on the river bank 210 feet in height. Thence by another single span of 2,300 feet the line passes to the Buffalo side of the river to another 210-foot tower. From there it drops down to a new 50,000 horse-power terminal house constructed for the distribution of this power in Buffalo.

For this long span crossing, 500,000 circular mils, sixty-one-strand aluminum cable is used. Each wire is secured to the

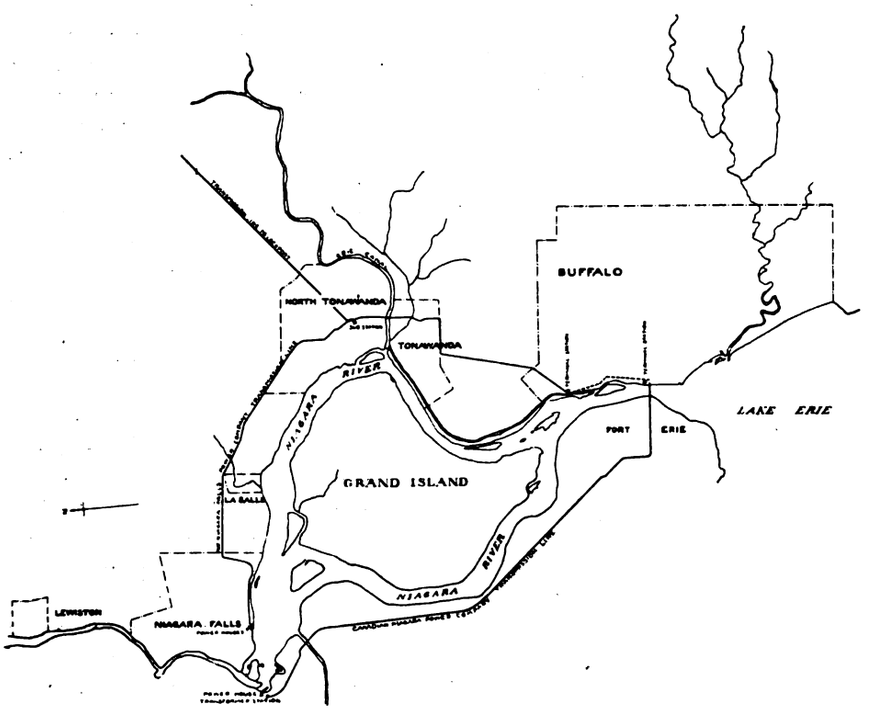


FIG. 7.—MAP OF THE TRANSMISSION LINE RIGHT OF WAY, CANADIAN NIAGARA POWER COMPANY.

The insulators are made of a compound known as "electrose." This material is a very good insulator, is very strong mechanically, and is entirely free from cracks and other defects which are common in glass and porcelain. Similar insulators have been used on the Buffalo transmission lines of the Niagara Falls Power Company for the past three years, and they are the only insulators on those lines which have caused no trouble. It is impossible to shatter electrose insulators by stone throwing, and they will frequently turn a rifle bullet without being damaged seriously. The conductor used on this line is of aluminum of 500,000 circular mils in section and having thirty-seven strands.

At Fort Erie the line is tapped by a top of one pole to an insulated support. At the towers the lines are attached through strain insulators to steel cables, which pass sheaves about twenty-four inches in diameter, and thence to weights which are equal to the tension on the wire in pounds. This amounts to 4,500 pounds on each line. The live portion of the line passes down the tower from the outside of the strain insulator to the terminal house on the Buffalo side and to the main transmission line on the Canadian side.

The power-house has been in successful operation for about a year, and five generators are now in service. The transmission lines to Fort Erie and Buffalo are now in process of construction, and are expected to be put in service about November 1.

The Faraday Society.

The twenty-first ordinary meeting of the Faraday Society was held on Tuesday, June 12, when a paper on "The Electrolytic Deposition of Zinc, Using Rotating Electrodes," by Dr. T. Slater Price and Mr. G. H. B. Judge, was communicated by Dr. F. Mollwo Perkin.

An improved form of apparatus for the electrolytic deposition of metals using a rotating cathode is described. The ordinary beaker is replaced by a tap funnel of about 100 cubic centimetre capacity, so that the electrolyte can be run off at the end of the experiment, thus obviating the use of a siphon. Use is made of a bicycle hub for rotating the cathode.

In the deposition of zinc from a pure solution of the sulphate, no extraneous electrolyte being added, with a current of two amperes (cylindrical cathode of gauze, twenty-two millimetres in diameter and forty millimetres long) and voltage 4.5-5.5, the results are uniformly low. The error increases with higher currents, and is due to the heating effect of the current. On keeping the electrolyte cool by means of an ice jacket good results are obtained, even in the presence of free sulphuric acid, provided that the concentration of the latter does not exceed a certain amount (about $\frac{n}{6}$).

It is further shown that zinc can be quantitatively deposited from solutions of zinc sulphate, containing 0.2274 gramme zinc in the presence of two to three grammes sodium sulphate. The deposit is better than that obtained by the usual method, using sodium acetate and acetic acid; it is not necessary to cool the electrolyte.

An improvement of the method of Kolloch and Smith (*Journal of the American Chemical Society*, 1905, 27, 1,255), using a rotating anode and mercury cathode is also described. It is found necessary not to have present more than two drops (40 drops = 3 cubic centimetres) of free sulphuric acid in order to obtain quantitative results in the estimation of zinc.

Dr. F. Mollwo Perkin described "A Simple Form of Rotating Cathode for Electrochemical Analysis."

The cathode consists of a spiral of platinum wire, or, better, iridio-platinum wire. Nickel wire may be substituted for platinum, and the author recommends its employment in place of the more expensive metal. Attention is also drawn to the

Digitized by Google

solubility of platinum anodes, with heavy currents 0.0016 gramme being dissolved in a cyanide solution in thirty-five minutes.

Mr. S. Binning and Dr. F. Mollwo Perkin read a paper on "The Electrolysis of Solutions of Thiocyanates in Pyridine and in Acetone."

On oxidation of thiocyanates with chlorine, persulphates, etc., a yellow coloring matter—canarine—is obtained. By electrolysis of aqueous acidified solutions of thiocyanates an apparently similar product, which was originally described in 1884 by Lurdow, is obtained. The authors consider that this substance is not identical with the canarine obtained by chemical means, because it shows certain reactions not given by the oxidation product. They find that in alkaline solutions no coloring matter is produced, but that cyanides are apparently formed. A difficulty met with in the electrolysis was the formation of the coloring matter on the anode surface, which caused a great resistance to the passage of the current. The difficulty was got over by using a lead cathode on which bristles had been fixed. This was rapidly rotated within a cylindrical platinum anode, the bristles cleaning the anode surface as the cathode rotated. With a current of five amperes (ten amperes per square decimetre) the electromotive force was five volts.

Anhydrous ammonium thiocyanate readily dissolves in dry acetone and pyridine, in either case there being no difficulty in obtaining a twenty per cent solution. These solutions readily conduct the electric current. In the case of the acetone solution with a current of 1.5 amperes (three amperes per square decimetre) the electromotive force required is 6.7 volts. With pyridine for the same current it is about nine volts. In the case of the acetone solution a yellow amorphous powder separates out. With the pyridine solution the liquid becomes orange-red, but no precipitate is produced. On pouring this orange solution into a large excess of water an orange precipitate falls out. These two substances are certainly not identical with the canarine obtained by oxidation; at present the authors are unable to say whether the product obtained from acetone is the same as that produced from pyridine. It is found that when a lead anode is employed in the pyridine solution it goes into solution; lead thiocyanate is produced and metallic lead is deposited at the cathode.

ECONOMICAL LUBRICATION OF LARGE POWER PLANTS.[1]

BY W. M. DAVIS.

In the lubrication of a large plant the first consideration is, of course, efficiency, then economy, although some engineers seem to think that it is impossible to attain the first and at the same time give any consideration to the latter. To obtain efficient lubrication the first thing to do is to see that the lubricants used are of good quality, either choosing well-known or tested brands, or specifying what they shall be composed of and the test that they shall conform to. Next is to see that suitable and reliable appliances are used to feed the oils, that crank pins, eccentrics, bearings, etc., be provided with centre oilers, telescope oilers, sight-feed cups, or other devices, so that every drop of oil that is fed from the cups will go directly to the bearing surface, without any being thrown or spattered over the engines or machinery.

For slow-speed engines ordinary sight-feed cups, properly looked after, will give satisfactory results, but for heavy high-speed work the continuous oiling system with the oil flowing from an overhead tank to the bearings, in streams if necessary, thence through a filter and back to the overhead tank, is the most efficient method of lubrication. From an economic standpoint, the success of such a system will depend entirely upon the means provided to catch the oil after it leaves the bearings.

With slow-speed engines, and, in fact, with all machinery that uses oil in quantities, every bearing on which oil is used should be provided with substantial sheet-steel pans, arranged, if possible, to drain the oil to some central point, into a bucket or tank, from which it can be taken to the filter. When the crank case is enclosed, care should be taken to keep the oil as free from water as possible, as water will sometimes travel along the piston rod into the crank case, and, if it is the least bit alkaline, form compounds used in the boilers; the oil and water together will sometimes form a compound which is hard to separate, and which lowers the quality of the oil.

On slow-running engines, where the pressure is not excessive, and on some slow-running shafting, a good grade of grease or tallow compound will often give good results, but where the compression cups are used the grease should be quite soft, so that it will spread freely. If too hard, great pressure will be required to feed it, and it will also tend to increase the friction load.

In regard to cylinder lubrication, no one can make any hard-and-fast rule as to the proper amount of cylinder oil that should be used; that will have to be determined by test and experiment. First, a good quality of oil should be provided. Second, to get economical results, make the conditions as favorable as possible. See that the steam is dry; do not carry the water in the boilers too high; do not use an excess of strong alkaline boiler compound and, above all, do not set the piston rings out too tight. Before putting the rings in the piston, chamfer the edges off slightly with a file. If the edges are sharp they will tend to scrape the oil off the surfaces. Where the engine speed is constant there is little choice between a force-feed pump and an ordinary sight-feed lubricator. Either will give sufficient and economical service if properly taken care of; but where the work is intermittent, the engines stopping and starting, as is the case with mining engines, tugboats, etc., the force-feed pump is the more economical.

To determine the proper amount of cylinder oil to use in any particular engine, first have the conditions as favorable as possible. Then gradually reduce the oil feed and note the action of the valves. If they work smoothly it is a good indication that the cylinder is all right; but if they commence to groan increase the oil feed slightly. In this way the minimum amount of oil that should be fed can be determined very closely. After this the cylinder head should be removed and the surface of the cylinder examined. If it looks oily and, when wiped over with a piece of soft paper, a stain is left on the paper, it is certain that enough oil has been fed.

Another important matter in economical lubrication is in the receiving, handling and proper distribution of the lubricants. If the plant is a large one the oil house should be provided with storage tanks of sufficient size to hold a tank car of each kind of oil. By purchasing the oil in tank cars there is a reduction in the price per gallon and a saving in the labor of handling of the oil and the empty barrels. In a small plant where only a few barrels of each kind of oil are used a month, tanks holding from two to ten barrels should be provided, so arranged that the oil can flow by gravity from the barrels into the tanks. Care should be taken to see that the barrels drain out clean.

[1] Abstract of a paper read recently before the Institution of Mechanical Engineers of Great Britain.

Digitized by Google

Electrical Notes from Europe.

(By Our Special Correspondent.)

THE French Thomson-Houston Company has been making a series of tests in the suburbs of Paris with a single-phase system for tramways. Alternating-current is furnished from a motor-generator set working upon 500 volts direct-current, and it is coupled to an alternator giving 500 volts and twenty-five cycles. An experimental trolley line takes this current, and the cars, which are of the same type as is used within the city, are run back and forth over a short section of track. On the cars are mounted two Latour motors of the four-pole type designed for fifty horse-power each, working at 300 volts, single-phase current. Owing to the municipal regulations a higher voltage than 500 could not be used on the trolley wire. A transformer placed under the car-body lowers the voltage from 500 to 300 volts. The secondary has a number of terminals, so as to allow the use of a controller for varying the voltage on the motor. So far the tests have been very satisfactory. The air-gap of the motors, which is two millimetres at present, could be increased if desired, and it is found that the motors can start up with three times their normal couple, corresponding to 150 horse-power.

In a paper read before a recent conference, M. Rene Koechlin, a well-known engineer, exposed his project for securing a large amount of water power from the Rhine, upon the position which lies between Bale and Brisach. Here the river has a rock bottom, and M. Koechlin gave the details of a dam which could be erected to the best advantage. From the dam leads an intake canal of some size, to a distance of four miles or more. The canal is 100 feet wide and fifteen feet deep. At the end of the canal he proposes to erect a large turbine station which will utilize a head of water varying from twenty to thirty feet, with a large volume of water. Under these conditions the plant would deliver 35,000 horse-power and would contain twelve turbines of 3,000 horse-power each working at low-pressure, coupled to three-phase alternators. Transformers would raise the voltage to 10,000 volts for the overhead line. Should the station be overloaded, it is proposed to erect a second hydraulic plant in the neighborhood, having about the same capacity.

The Oerlikon company has been making experiments on the high-tension single-phase system for electric locomotives over a section of line from Seelbach to Affoltern or about two miles in length. Two different forms of locomotive are used. In the first locomotive is mounted a rotary set for converting the current so as to use direct current on the motors. An induction motor takes 15,000 volts current at fifty cycles from the trolley wire. It is coupled to a generator and the latter supplies the motor circuits through the controller. On the axles are mounted two motors of 200 horse-power, making a total of 400 horse-power for the locomotive. The total weight is about fifty tons for the first locomotive. On the second locomotive the line current is first lowered by two transformers to 750 volts and is then sent into two specially designed motors using single-phase current and mounted in series. Each motor is rated at 200 horse-power, and the locomotive weighs forty-five tons. Different forms of trolley are used in the experiments and also various methods of suspending the wire. So far the results have been generally favorable, and the trains have made about 2,000 trips over the experimental section.

That direct-current at high-tension on the constant-current system can be used successfully for long-distance transmission of power has been well proved by the St. Maurice—Lausanne and other important plants in Switzerland which have been designed on the Thury system. According to the recent tests made at Geneva by the same company, we may expect some sensational developments in regard to the direct-current system. It is claimed that it can use two or three times the highest voltages which are allowed for the alternating-current upon overhead lines. Should this prove to be true, we will find the distance to which current can be transmitted greatly increased. Experiments with new apparatus have been made in the presence of leading engineers from different parts of Europe. According to reports, it appears that as high a voltage as 100,000 has been used between the line and earth, which is equivalent to 200,000 volts between two wires. As we are now limited to 60,000 volts or even less than this for alternating-current, the experiments are of great practical interest.

Among the most extensive electrical enterprises in France must be ranked the electric tramway system which has been recently completed in the Mediterranean region. It covers a continuous length of thirty miles and runs between Cagnes and Menton, passing by Nice and Monte Carlo. Great difficulty was experienced in laying the road-bed, as the road runs along the Corniche route overhanging the sea, and this route had to be enlarged considerably in many places, tunnels cut in the rock, etc., which took a large amount of work. The road is one metre (39.3-inch) gauge, and was partly in single and partly in double track. It uses a Broca rail weighing 100 pounds per yard. The rolling stock consists of 106 motor cars of two axles and two motors each, forty-two trailers and three hauling cars. There are also twenty-two freight cars in use on the line. Between Nice and Monte Carlo, owing to the narrow way and sharp turns, a form of double motor car is employed which consists of two short cars coupled together. The usual form of overhead trolley system is employed, with metal poles and brackets. Current at 550 volts is supplied from six substations along the route, which receive 10,000 volts alternating-current from a hydraulic plant. In the Sainte-Agathe substation, which may be taken as an example, have been placed two motor-generator sets of 250 kilowatts each, a battery of 281 Union cells and a booster group of thirty-five kilowatts. The freight traffic on the new lines promises to be considerable. The system has been installed throughout by the French Thomson-Houston Company and the Société de l'Energie Electrique.

Among the aerial telegraphy projects we may mention the great station which is to be erected in Germany at Nauen by the German Aerial Telegraph Company on the Telefunken system. The new plant will differ considerably from the recently erected stations, seeing that it is to consist of a single high tower, instead of the four-tower form such as is used in the government plant at Norddeich and also at Oberschöneweide, near Berlin. At the Nauen plant the tower is to have a set of wires running down to the ground and forming a sort of screen for sending and receiving the waves. This form of construction is less expensive to set up, although it may not be as powerful as the funnel-shaped construction which is used in some cases. The height of the tower is to be nearly 300 feet from the ground and it is expected to cover a distance of 1,000

Digitized by Google

miles, so that it can signal to most of the leading points on the Continent. At Paris the experiments which have been made on the Eiffel tower for some time past have given good results, and the military authorities are now taking measures to use the tower as a centre of operation for signaling between Paris and the different fortified places to the east and west. Signals have been sent to Belfort for some time past, and there is no doubt that the proposed system will prove of great value in military operations.

Walter Wellman's great airship with which he expects to reach the North Pole has recently been finished at the Louis Godard establishment at Paris and is now making a series of trials at the headquarters of the expedition at Spitzbergen. One of the novel points will be the use of a wireless telegraph apparatus which will be mounted in the basket cabin on the deck of the airship, and will use the steel guide rope trailing on the ice as a mast-wire. Signals will be sent in this way to Hammerfest, and thus the news of the expedition will always arrive. This will prove a most valuable aid to the expedition. The Norwegian government, in the person of the minister of public works is now engaged in erecting the stations at Spitzbergen and Hammerfest for this purpose. Major Hersey who represents the United States weather bureau in the expedition, has been at Spitzbergen for some time in the interests of the party.

The Canton of Zurich proposes to erect a large hydroelectric plant in the valley of the Albula, and the station is to be fitted with machines to the extent of 20,000 horse-power. It is said that the plant is to cost $2,000,000 to erect. From the dam will run a canal four miles in length, ending in a circular water chamber cut out of the rock. From here will leave two penstocks of six feet diameter running down to the turbine station. The latter is to contain eight turbine and dynamo units of 2,500 horse-power each. It has not been decided as to what kind of current will be used. It is proposed to use three-phase current with 70,000 volts on the line, or direct current with 79,000 volts between the poles, with a grounded neutral wire, making 39,000 volts between a wire and ground. In either case the overhead line will be double, and will run upon beton poles, using metallic towers in a few cases. The overhead line will have switching apparatus for dividing it into sections every twelve miles.

Different methods of melting glass by the electric arc have been proposed. One disadvantage coming from the use of the arc is that small particles of carbon are apt to enter the glass, especially when a long arc is used. Mixing oxydizing substances with the glass may help to overcome this, but not altogether. On the other hand no success has been obtained by using metal electrodes instead of carbon. The method of blowing the arc over the glass is not to be recommended, as it only heats it in spots. In order to melt a pound of glass we need from two to three kilowatt-hours for the arc. It has lately been proposed to use cryptol for heating the glass. The crucible containing the glass is placed in a mass of cryptol. Current comes from a carbon plate at the lower part of the cryptol and goes to a carbon rod or series of rods placed in it. The resistance of the mass is changed by raising or lowering the rods. Fusion of the glass is easily obtained in this way, seeing that it is much lower than the heat of the arc. A current of 100 volts was used in the above tests, and it seems that this method may have some value.

Tests upon windmills for producing current have been carried out for the Danish government by Professor La Cour at Askow, with very good results. With a four-wing wheel, which he finds to be the best form, using fifteen square yards surface, and a wind of twenty feet per second we obtain two horse-power. A wind-speed of thirty-five feet per second gives about ten horse-power. In order to provide a reserve during an absence of wind he finds that a small petrol motor which can be coupled to the dynamo is the best to use, as it costs much less than a storage battery. At Askow he has been running a windmill plant which fed 450 incandescent lamps, with some arcs and motors. Such a plant costs $4,700 to erect, including the price of the ground, and it costs $165 per year to operate it. A plant of this kind would be very good for farm use, and a much smaller one would answer in many cases, costing in the neighborhood of $1,000. A number of windmill electric plants of this kind are now running in Denmark.

It is proposed to electrify a number of the Italian railroad lines which end at Novara in the northern part of the country, which are now operated by steam, and to this end the railroad department has lately requested the minister of public works to arrange for constructing a hydraulic plant for securing the necessary current. This can be done by using the water of the Lessin, and it is stated that a 7,500-kilowatt hydroelectric station will be erected. From the large dam which will be placed across the river, will lead a canal of some twelve miles length running to the turbine house. The same canal will be utilized in order to furnish a large supply of water for the already existing Cavour canal. The latter is used for irrigation, but at present it is desired to increase its supply. It will cost about $3,000,000 to construct the canal. At the same time the Italian government has been occupied with the question of the use of electric locomotives for the Simplon, as concerns the portion lying outside the tunnel on Italian ground and running from Domo D'Ossola to Iselle. This portion of the track along with the line inside the tunnel and the part lying on Swiss territory will be electrified and as soon as the three locomotives are delivered from Switzerland we may see the new line running.

Finland is a country in which electrical affairs are commencing to be developed, and already a number of large orders have been given to the leading electrical firms for apparatus of various kinds. A number of new electric plants are now in project in this country. Among the most important of these is the proposed plant which the municipality of Helsingfors has recently decided to erect for supplying light and power to the city. The estimated cost of the plant is near $500,000, and a credit has already been voted for the purpose. As it is proposed to utilize some of the large falls which are found in the country for erecting hydroelectric plants there will no doubt be considerable activity in electrical matters. It is likely that electric traction will be applied upon many of the railroads, as this question has already been taken up by the government, which controls all the lines. Reports state that a large amount of capital is to be devoted for this purpose.

In Switzerland some of the army corps have been making tests upon the use of a portable high-power arc projector for field use, and it seems to answer all the requirements. The Cuenod firm, of Geneva, has built this apparatus. The projector is mounted on an automobile chassis and is about three feet in diameter. The automobile makes a speed of five to ten miles an hour, and is fitted with a dynamo coupled on the shaft of a gasolene motor. By means of a new system, a cable connected with the projector allows it to be maneuvered from a distance of 600 feet.

Digitized by Google

and thus it may be put out of reach of the enemy's fire.

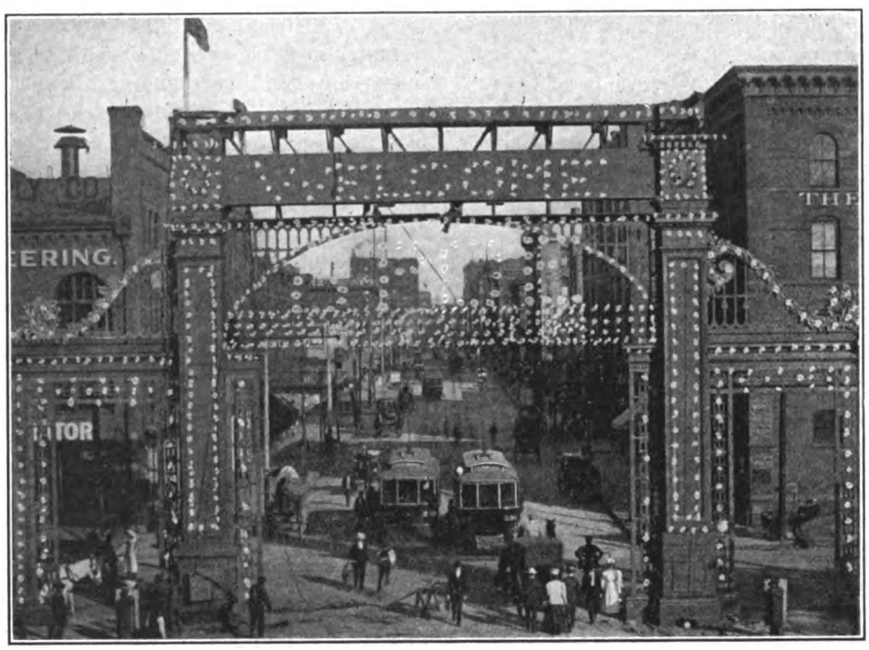
A large company has been formed at Christiania for operating the new Birkeland and Eyde process for obtaining nitrogen from the atmosphere. It is said to be capitalized at $2,000,000, part of which is furnished by German and French banking houses. The process consists of treating air by means of the electric arc and so taking out the nitrogen in a fixed or a combined state, especially in the form of nitrates, and the latter will replace the Chile nitrates and others. At Nottoden has been erected a large plant which uses three of the Birkeland apparatus working with powerful arcs; each of these units takes about 700 horse-power to run it. The arcs are contained in a set of stone towers or furnaces in which the nitrous gases are transformed into nitric acid or are combined so as to form nitrate of lime. In the three apparatus they are able to treat some 3,000 cubic feet of air per minute. Not long ago the capitalists who were interested in the process sent a committee of experts to examine the plant and they made a very favorable report on the same, which led to the formation of the present company. It is expected to use a large amount of hydraulic power in the future especially for the production of nitrate of potash.

It is estimated that the total amount of hydraulic power which is obtained from the falls in Switzerland for running electric plants is now more than 225,000 horsepower. Of this amount we find forty per cent used for electric lighting, thirteen per cent for traction, twenty-three per cent for electrolytic work and twenty-four per cent for motors. Notwithstanding, the great amount of power which the electric plants furnish, Switzerland was obliged to import as much as $11,000,000 of foreign coal during the period from 1898 to 1904. In view of this it has been desired to utilize a number of new falls so as to obtain a large amount of electric power. Thus a new plant for which a concession has been obtained in the Bernese Oberland is expected to yield 40,000 horse-power. The Canton of Berne is interested in this project. Seeing that the railroads will need as much as 150,000 horse-power, still other plants will no doubt be erected. A concession has already been obtained for a large hydroelectric plant on the Rhine near Numpf, which will afford a 230-foot head of water. A canal fifteen miles long will run from the dam to the turbine station.

The Italian government proposes to assume control of all the telephone lines in the country in the future, and to this end the minister of posts and telegraphs and telephones is making arrangements to have the new telephone systems erected by the state, as well as to take over the lines which private companies are now operating. A project is on foot at present for carrying this out in the best manner, and it is proposed to indemnify the companies owning the lines by means of a series of annual payments which will continue up to the time when the concession ends. It is expected that the telephone receipts will be sufficient to cover this expense and at the same time allow the state to operate the lines, so that no additional expense will be required for this purpose. The leading telephone companies seem to be disposed to make such an agreement; among these are the Italian Telephone Company and the North Italian Telephone Company. This would give the state control of twenty-four urban systems, among these being Rome, Florence, Naples, Venice, Milan, Lurin, etc., and including most of the large cities, as well as fifteen interurban lines.

C. L. DURAND.

Paris, June 30.



ELECTRICALLY ILLUMINATED ARCH, DENVER, COL.

The Denver "Welcome" Arch.

Denver will have a most elaborate permanent electrical display in the welcome arch now being built in that city. The arch which is now in course of construction spans the street directly in front of the entrance to the Union depot and will be covered with 400 incandescent lights. The sign "welcome" will blaze out to every visitor who steps within the gates of the city.

Denver is aggressive in its advertising. It will take up anything that has the earmarks of success—of getting business. The opinion is firmly rooted and citizens back it with firm convictions that if you push your city you push your own interests. When the Denver Gas and Electric Company began a most spirited campaign in favor of display lighting for advertising purposes a number of years ago, it met with a cordial welcome. The business men found that lighting increased their business. They also found that the general scheme of lighting added to the already numerous attractive features of their city. All of a sudden Denver bloomed in the lead as a splendidly lighted city and became known as "The City of Lights." That reputation was well worth sustaining, the citizens reasoned, and the slogan went up "Boost for the City of Lights." In no time every dark corner in the business section was turned into a flood of light and there was a ready response to any suggestion that would improve the general lighting of the city both commercial and public.

It was suggested that a welcome arch which would express the hospitality of Denver's citizens be erected at the entrance to the Union depot. The suggestion resolved itself into a subscription of $13,000 for this purpose. Divers interests and individuals gladly contributed this amount of money. The arch will be lighted for the first time on the occasion of the Elks' convention which will be held in Denver July 16.

Digitized by Google

ELECTRICITY: THE POWER BEHIND THE SOUTH.[1]

BY W. S. LEE, JR.

If we should examine a railroad and industrial map of the South made fifty years ago, we should find, located along the ridges, very few and short railroads. We should also find situated along streams a few cotton, woolen and other factories. In almost every case the articles manufactured were for local consumption and were furnished to the various large farms or plantations situated in the immediate vicinity.

As railroad construction began rapidly to increase in the South, the tonnage of these small factories was not considered sufficient inducement for the location of railroad lines along the valleys. Consequently, these locations were made on ridges or plateaus which afforded cheaper construction.

For many years the revenue of the railroads was derived almost entirely from transportation of agricultural products, but within the past fifteen years the South suddenly became a manufacturing as well as an agricultural section.

The rapid development of manufacturing in the South naturally caused manufacturers to seek some mode of transportation, and as a result the factories were located along the established lines of the railroads.

On the other hand, if we should examine railroad and industrial maps of New England for the same time we should find the condition reversed. New England having been a manufacturing country before the advent of railways, its water powers were developed and factories located along the valleys. Consequently, when railroads were built in New England they were forced to follow the valleys, as the freight on the factory products furnished the principal source of revenue. As a result, New England had the advantage of cheap motive power while the South struggled along with the more expensive.

It is true that a few water powers were developed for mill work, but being located away from the railroad, experience showed that these mills, although having cheap power, were at a great disadvantage, owing to the lack of transportation facilities, in competing with mills located on railroads.

Our engineers saw that it was necessary to bring the power interests and the railroad interests together, and have been wrestling with this problem since the beginning of the manufacturing era. The railroads could not be moved from the ridges to the valleys, neither did the business warrant the expenditure necessary to build another system of railroads along the streams. The alternating-current generator and transformer came to their assistance and opened up the way. By the generation of electrical power on our streams, and its easy transmission over long distance by wire, cheap power with good railroad facilities can be placed at the disposal of every manufacturer. While our progress has been greatly delayed on account of these topographical and railroad conditions, we are to-day in a position to derive more benefit from our resources, in many cases, than if our streams had been developed in the days of direct drive. The manufacturer is able to locate factories on high ground, thus obtaining the advantages of better light, healthier and more convenient surroundings, while if the direct drive were used factories would have to be placed in valleys near water powers, where they would be in many cases cramped for room and oftentimes located on unhealthy ground.

The solution of the problem of transportation and power interests immediately created a prosperous condition in the South. Our agricultural and manufacturing and agricultural statistics show that we are not only large producers of raw cotton, but that we are fast becoming a cotton-manufacturing centre of the world. This gratifying advance in Southern wealth, since the beginning of this century, is immediately connected with the betterment of the cotton situation. This wealth, as shown by increased assessment of property, amounts to over one and one-third billion dollars.

Considering that the valuation of the cotton crop for 1904-1905 amounted to six hundred and eighty-five million dollars, that is, the cotton crop is worth more than one-half the value of all the other crops, we see that something like forty per cent of this one and one-third billion of increased valuation is due to our increased cotton crop. But of the 13,566,000 bales that the South has grown, our spinners have taken 2,116,318 bales against 2,193,937 bales taken by the Northern spinners. Considering the fact that ten years ago the Southern mills consumed less than half as much as the Northern mills, it is very encouraging to note that we are almost on a par with the North, and the advantages which the South possesses are good reasons for believing that the South will, in a very short time, be spinning the greater part of its cotton crop instead of sending it to the North and abroad for manufacture.

The advantages of the South as a cotton-manufacturing centre are summed up as follows:

1. Mills located in the South are enabled to secure their raw material almost at their doors, and it will be many years before any state manufactures as much cotton as it produces. This, of course, reduces freight rates to a minimum.

2. The various railway and steamship lines radiating to every part of the world enable the Southern mills to offer their goods in all markets. The completion of the Panama canal will afford still further advantages in transporting our goods to the Orient.

3. Although help has been somewhat scarce, due to the very rapid development of mills, nevertheless, the South is building yearly a great number of mills and securing help for same. The help of the South is fast becoming more expert, consequently, the same number of hands are annually producing more goods. The healthy location of the cotton districts of the South is drawing more and better help into the cotton mill district every year.

4. The South's greatest asset and advantage consists in its numerous water powers situated throughout the cotton-producing and cotton-manufacturing district. The South has something like two million horse-power still to be developed in the very heart of the cotton field, and in a climate where ice can not materially affect this development.

It seems strange that this enormous power should have lain dormant in the midst of our factories while they were producing power by steam at a great cost. It would seem that the energy of these water powers was destined to lie dormant until conditions arose in which all factors would work in unison for maximum advantage and that the South would then proclaim that it had become the manufacturer of cotton goods for the world.

The advantages of the electric drive in cotton manufacture were explained as follows:

With an electric drive a meter can be placed in the circuit, supplying power to any machine or set of machines and the instantaneous power, or total power for any given time measured. This may not at first sight seem to be of such great importance, but after due consideration the manufacturer will note that one of the greatest problems before him to-day is how to obtain exact and definite knowl-

[1] Abstract of an address delivered before the American Cotton Manufacturers Association, Asheville, N. C., May 16.

Digitized by Google

edge of the cost of production. Keen competition requires that each operation in manufacturing be figured to a certainty in order that every means may be taken to reduce the cost of production. To illustrate the importance of this question of measuring the power necessary for driving any machine, we note an instance that came under our observation some time ago. One of our engineers was called upon to explain why a certain seventy-five-horse-power motor was running hotter than when it was installed. Going to the wattmeter he found that his motor, together with two motors of the same size, were taking 260 kilowatts. Knowing that this was abnormal he asked the superintendent to have the shafting oiled, which was done that night. Next day this meter read 220 kilowatts; i. e., for want of oil on the shafting, these motors had been taking over eighteen per cent more current than was necessary to drive the machinery.

One set of machines may be operated when it is not advantageous or convenient to run the whole mill. Often one part of the mill gets behind and has to run part of the night. If the mill is driven by its own steam plant the engine attendant and fireman have to be kept on duty and the whole mill run, to supply power for this one part, but if this mill were buying power from a central station, all that would be necessary would be to throw the switch for the one motor and proceed to work. In this connection we have known cases when it was impossible to operate the machine shop in order to make repairs on parts affecting the main drive, simply from a want of these parts. With the machine shop driven by separate motor, this could rarely happen.

The enlargement of a mill is made independent of its relative position to the main drive. With a mechanical drive all details relating to the enlargement must be determined before the plans of the original mill are made. The engine, the boiler room and main shafting must be planned with this in view. This means a large additional cost to the mill until the enlargement is made and if the enlargement is not made, a waste of money. But when the electric drive is used it is only necessary to add another building and buy more motors. In many cases the high pressure engine is installed and room left for the low pressure side with the main pulley placed at one end of the mill. This arrangement works very well when enlargement is made shortly after first installation, but we know cases where mills have been working for years on a very inefficient basis, due to the fact that the enlargement has never been made. Again it often happens that a mill will have an available site for an additional building or wish to drive a pump that can not be reached with mechanical drive. Under such conditions electric drive displays its adaptability. Furthermore, a mill can be more readily designed to effect a saving in handling a product from one department to another.

The amount of shafting is materially decreased and a saving in frictional losses is thereby effected. This cutting down of shafting means a saving in first cost of the mill, a saving in labor and oil, and adds much to the appearance of the mill. The saving in frictional losses can not be too strongly impressed upon a manufacturer. As an illustration: The indicated horse-power of a prominent cotton mill in the city of Charlotte, N. C., with steam power was 450 horse-power; since using electric motors the power to drive this mill has been reduced to 345 horse-power, clearly demonstrating that the frictional losses of engine belting and shafting in the steam drive exceed those in the electric drive.

By the substitution of lighter belts for large heavy ones, a saving is effected in first cost and in bending frictional losses. Before the introduction of the electric drive, large heavy belts were used, but many mills electrically driven are now running with no belt wider than six inches. In the old mill several belts were used between the engine and the machine operated, and every belt meant so much slippage and a consequent loss of speed and power. This is confirmed by the common practice among cotton mill superintendents in figuring speed to allow a large percentage for slippage and in cases where mills have been changed from mechanical to electric drive by the speed being found too high, due to the fact that there was no slippage allowed for, as in the mechanical drive.

The output is increased and the quality of goods is improved. That system which maintains the speed in the machinery nearest to the maximum limit and at the same time maintains that speed constant will show the largest production. That these conditions are more nearly fulfilled by the electric drive than any other motive power is daily demonstrated in mills using this system. This increase in production is due largely to the fact that the torque is constant at all times in the motor. On the other hand the torque of a reciprocating engine varies from nothing, when a piston is at the end of its stroke, to a maximum at the middle and to nothing again at the other end. The speed, even with a heavy fly wheel, varies materially throughout the stroke and causes pulsation on high-speed machinery like spindles or warpers. These pulsations in many cases throughout the mill may be multiplied in intensity and should some weak or defective thread encounter this pulsation at a proper time, it will break. The machinery being automatic, the moment one thread breaks the whole machine stops until an operator can repair the thread and start the machine. It is due largely to the above reason that the electric drive in many cases has increased the production from two per cent to four per cent.

Lower First Cost for Small Manufacturers—If the electric drive is suitable for large manufacturers it is doubly so for small manufacturers. Many firms which are now rated high were started with very little capital and the cost of steam plant together with land and the building to install engine and boiler, was a serious consideration to such an infant industry. For many reasons boiler and engine can not be placed in a third or fourth story while a motor can be placed almost anywhere, and at a very small outlay as compared to that of a steam plant. The cost of coal combined with rental of property on which to erect a steam plant in a city is often enough in excess of what power could be purchased for, from a central station, as would make a good working profit for a small manufacturer. Especially is this true if the manufacturer uses power intermittently for his work, or has a variable load. Power that cost $30 per horse-power per year used continuously may cost $60, or even more, if used only a few hours each day, for the fires have to be kept under the boiler, and the rent on property has to be paid, whether the engine is doing its work or running idle; while in the case of electric drive the power could be shut off and expense stopped. The manager of a company in Charlotte, using three small engines before conversion to electric drive recently told the writer that their power now cost them about $2 per month more than they formerly paid their fireman.

We can safely say that the development of this mighty agent, which is such an important factor in building up one of the greatest manufacturing centres of the world, will certainly save each and every customer at least $5 to $10 per horse-power per annum on each horse-power consumed.

In concluding, we can not but insist that with its advantages, adaptability, the great saving, this mighty and mysterious agent is truly the power behind the South.

Digitized by Google

PROFESSIONAL ETHICS.[1]

BY ROSSITER W. RAYMOND.

There are a few things which are not taught in school; and among these are the ever-changing problems of professional ethics, concerning which, perhaps, age may still fairly claim a respectful hearing from youth, although it be inferior in other knowledge. And a word on this subject may be all the more appropriate now, when the ethics of business are involved in confusion by the volunteer reformers who find fierce delight or selfish gain in attacks, denunciations, exposures and "sensations."

In my judgment, men mostly try to do right, and fail chiefly in their decisions as to what is right through inexperience and incomplete knowledge.

Most of you are going to be engineers, in one or another department of that multifarious profession. All of you, I think, will be called upon to serve your generation in one or more of the following ways, namely, as authors, employés, agents or advisers. Let me offer, therefore, some suggestions, born of experience, as to the ethics of each of these positions.

As authors, take pains to think clearly, and to state your thought clearly. Faults of style are usually moral faults. Qualifying clauses out of place indicate belated after-thoughts; mixed and false metaphors declare that you have pretended to see pictures which you could not possibly have seen, because they were absurd. When a distinguished senator of the United States, complaining of the unjust criticism which he had suffered, declared that he had been "gibbeted at the crossroads of public reputation by every foul bird of passage," he was mixing two visions, professedly seen by his poetic eye, which were so inconsistent that he clearly could not have seen either. And when one of the most eminent of American orators of the last generation, arguing for universal education and universal suffrage, said (in my hearing) that the time was at hand "when Liberty would stand by every new-born child, to drop in its cradle the schoolhouse and the ballot-box," he uttered not merely a mixed metaphor, but also an implied and unconscious falsehood, because he professed to see in a poetic vision a performance which would have been fatal to every American baby, and therefore not glorious reform, but the meanest kind of murder!

[1] Abstract of an address to the graduating class at Lehigh University, South Bethlehem, Pa., June 1.

It is the product, not the process of your thinking, which you will be called, as authors, to express to your fellowmen. Don't give them unnecessary trouble in finding out what you mean to say, or on what grounds you say it; don't assert, as of your own knowledge, more than you really know; and don't hide in generalities or ornamental illustrations your actual ignorance as to this or that definite proposition.

One of the most frequent sins of authorship is the reckless use of quotation marks. Even the eminent historian Froude was guilty of this sin when he printed as quotations his own summaries and interpretations of letters in the case of Mary, Queen of Scots. I think it was the *Saturday Review* which uttered the famous verdict, justly considered to express the utmost severity of condemnation, "Mr. Froude does not understand the meaning of quotation marks!" Remember always that a quotation, making the original author responsible, must not be condensed or modified by you.

Again, verify all quotations, direct or indirect, whenever you can, and give such full references as will enable your reader to pursue the subject further for himself. If you are unable to do this, then plainly say so, referring, not to the original author of the statement you cite, but to the author whose professed quotation of it you adopted. Remember that, when you quote, you guarantee the accuracy of your quotation, and practically assure your readers that you have verified it.

As employés, think more of your duties than of your rewards or your supposed rights. Even from a selfish standpoint, loyalty commands to-day the highest price in the market.

One of the greatest inventors and mechanical engineers of the last century once said to me: "I can find many young men who are competent to erect engines, but very few whom I can thoroughly trust to do it, in complete devotion to my interest as employer."

Believe me, my young brothers, such devotion is to-day not only more honorable, but more profitable, than ever before in human history.

As agents, your duties are as clearly defined by law as by honor. Under either rule, you may not have secret personal interests, affecting your relations to those whom you represent.

Perhaps the commonest question of casuistry occurring in modern business is that of "commissions." As the agent of your employers, you have to purchase a steam engine. After getting the prices and inspecting the engines of all the manufacturers, you decide upon the machine most suitable, on the whole, for your purpose, and, in all legitimate ways, beat down the sellers thereof to their lowest price. Just as you are about to close the bargain at that price, they say, "This covers, of course, your commission of ten per cent." When you reply that you do not expect any commission, and suggest that, instead of paying it to you, they take it from the amount of the bill they send to your employers, they tell you that, according to some trade agreement, they can not charge a lower price, but can pay a commission to the selling agent. Now you are not the selling agent, but the purchasing agent; and, explaining this difference to them, you tell them that you will be in honor obliged to pay your employers whatever commission may be paid you. To this they reply, with a kindly but cynical smile, that they do not care what you do with the money after you have got it; and you see clearly that they regard your protestations of honor as part of the formula which precedes your acceptance of the money. They do not really believe that you will not keep it, if you get it.

I am repeating an episode of my own experience; and perhaps my solution may be of use to you. I declined the commission offered in currency; required it to be put in the form of a check to my order; endorsed that check to the order of my employers; and presented it to them, leaving them, if they saw fit, to return it to me as a legitimate perquisite of my position. They did not see fit; and they were quite right. But the most important feature of my action was that the return of the check, thus endorsed by me in their favor, convinced the manufacturer of my honesty as no amount of high-toned oratory on my part could have done.

As expert advisers, you may be called to counsel either private clients, or the public at large, in courts of justice.

As advisers of clients, you will encounter little difficulty in deciding what professional honor requires of you. Yet, now and then, perplexing cases may arise. For instance, you are called upon to estimate the prospects and suggest the best method of exploration of a mineral property owned by your employer. He asks you, not how much money the property is worth, but whether, in your judgment, it is promising enough to warrant the expenditure of money upon it by the actual owner. You make an encouraging report, which he afterward publishes, in whole or in part, to aid the sale of the

Digitized by Google

property or of the stock of a company to which he has transferred it, at a price never considered by you, and beyond your estimate of its present value.

In view of such a possibility, you ought, in the first place, to put into a report of this class no vague, glittering prophecies of future profit, or paragraphs which could be used, without their context, to support sanguine speculative appeals. State clearly, at the beginning of such a report, its purpose and scope. If your employer should subsequently make such use of it as would involve you in propositions you never made or meant to make, protest promptly. Such a protest, to be effectual, should be reenforced by your own original and carefully guarded statement. Nevertheless, make it anyhow, and make it promptly, if you deem it worth making at all. Post-mortem disclaimers by experts, after the collapse of mining schemes with which their names have been fairly or unfairly connected, have very little effect. You can not be too careful to make your record absolutely plain, and to protect it by instant protest and exposure, against even the appearance or suspicion of connivance in delusion or deceit.

Again, you may have occasion to appear as expert witnesses in court. Such witnesses are called in cases involving patents, mining titles, the detection of poisons, the details of medical practice, or the value of professional services, etc.

Expert testimony has been, and is, the subject of endless controversy. It is often urged that experts should be appointed by the court, to give advice without favoring either party. This is, in fact, done in criminal cases, where analyses are made for poison; in cases of alleged lunacy, etc.; but I think experience has shown that in ordinary litigation, especially as to patents and mining titles under our laws, justice is best secured by allowing each party to present its own experts, requiring them to submit to cross-examination, and leaving the bench and the jury box to pass judgment upon the evidence. The difference between an expert and an ordinary witness is that the former is permitted to give his opinions, however reached, while the latter can give only facts of personal knowledge. The oath of an expert, therefore, binding him to tell "the truth, the whole truth, and nothing but the truth," covers the ordinary obligation as to facts, and also the obligation of the full and truthful statement of expert opinion. Yet there is no doubt that this opinion must be, to some extent, a partisan one. No party to a lawsuit will put an expert on the stand without knowing beforehand that his opinion will be favorable to the contention of his employer. Nor would any such expert be doing his duty, either to the court or to his employer, if he uttered an opinion so carelessly formed or loosely held that he could not vigorously defend it, or would run the least risk of changing it under cross-examination. The situation is often complicated, critical and exciting. The following suggestions may assist young experts to deal with it:

When such an engagement is offered to you, accept first a retainer for which you undertake to examine the case, form an opinion, and state it to your employer. In a mining case, two such preliminary investigations may be necessary: the first being based upon the *ex parte* case, submitted to you by one side, and the other upon your own personal examination of the facts. After the latter, state clearly to your client the opinion which you are prepared to maintain. If it does not support his contention, he will not wish to put you on the stand as a witness; but you are bound not to assist, either in that case, or (without his permission) in any other, involving the knowledge you have acquired in confidence from him, parties whose interests may be hostile to his.

If you take the stand as an expert, you ought to know already all the facts and authorities which bear upon your opinion. Whatever has been previously adduced in the pending case, you should, of course, have taken into account. What is produced which takes you by surprise, you should not meet with a rash denial or quibble. Your true and wise course is to declare that you are giving your deliberate and careful opinion upon all the facts known to you, and you can not hastily revise that opinion upon new evidence, which you can not, in a moment, test, sift and weigh.

Don't try to be smart or witty under cross-examination. Such an encounter is like a fencing-match in which you have your hands tied. For you are answering under oath, while the enquiries and insinuations of your antagonist are unrestrained. Maintain your opinion manfully; but do not even seem to be fighting for your client. Still better: do not fight at all, but assume throughout that the cross-examination attorney is honestly in quest of information, and give it to him with courteous generosity. If you thus give him no opening for insulting comment, he will probably not make any. If he should do so, do not try to protect yourself, but let your counsel, or the court, protect you. I have seen a witness get the better of a lawyer in repartee, and lose the case; and I have seen witnesses browbeaten and embarrassed by clever lawyers, but vindicated by the verdict of the jury, which could not be diverted by mere wit from its search for truth and justice.

If you are called upon to answer categorically, yes or no, a question ingeniously so framed as to involve through such an answer some misconstruction of your opinion, do not fence, dodge or quibble, as if you were afraid to meet the issue, but give at once the categorical answer demanded, and immediately ask the court to permit you to make an explanation. This is your right, and will be promptly granted, while your enemy gnashes his teeth.

It happens sometimes, in mining cases, that an expert, after the trial of a case in which he has testified, is obliged by later developments to change his opinion. For instance, in a certain lawsuit, it is a vital question whether a certain mining claim exhibits two lodes, or only one. You testify that there are clearly two. But deeper mining shows these two to have united, so that there is, as you are obliged to acknowledge, only one.

Such changes of scientific conclusions are common enough. We are all revising our old views upon new evidence. But permit me to urge upon you a rule of policy which is most important. If you have once advocated under oath, and for an expert's fee, a given opinion, do not announce your recantation of that opinion as a paid expert. Put it in a technical journal or book, if you like—but do not let yourself be caught in a situation where you have to explain it to a jury! If you ask me whether you have not a perfect right to announce anywhere an honest change of opinion, I reply that it is your duty not to do an honest thing in such a way as to incur a probable suspicion of dishonesty. You might honestly call upon me in Brooklyn as a stranger, and tell me that you had had your pocket picked of nearly all your money, and lacked forty-nine cents to get you back to South Bethlehem. But you had better foot it back to Bethlehem than bring me that story! Honest people have no right to act like impostors! And, to return to the instance I have given, if you have once appeared as the defender before judge or jury of an opinion which you have been subsequently obliged to abandon, make your new opinion known (if it be of sufficient importance) in some clearly disinterested way; but not

Digitized by Google

under circumstances which might cast suspicion upon your sincerity.

Is there no general formula by which a man may be guided in all such questions of casuistry? The Ten Commandments, the Golden Rule, are formulas which often prove difficult of application, or easy of evasion, in concrete cases. Let me suggest to you, for rough practical use, a maxim, apparently (though, I think, not really) framed on a lower plane.

"Do nothing that you can not tell."

If there be any doubt as to the matter, tell it anyhow to the parties affected by it. If there be no reason for telling it at the time, make a complete and unchallengeable record, for the possible future use of yourself, as well as of others. To forget circumstances may be equivalent in effect to hiding them. It is mortifying indeed to face the partial record of some old transaction which you know was all right, but can not now prove it so, because the stub of your check-book shows no particulars!

In these days especially, we are learning the folly of secrecy. On every side, eminent men, and (I make bold to say) really honorable men, are incurring disgrace by reason of acts hidden either from them or by them. Some of these acts they might be able to defend, but for the damning suspicion attached to the circumstance of concealment.

It may be—and to speak frankly, such is my personal opinion—that the present excited public feeling is in great danger of going too far in its hasty and indiscriminate condemnation of alleged evils. But that is not the question that I am now considering. My present deduction from the prevalent chaos of accusations is this: if many things, now represented, or misrepresented, to us as scandalous abuses, had been openly done from the beginning, how much more comfortable good men would be! And, on the other hand, how many things which could not have been done openly would never have been done at all!

Certain it is that men "love darkness rather than light," when "their deeds are evil." If you are not of such, why not walk always in the light?

At the joint meeting of the American Institute of Mining Engineers and the Iron and Steel Institute, commencing in London July 24, the following papers will be read:

"Belgian Practice in Large Gas Engines," by Professor H. Hubert (Liège); "Electric Steel Smelting," by E. C. Ibbotson; "German Practice in Large Gas Engines," by K. Reinhart (Dortmund), and "British Practice in Large Gas Engines," by T. Westgarth.

BOOK REVIEWS.

"The Practical Testing of Dynamos and Motors." Second edition, enlarged. Charles F. Smith. Manchester, England. Scientific Publishing Company. Cloth. 306 pages. 6 by 9 inches. Illustrated. Price, 5 shillings.

This manual for the electrical engineering laboratory describes the methods of conducting the tests usually carried out there. It gives the methods and the apparatus for making electrical measurements, of testing iron, and of conducting tests on direct-current dynamos and motors. It does not go into the analytical side of testing, but it does give excellent directions for conducting such tests. It leaves to the student, as is proper, the work of digesting his results and drawing his conclusions.

"American Street Railway Investments." 1906 edition. New York. McGraw Publishing Company. Cloth. 432 pages. 10 by 13¼ inches. Supplied by the ELECTRICAL REVIEW at $5.

The thirteenth annual edition of "American Street Railway Investments" covers 432 pages of statistical matter, an increase of seventeen pages over the edition of 1905. This increase is due partly to the addition of reports from new roads, partly to more complete statements from roads which have previously reported, and partly to the publication of a considerably greater number of maps of operating properties than have appeared in previous editions. Forty-nine maps are given, showing the systems of fifty-two separate companies. The same general arrangement of the reports has been adhered to, and the indexes are exceptionally complete.

"Steam Turbine Engineering." T. Stevens and H. M. Hobart. New York. The Macmillan Company. Cloth. 814 pages. 6½ by 9 inches. 516 illustrations. Supplied by the ELECTRICAL REVIEW at $6.50.

It has been the endeavor of the authors of this book to deal with the subject from the standpoint of the purchaser and user of steam turbines. The latter is only incidentally interested in the theory and design of the turbine, but he is doubly concerned in the question of its economy, not only as regards steam consumption, but also as regards first cost and maintenance. A vast amount of data has been compiled, which is presented in tabular form and in the shape of graphical figures relating to tests of a large number of turbines under various conditions. From these tests other results are deduced, representing standard conditions, which enable a comparison to be made of the different machines. The different types of turbines, as well as the different makes of turbines of the same type, are discussed in detail, special features of mechanical design in each case being pointed out. These machines include English, American and Continental makes. This is followed by a discussion of the performance of reciprocating engines, in order that a comparison may be made between these prime movers and the steam turbines. The effects of steam pressure, superheat and vacuum on the turbine performance are considered. This is followed by a discussion of the construction of the power plant, and descriptions are given here of a large number of modern installations. The book concludes with a discussion of the steam turbine as applied to marine practice. The authors have, undoubtedly, expended a large amount of time in compiling a great deal of useful information, and they have spared no pains to reduce this to such a form that the purchaser can avail himself of it. A minor feature of the book which may be criticized is the poor character of many of the illustrations. Photographic processes have been so developed that there is to-day no excuse for a blurred and indistinct illustration, and when a photograph of the device may be had for the asking there is still less excuse for rephotographing from a half-tone. This has been done in a number of instances in this particular work, which gives it a slovenly look. It may be said that it is not alone in erring in this way, for a number of English books have come to hand recently in which the same inexcusable practice has been followed. Perhaps in this case it is a little more offensive than usual.

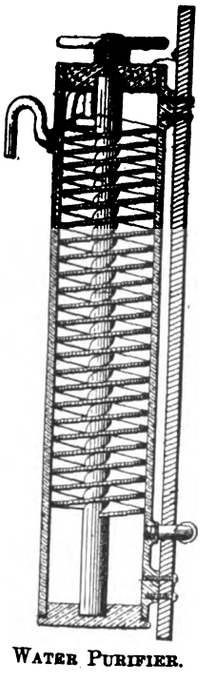
"Industrial Furnaces and Methods of Control." Emilio Damour. Translated from the French by A. L. J. Queneau. New York. *The Engineering and Mining Journal.* Cloth. 218 pages. 6½ by 9½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $4.

A preface to this work has been written by Professor Henry M. Howe, of Columbia University, who says: "Mr. Queneau has here laid the industrial world, and especially the metallurgical world, under great obligation for bringing together his own admirable translation of Damour's admirable work, and welcome chapters by himself and Dr. Bolles on the control and efficiency of heating operations through pyrometry and chemical analysis, and on the design of chimneys and regenerative gas furnaces." The work consists of a description of various types of furnaces; a theoretical study of recuperation; a discussion of pyrometry by Mr. Queneau, and a chapter on calorimetry by M. N. Bolles. Part III deals with the theory and design of chimneys.

Digitized by Google

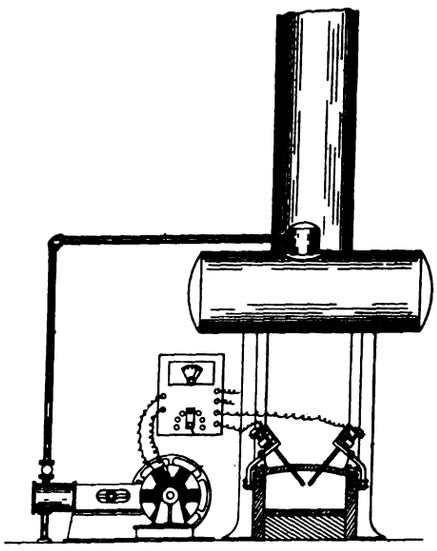
Electrical Patents.

Albert E. Dieterich, Washington, D. C., has obtained a patent (823,671, June 19) for an improved electric water purifier, which he has assigned to E. E. Sager and F. E. Holt. This invention relates to a certain new and useful improvement in electrical water purifiers in which water is purified by electrolytic action in the presence of aluminum electrodes. In its generic nature the invention includes a casing, a pair of aluminum electrodes held therein in the form of spiral screw and means for rotating this screw at times to eject the precipitate, and means for rendering the electrodes electrically charged. Primarily, the invention seeks to provide a device of this character of a very simple and effective construction, which can be easily and cheaply manufactured and in which the parts can be readily assembled, or detached from one another for purposes of repair or cleaning, and in which means are provided for ejecting the precipitate from the apparatus without removing the electrodes. The invention comprises an open-ended cylindrical casing, closure plugs for each end of the casing, the closure plugs being formed with bearing portions, a rod held in the bearing portions between the closure plugs, a pair of spiral electrodes held on the rod and in engagement with the walls of the casing to form spiral water passages from one end of the casing to the other, the casing extending beyond the electrodes, to form a collection chamber, a water inlet for the casing at one end thereof, and a water outlet for the casing at the other end thereof, a pair of contact-plates carried by one of the closure members, contact-brushes carried by the electrodes for engaging the contact-plates, and means for connecting the contact-plates with an electric circuit.



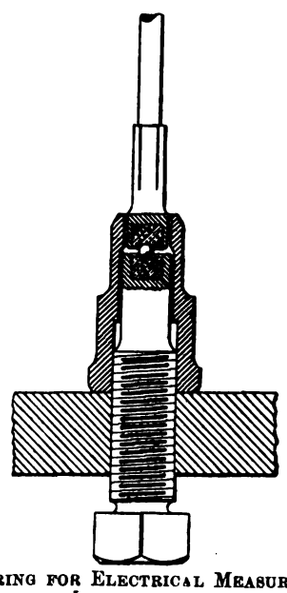
WATER PURIFIER.

Enrique A. Touceda, Albany, N. Y., has obtained a patent (823,560, June 19) for an improved art of metallurgy. The principal objects of this invention are to secure greater economy in time and fuel and to permit without increased fuel expense a wider range in the chemical composition of the material under treatment in the operation of metallurgical furnaces. The invention consists in the method of procedure, whereby heat of comparatively low intensity escaping from a metallurgical furnace is converted into electrically generated heat of comparatively high intensity and returned within the furnace. The invention is applicable in the use of various kinds of metallurgical furnace adapted for burning solid liquid or gaseous fuel, and it is particularly adapted for use in a non-regenerative reverbatory furnace in the process of preparing iron for malleable castings. To this end, the inventor places a steam boiler between the hearth chamber and the stack, so that it will be heated by the products of combustion passing from the former to the latter. Connected to this steam boiler is an engine, which drives the dynamo, and the current generated by the latter is employed for forming an electric arc adjacent to the hearth within the furnace, thereby producing an additional heat.



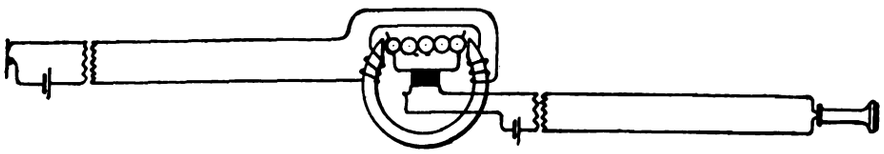
METALLURGICAL FURNACE.

An improved bearing for electrical measuring instruments has been invented by Walter Ehmsen McCoy, of New York (824,194, June 26, 1906), and he has assigned the same to Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. The invention relates to electrical measuring instruments, particularly those of the integrating or registering type, and it has for its object to provide effective and durable bearings for the spindles of the rotating members of such instruments. The invention consists of a bearing for an electrical measuring instrument shaft or spindle comprising an adjustable stud provided with a jewel having a concave bearing surface of single uniform curvature, a jewel mounted in the end of the shaft or spindle and having a concave bearing surface of single, uniform curvature and a polished steel ball interposed between the bearing surfaces and having a radius of curvature that is less than that of the bearing surfaces.



BEARING FOR ELECTRICAL MEASURING INSTRUMENTS.

Edward E. Clement, Washington, D. C., has obtained a patent (823,763, June 19) for an improved telephone relay. This invention relates to telephone relays wherein a translating device included in one circuit in which current is being periodically varied to correspond to sound undulations reacts upon a second translating device to reproduce variations in a second and independent circuit. The object is to eliminate what is known as the "time constant," or, at least, to so reduce it as to permit of the production of electrical undulations in the second circuit corresponding to the original sound waves without appreciable distortion.



TELEPHONE RELAY.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Power Gas Transmission.

In this section of a series of articles on gas-producer plants and gas engines, C. A. Smith discusses the dangers incident to the use of gas, the thermal values of the various kinds of gas, and the economy which may be obtained. In pointing out some of the possibilities of power gas he says that it is especially in transmission work that the great future of a cheap producer gas lies. It will even be found superior to electricity for transmission purposes. It has only been recently that the centralized generation of power has been considered. Until such a method of transmitting or distributing it was discovered it was useless to consider method of transmitting or distributing it application of electricity has completely altered the whole question, and has been the main factor in bringing about the development of large power schemes and the great reduction in the price paid for power in most districts. More recently, a great impetus has been given by the invention of what is popularly called producer gas. Of recent years a good deal has been said about generating electricity at the mine and transmitting it to various industrial centres, but it will be considerably cheaper to manufacture producer gas at the same point and transmit it through pipes to the industrial centres, there to be used for driving engines for generating electricity and also for heating purposes and furnace work. The questions of the distribution and transmission of power must not be confused. For the former it is agreed that there is no agent to compare with electricity. For the latter it is suggested that it is more economical to employ producer gas and pipe than electricity and cables.—*Abstracted from the Engineering Times (London), June 21.*

Electrical Measurements of Very Short Time Intervals.

In physical researches the duration of time intervals is usually determined by means of a moving body. This may be a body which is allowed to fall, an oscillating pendulum or any form of chronoscope. Such devices involve in their use errors which are difficult to estimate and hard to avoid. A simple method of measuring such short time intervals is described here by M. Devaux-Charbonnel. It depends upon the fact that certain electrical quantities involve the fundamental physical dimensions, one of these being the unit of time. This quantity frequently occurs in a simple expression, such, for example, as that for the discharge of a condenser closed on a resistance. By determining the difference in the charges on a condenser at different times, the time interval which has elapsed can be computed if the constants of the discharge or charge circuits are known. A simple method of doing this is to connect the condenser in parallel with a known resistance, and across both apply a known potential. A steady current will then flow across the resistance, and the condenser will take in a known charge. If, then, a falling body actuates successively two switches, one of which opens the charging circuit, leaving the condenser to discharge through the resistance in parallel with it, and the second closes the condenser in circuit with a ballistic galvanometer, through which it will discharge quickly, the throw of the galvanometer will determine the quantity of electricity discharged by the condenser. The difference between this and the charge which it originally held is the quantity which has flowed through the resistance during the time intervening between the operation of the two switches. As all the electrical quantities entering into this determination can be measured accurately, this time can be computed with corresponding accuracy. The method may, of course, be applied in a number of ways for other purposes.—*Translated and abstracted from L'Électricien (Paris), June 23.*

Electric Power on the Great Western Railway, England.

Although a number of the railroads running into London have been equipping their suburban systems with electric cars, they have not yet all fully realized the advantages of the change, because it has been necessary to run in between electric trains, trains hauled by steam locomotives. Thus, although the change in motive power made a higher schedule speed and a more frequent service possible, the presence of the steam locomotives prevents this being realized. Of these roads, the Great Western is probably furthest along in its change. On this road the work of fitting up for electric traction on the suburban lines has been completed, and the steam trains removed, so that at last it will be possible to obtain the improved train service on the Circle. The power station for this company is at Park Royal, and is equipped with eight 750-kilowatt, three-phase generators, each driven by a triple-expansion engine running at 250 revolutions per minute. There is, in addition, a storage battery charged by means of motor-driven boosters, and an auxiliary plant of two 150-kilowatt, 660-volt, three-phase generators, the power from which is used for driving auxiliary machinery in the plant. Steam at 200 pounds pressure per square inch and 150 degrees Fahrenheit superheat is supplied from water-tube boilers. The steam pipe is of solid drawn steel tubing, arranged on the ring system in the engine room, and in duplicate in the boiler room. The main generators deliver current at 6,600 volts, fifty cycles per second, which is transmitted by three-core, paper-insulated, lead-covered and armored cables laid underground on the solid system. Power is transmitted to three substations, the furthest being five miles from the generating station. At these points the current is transformed by means of motor-generators to 630 volts, direct-current, at which pressure it is supplied to the third rail. There are eleven distributing centres where 6,600-volt current is transformed down to 110 and 220 volts for lighting purposes. At each of these centres there are two sets of three transformers, each set being capable of handling the maximum load. Current is supplied to and taken from the train by means of two conducting wires. The positive conductor is placed on one side, sixteen inches from the running rail and three inches higher. The negative rail is placed on the other side, twenty-eight and one-half inches from the running rail and one and one-half inches above it. These rails are of channel shape, and supported on cast-iron caps cemented into porcelain insulators attached by iron clips to the ties. The rails are not fastened to the insulators, but are free to move, so that the latter will not be broken by the strains due to the motion of the ties as a train passes. The conductor rails weigh 102.8 pounds per yard, and have a conductivity equal to fifteen, with copper taken as 100. They are divided into sections of approximately the same length as the distance between stations. — *Abstracted from Engineering (London), June 15.*

Digitized by Google

The Relative Proportion of Radium and Uranium in Radioactive Materials.

Some time ago Messrs. E. Rutherford and B. B. Boltwood gave an account of measurements which had been made to determine the amount of radium present per gramme of uranium in natural minerals. Previous experiments had shown that the amount of radium in a mineral was always proportional to its content of uranium, and it was pointed out that the weight of radium present per gramme of uranium was a constant of considerable practical and theoretical importance. The method adopted for the investigation depended on the preparation of a standard solution of radium bromide, and the amount of radium emanation formed in it was compared with that formed in a radioactive material containing a known quantity of uranium. Since the electrical comparison of the various amounts of radium emanation can be made with considerable precision, the accuracy of the results was mainly dependent on the exactness with which the solution of radium taken as a standard had been prepared. This standard solution was prepared by Rutherford and Eve, the material used being taken from some stock crystals whose heat constant was known. The result of the experiment was that the amount of radium corresponding to one gramme of uranium in a material should be 7.4×10^{-7} grammes. Recently, however, some experiments made by Eve indicated that the solution used for the above determination was in some way defective, and that the quantity of radium actually in solution was less than had been assumed to be present. It was found that a considerable portion of the radium had been deposited on the surface of the glass vessel in which the solution had been preserved. A new standard solution has since been prepared with the greatest care, using in this case as the solvent dilute hydrochloric acid. The previous standard had been prepared with pure water. The new solution was boiled vigorously, and then allowed to stand for exactly four days, at which time the emanation which had accumulated was removed and transferred to an electroscope, and its activity measured. From these measurements it has been calculated that the quantity of radium associated with one gramme of uranium in a radioactive material is equal to approximately 3.8×10^{-7} grammes. The new value is about one-half of the old. It follows from this figure that a ton of sixty per cent uranium ore will carry about 0.2 gramme of radium, or 0.35 gramme of radium bromide. These numbers are more nearly in accord with the quantities of radium extracted from the ores in actual practice than were the previous figures.—*Abstracted from the American Journal of Science (New Haven), July.*

The Magnetic Survey of the North Pacific Ocean.

Some preliminary results are given here by Dr. L. A. Bauer of the magnetic survey of the Pacific ocean which is being carried out by means of funds supplied by the Carnegie Institution, of Washington, D. C. The author first dwells upon the necessity for this survey, pointing out that, except for the voyage of the British vessel, Challenger, this, the largest of the oceans, is practically a blank as regards our magnetic knowledge. All information known regarding it, except that mentioned, has been derived from observations made on or near the coast. Attention is further called to the fact that our magnetic charts are, in general, no better to-day than they were in 1845, for, although many magnetic surveys have been made, the charts are still completed by referring to old observations. The vessel selected for this survey was the brig, Galilee. She was altered somewhat to make her more suitable for the work, all the steel rigging being removed and replaced with Manila rope. A wooden bridge was erected fifteen feet above the deck, thus placing it twenty-five feet above all large bolts—far enough away to reduce the disturbance the latter might cause to a very small amount. The vessel is not entirely non-magnetic, but, from tests, it was found that the deviations caused by her were less than with any other vessel used for such surveys. She is 132.4 feet long and has a displacement of 600 tons. The first cruise was made in December last, observations being taken at various places on the shores around San Francisco. In this way the most suitable place for swinging the ship was determined. During this work the vessel was swung by a tug, but after putting out to sea she was swung under sail. On account of the delay caused by this method of working, a naphtha launch was added to her equipment later. After the first trip to San Diego the Galilee left for the Hawaiian Islands and made several complete circuits, covering a distance of over 10,000 nautical miles. It was found that the instruments with which she was provided could be used at sea with considerable accuracy, the greatest trouble being due to fogs, which made it difficult to take declination observations. Descriptions are given of the instruments employed in the survey and of the methods of using them. The general conclusions resulting from the work so far accomplished are that on a vessel like the Galilee, with the small deviation coefficients encountered at the positions of the various instruments, the measurements need not be much inferior to those made on land. The dip of the needle can be determined within five minutes of the absolute value, and the horizontal component of the earth's magnetic force to about one part in 500. In a moderately rough sea the average results are not so accurate, but are still satisfactory. The data obtained are compared with the British Admiralty and the German Admiralty charts. They show that the British chart is, on the average, more correct than the German, though both charts show values too small for the eastern declination. The latest charts for lines of equal horizontal intensity give uniformly too high values, on an average about one part in twenty-five.—*Abstracted from Terrestrial Magnetism and Atmospheric Electricity (Baltimore), June.*

Underground Telegraph Wires in England.

A letter written recently by the British postmaster to the Association of Chambers of Commerce deals in the following way with the work of laying all telegraph trunk lines underground. Up to the present time the underground line between London and Glasgow has been completed. The spur line to Manchester has been continued through Bradford to Leeds, and, in the south, an underground line has been laid from London eastward as far as Chatham and westward as far as Slough. Thence a pipe has been carried as far as Reading, though the cable has not yet been placed. During the present year it is hoped that this pipe line will be extended to Bristol, and that the cable will be carried as far as Chippenham. The department is carrying on the work of laying the wires underground as rapidly as possible, and has in contemplation extending this underground system of cables to the landing places of important Atlantic and Mediterranean cables throughout Great Britain.

Train Service via Simplon Tunnel.

As a consequence of the opening of the Simplon tunnel in May, a train *de luxe* is now run tri-weekly between England and Italy *via* Calais, Paris, Lausanne and Milan. Two day and two night express trains are also to be run between Paris and Milan through the tunnel.

Digitized by Google

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

ORGANIZATION AND CONDUCT OF A NEW BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.

BY M. S. SEELMAN, JR.[1]

(Concluded.)

Here is a point that should be borne in mind: Never send out a piece of advertising matter without enclosing a return post card. A fundamental law of political economy is that man is a lazy animal and you want to make the path to your front door as easy and smooth as possible. Each different branch of the business should have its distinctive return post card, so if you send out a lighting circular you enclose a lighting post card; a sign circular, a sign post card, and the same with power, fans, heating and refrigeration, if you go that far. Don't make it a postal card; that is expensive; but an attractively printed post card with your address and place for one cent stamp on one side and on the other a printed form referring to the matter in hand and space for the name and address of the sender. I have experimented as to the relative advertising value of the penny United States postal card and the plain post card for this return work, and find that while the cost is as six to one the latter is nearly as effective as the former. This return post card method gives you a fair chance to estimate the interest your advertising is arousing and leads, if the advertising is right and other things being equal, to a continuous and often surprisingly large amount of new business.

The system of doing the bulk of your advertising by mail distribution of circulars, booklets, etc., rather than through the newspapers is the best because you reach, if your campaign is rightly conducted, just the people you wish to reach and with the least waste of expensive publicity. Your list of prospects is a good list to work on and that can be supplemented by special lists for special purposes, as for instance, a sign list composed of present store customers and stores not yet using the service, but whom you hope some day to secure. Your sign proposition may be the entering wedge.

[1]Winner of the $500 prize given by the Cooperative Electrical Development Association, Cleveland, Ohio.

And this brings us now to another very important feature of and factor in a new business campaign, and that is the special propositions.

And right here I want to say that if you want to get a big share of new business, you have got to be liberal, you have got to go half way to meet the customer, you have got to be willing to spend a dollar to make two.

A good many companies are ready to make extensions, even in cases where it takes quite some time to get back the original investment, not to mention a profit, yet they turn away haughtily from the proposition to supply a customer with some equipment which in a far shorter period pays for itself and gives a handsome return on the money invested.

There's the free sign proposition for instance; it has proven "good business" everywhere it has been tried, so far as I know. A panel sign costs you complete about $45; with overhead construction, customary in the city of 50,000 or less, to hang and connect the sign ought not to cost more than $25. Here's an investment of $70. Take 200 per cent of your investment—$140—divide it in twenty-four parts and offer your customers free signs on a two-years' guarantee of $6 a month. You are sure to get back the cost of the sign and installation well within the two years, even if the customer's current bills do not run above the guarantee (which is unlikely). As a matter of fact you usually get back the actual cost, including the proportion of operating expense, within the first year and all the rest above percentage of operating work is "velvet," especially as in fully ninety-five per cent of cases the customer keeps on using the sign far beyond the two years of his contract. Not only this, but each sign you thus erect is a good advertisement for you and helps bring another, besides being, as aforesaid, in many cases an opening wedge for other business with the customer, and you retain title to the sign; so that in case of the worst your loss must be small, as the sign with slight changes can usually be utilized for some other customer.

With individual letter signs the return of the investment with profit is even more rapid than with the panel sign because they use more current in proportion to their cost to you. When giving an expensive sign, however, care must be exercised as to the financial responsibility of the recipient.

Still another advantage of the electric sign proposition is that it leads the merchant to realize the advertising value of electric light, so that he not only burns his sign at night, but is likely to get in the habit of keeping his windows illuminated some hours after closing, and this again leads others to do the same. Such night lighting has a far-reaching effect in creating new business for the entire town, increasing the activity and energy of its life and materially assisting in its development.

The sign is a good advertisement to the customer too and economical as well. Suppose it costs him $10 a month for lighting it. How much newspaper advertising could he buy for that amount? How many circulars can he print and distribute? Why, it would cost him that much to buy a thousand postal cards without the charge for printing and addressing them, while his sign, for $10, is brightly visible for three or four hours every night to every one who passes the store, giving it a distinctive character and "burning his name into the public mind."

The town in which this free sign proposition will not "take," if it is properly advertised and pushed by the new business organization, must be dead indeed.

Then there are the special lamp propositions. There are doubtless many stores in the city in which we are hustling for new business, that are illuminated by the gas arcs or Welsbachs, which we find it impossible to touch with the ordinary standard incandescent lamp proposition. Here is where the Nernst lamp comes in, also the high-efficiency and meridian lamps. Each has its place. The Nernst is an attractive proposition to a customer, especially a lamp about three-glower size. It is highly attractive, even decorative, in appearance, gives a beautiful pearly white light and is in every way far superior to any gas lamp, being at the same time so efficient in wattage as to permit of free competition with gas. And from the station's standpoint it is not nearly so expensive of maintenance as—from some reports—we might be led to believe. If our

Digitized by Google

friends who are out after new business will supply these lamps free with free glower renewals, even with free wiring and installation for outside lamps, they will find this proposition a potent factor in securing new and profitable customers, and the stores where you install the lamps outside will most likely soon install them inside at their own expense. The meridian and high-efficiency lamps can also be worked in the same way, either in direct-current districts or on overhead circuits, where the customer, having his choice, may select one of these types as preferable. The new decorative and highly efficient "arc" clusters that have recently been placed upon the market may be utilized to advantage where the customer is disposed to complain of the arc lamp, at arc lamp cost of operation. They give adequate illumination of fine quality at a very low cost. With these, as with signs and other lamps, don't be afraid to go half way to meet your customer.

A method of getting one class of new business which has worked well in at least one large city, but which might or might not be applicable to the city of 50,000 or less, can be utilized with the drug stores.

Here hours of burning are long and the average drug store may not be able to afford the average rate for the average installation. Still you can not cut rates for him and be consistent. Get up an attractive advertising bulletin stand of wood and iron that will cost you about $15, with a frame in the top portion for a placard and beneath this pockets for bulletins and other advertising matter. Then make an arrangement with the druggist now using gas that in consideration of his permitting you to keep your advertising stand in a prominent place in his store you will pay him a sum, which subtracted from the bills at regular rates for lighting his store by electricity will make such illumination economical for him. The placards, bulletins, circulars, etc., are changed once a month. It is good advertising for the central station too, because as a rule the right kind of people deal in drug stores and while awaiting the compounding of prescriptions have time to read your advertising, which is placed where they can not help but see it.

One way to get at a gas-illuminated store is to offer to draw, gratis, plans for the electric illumination of the store which will provide a lighting far superior to gas, adding materially to the attractiveness of the establishment at a price little, if any, heavier than the storekeeper has been paying for an inferior illuminant. This can be done by selecting the right kind of lamps and glassware and arranging them to advantage. One of your canvassers could easily be educated to do this class of work. Once the plans are drawn, the storekeeper is very apt to become sufficiently interested to wire up and sign a contract.

Now as to residences and new buildings. In the average town of 50,000 there will be found about six architects, in the town of 25,000, three. One of the first acts our new general agent must do is to set himself to get acquainted with these architects, not alone in a business way, but, if possible, socially, so that a feeling of friendliness may spring up between them. Let him join their clubs, take them out to dinner, etc. After this "entente cordiale" has been established, our general agent is in a position to know from the start what is taking place in the line of erecting new structures and he is less likely to be called upon to continually fight the installation of isolated plants. Get the architects on your side.

Then, of course, the building permits must be followed up closely. Let no guilty man escape. Every new building must be wired, and the way to do this is to see the builder the day his permit is issued (before, if possible) and to follow him right up until the business is done. The same with permits for alterations. When the owner is about to make alterations in his home or store, that is the psychological moment to approach him about installing an electric illumination on the premises. These are new business pointers that can not be neglected.

A far stiffer proposition than the new residence is the unwired old one, and yet there are doubtless hundreds of these—even in a city of 50,000—which if wired would yield a fair and certain revenue. How to get them wired is the problem. Your advertising helps by bringing the householder to a realization of the many advantages and conveniences of an electric service. Then it is a good plan for your canvasser to call in the daytime, get the "lady of the house" on his side and then make an appointment for evening after supper, when the householder is likely to be in the right frame of mind and the canvasser can meet wife (already predisposed in his favor) and husband together. May and June are especially good months to canvass residences in, because families who are out of town in July and August can arrange to have the wiring done in their absence, saving them some inconvenience.

But there are householders who would like to have an electric illumination who do not feel that they can afford to pay out the cost of wiring in a lump sum. If these be reputable citizens let the company help them out by financing the deal, the money to be repaid within a year in monthly instalments. If this wiring would cost $200 to $250 and that is more than the householder wants to spend, suggest to him that he wire his living rooms—dining room, kitchen, cellar, back parlor, parlor and lower halls, which can be done within $100, including fixtures.

The above refers to cases where the tenant is also the owner. Where he is not the owner the difficulties multiply. Here is a plan or scheme that might prove efficacious under the latter circumstance and is worth while trying where neither landlord nor tenant is willing to pay the complete cost of wiring. Approach the tenant and tell him that you can appreciate the fact that he is unwilling to spend from $100 to $250 in improving somebody else's property, but that it certainly is worth something to him and his family to enjoy the comforts, conveniences and elegancies of an electric service. Then make this proposition to him: if he will see his landlord and get the landlord to pay one-third the cost of wiring, and he (the tenant) will pay another third, the company will pay the remaining third of the bill. This ought to be an attractive and paying proposition for landlord, tenant and company.

You can secure residence lighting, also, planning on paper an appropriate illumination for some particular home and interesting the resident in these plans. It is a case of being alive and hustling.

In pushing electric heating and cooking devices some companies have acted in cooperation with the department stores. From personal experience, I should say it is better for us to go it alone and let the department store do the same. Our standpoints and purposes are widely different. The store sells the appliance for the profit in the sale and the profit must be a large one, for sales are necessarily limited in number. The central station's object is not to make a profit on the sale, but to get the appliance on the system where it will use current. For a General Electric six-pound iron, for instance, the store charges $4; the iron cost the central station about $2.85 and the latter is glad to sell it for $3 if an arrangement with the store does not tie its hands; and you can sell four irons at $3 to one iron at $4.

The method which has been most successful in placing irons is to send them out on trial, putting one in every house equipped for an electric service. In the

Digitized by Google

city of 50,000 or less, I would advise either using one of your canvassers for this purpose throughout the city, or else making each canvasser take care of his own district in this respect. Load the irons in an auto, and when leaving each iron for a trial of from thirty days to three months, have the canvasser give a little selling talk and leave a neat circular calling attention to its many advantages. Also let him leave a postal card addressed to the company, explaining that it is possible, though not probable, in first using the iron that some trifling trouble may be experienced, in which case, tell the customer not to condemn the iron but to send the postal card, when the company's representative will call and straighten out the kinks. The iron is all right and if followed up in this way is bound to prove a boon to the housewife and a source of revenue to the company.

As a matter of fact, these irons could be given away with profit by the central station. They cost, say, $3, and bring in a revenue, which begins the minute they are placed on the system, of about $1 a month. In three months the first outlay is returned, in six months the iron is completely paid for out of the profits, and becomes from that time a constant agent of profitable income. And it is day load, too. In those cities where you may fail in securing the $3 for the irons—give them away.

Other heating and cooking devices are not so valuable to the central station as the iron, but they all have their place in popularizing current. You have your display of them in your showroom. Get up a "demonstration." Hire an attractive young lady to do the cooking and send out invitations to your customers. Give them something dainty to eat and a small souvenir of the occasion. Have your advertising and your men follow this up and you will sell a sufficient number of appliances to make it pay.

The use of electric fans can be increased by judicious advertising and canvassing; and if you are not afraid of complications with contractors and supply dealers, by selling them at a low figure—a price approximately cost. If you have considerable surplus supply, rent them out for the summer months.

I have purposely kept the subject of increasing the power business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and at the same time ordinarily the most difficult to secure.

First of all, let me say that while it is possible to secure lighting business at a higher price than is paid for other illuminants, because of superiority and also because average installations are of such size that isolated generating plants are impracticable, to get any large slice of new power business, your price has got to be right, for even if you can go into a factory and demonstrate how by cutting out friction load you can largely reduce the energy required to turn the wheels, if your rate for current is too high there is nothing to prevent the mill owner from taking advantage of your trip, eliminating much belting and shafts, installing motors and putting in his own dynamo.

Power business is such good business that special effort to get it is well worth while. If within the limits of possibility make your rate right to begin with.

It is more difficult to secure a good power canvasser than the other kind. If your general agent is enough of a technician and sufficiently familiar with power problems to handle this end of the business, that is a tremendous help. If not, and there is much power business in your town, then, in addition to your other canvassers, you will have to hire a power expert.

The way to get power business is to get it. There must be energy, enterprise and indomitable tenacity on the part of your power man, backed up, on the part of the company, by a readiness to help and a willingness to be liberal. I know a general agent, who is also a power man in a manufacturing city of 25,000 inhabitants, who has got a big load of new power business for his company by use of the qualities I have mentioned. He goes into a factory, indicates, at the company's expense, the engines in use, figures out the energy saving he can effect by the use of motors, installed to the best advantage, finds out what its coal and water cost the factory, and has been enabled more than once to go in and win on a guarantee not to exceed for expense of operation these coal and water charges, getting eventually from four to six cents for the current. If the factory owners balk at the expense of motors, he offers to buy them and receive payment in instalments. If installation is going to interfere with the needed operation of machinery, he agrees to install the motors at night, on Sundays and holidays. That man has got ginger, and he does the business. He is now running not so very far away from that ideal condition where peak is nearly uniform for at least twelve hours per day. This man's example is a good one to follow.

There is one matter that your general agent and canvassers must not lose sight of. In the natural desire for new business, do not overlook or neglect old business.

As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The customer ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is of the utmost importance in more ways than one, retaining his good will. If the customer has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. Actually the old customers ought to constitute one of the most fruitful fields for new business. Don't neglect them.

The organization for getting new business outlined in the foregoing has the advantage of being elastic. If you require fewer canvassers than you at first figured upon, it is easy enough to lop them off; if you need more, to get them. I believe that if the ideas and plans of action suggested or described in this paper are followed with a reasonable degree of faithfulness and a proper adaptation to the peculiarities and exigencies of the particular central station making the trial, the result will be such a large volume of new business that, besides more canvassers within a year, you will require three additional members of your commercial staff, as follows:

A man to take hold of contracts as soon as they are signed and follow them up until connection is accomplished.

A secretary or assistant to the general agent, who shall attend to the mass of correspondence, and fulfil the office function of the general agent while he is engaged on the outside on new business propositions.

A record and filing clerk to handle the reports of canvassers, make out orders, and assume systematic charge of the papers and records of the department.

Erratum.—In the preceding section of this article, page twenty-seven, second column, six lines from the bottom, the clause reading "at other times using advertisement each week in dailies," should read "at other times using advertisement each week in weekly papers and about three times a week in dailies."

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

New Hubbell Candelabra Socket.

The accompanying illustration shows the new candelabra socket manufactured by Harvey Hubbell, Incorporated, Bridgeport, Ct. No switch arm is needed when this socket is used. The standard length of chain on each socket is three inches. The sockets may be furnished, however, with chains of any length to suit requirements. This socket is very carefully constructed, having in mind the strains which are put upon the shell and the contact mechanism by reason of the pull on the cord. There is ample space between the contacts, the insulation has been very carefully worked out, and the socket is built rigidly and makes a very handsome appearance.

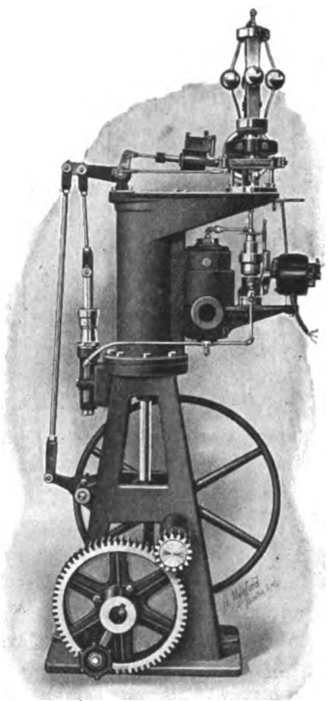
NEW CANDELABRA SOCKET.

A New Water-Wheel Governor

The speed regulation obtainable with the relay valve form of control, and the popularity of the type N vertical governor for water-wheel plants has led the Lombard Governor Company, of Ashland, Mass., to design a class of vertical governors having the same relay valve mechanism as the type N, differing from that machine principally in the relative position of the terminal shaft and main hydraulic cylinder.

These new governors are designated Type Q, the accompanying illustration showing the general appearance of the governor. At the present time they are made in two standard sizes, Q-6 developing 6,700 foot-pounds and Q-7½, 10,000 foot-pounds, being so much smaller than the Type N, which has a capacity of 31,000 foot-pounds, it is found desirable to put the terminal shaft near the ground with the power cylinder above. Maximum stability is thus obtained, while the controlling mechanism is brought to the most convenient height.

In Type Q governors, the hydraulic cylinder is cast of hard dense iron in one piece with the valve chamber and the support for the centrifugal balls. The base frame has the shaft bearings cast integral, so that the heavy stresses which are transmitted can not possibly cause displacement of any parts. The piston rod is drawn steel, the rack is forged and cut from open-hearth steel and the rack gear is cut from a solid steel bar. The terminal shaft is ground and has the rack gear shrunk on by heat. All relay and regulating valves have renewable parts of hardened steel. The centrifugal and anti-racing mechanisms are of standard form, with latest improvements. The hand-wheel device is also of regular design, having a simple disconnecting clutch for the terminal shaft.



TYPE Q VERTICAL WATER-WHEEL GOVERNOR.

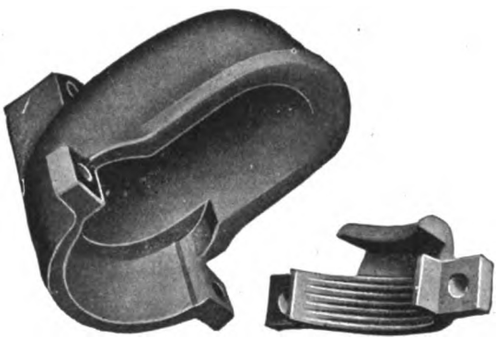
The sensitiveness of the governor may be increased or diminished at will, while it is in operation, by moving the micrometer cap of the regulating valve. The maximum speed of motion of the turbine gates may be varied through a wide range by the relay valve adjustment.

When safety permits, the Type Q governor may be adjusted to completely open or close the turbine gates within one second. Much slower action is easily obtainable; but it should be generally known that where hydraulic conditions permit, the speed regulation will be better in proportion as the governor moves quicker.

Type Q governors are provided with independent oil pumps of simple and reliable construction. These have cup-leather pistons which are very durable and may be renewed at slight expense. The valves and seats are of hardened steel. The tanks which are furnished are vertical and made of drawn steel. They are compound, containing a vacuum compartment above and a space for pressure below. Each governor has one of these tanks.

The "G. V." Pipe Cap.

The accompanying illustration shows the "G. V." pipe cap, manufactured by Gillette, Vibber & Company, New London, Ct. This cap is adaptable for covering the outdoor end of service pipe carrying any number of electrical wires. The caps are carried in stock from one-half to three inches, and may be used with either threaded or plain pipes. They are heavily galvanized to prevent corrosion, and are easily adapted to every condition.



"G. V." PIPE CAP.

Effect of Load-Factor on Fuel Consumption of Diesel Engines.

The curves on the accompanying diagram were plotted from data obtained from Diesel oil engine plants in regular operation covering a period of some months. They are of interest as showing the manner in which the fuel consumption (and therefore the cost of power) varies in remarkably close relation to the load-factor.

One characteristic of the ideal engine would be to have the cost per brake-horse-power-hour constant at all loads. If this

Digitized by Google

could be obtained the curve plotted from the data would be a horizontal, straight line.

In the combustion engine in which gas or vaporized oil is mixed with air and the mixture compressed and exploded, economy depends on a correct proportioning of the gas used with the air and the uniform compression of the mixture. The

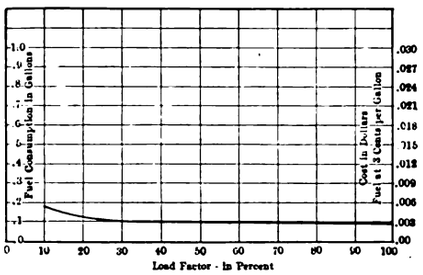


FIG. 1.—EFFECT OF LOAD-FACTORS ON DIESEL ENGINE ECONOMIZER.

allowable range of these proportions is very small for a given gas or oil. Should too much gas be admitted there will be insufficient oxygen present to support complete combustion and unburned gases will be exhausted and carbon deposited. If, on the other hand, too little gas is admitted the mixture will cease to be inflammable. And again, if governing be effected by varying the quantity of the mixture the compression will vary considerably, with great variation and loss of economy on light loads. It is evident, then, that a considerable increase in fuel consumption per horse-power-hour will be noted as the load-factor is decreased in combustion engines which govern by varying either the quality or quantity of the mixture.

The Diesel oil engine operates on principles which make possible the economy revealed by the fuel consumption and load-factor curve shown in Fig. 1. It operates on the four-stroke cycle principle, having one motor, or impulse, stroke in every four. Its cycle differs from the Otto, or common gas engine cycle, in that on the first, or admission, stroke the piston draws in a full cylinder of pure air instead of air and gas or vaporized oil. During the second stroke this pure air is compressed to such a high point that the temperature, due to compression, is sufficient to ignite any liquid fuel injected into it. This does away with all igniter systems.

At the end of the second stroke a charge of crude or fuel oil, distillates or even water-gas tar in a finely atomized state is injected into the intensely heated air, by a jet of highly compressed air from an auxiliary reservoir. The third, or power, stroke is taken up with the gradual burning of the fuel as fast as it enters the combustion chamber, and the expansion of the burned gases; while the fourth, or exhaust, stroke scavenges the cylinder.

The governor does not act to control the quality or quantity of a mixture, but acts on the oil pump of each cylinder, regulating the amount of oil injected into the cylinder at each power stroke. The supply of oxygen, even on full load, is more than sufficient to ensure complete combustion, thus preventing any loss of unburned fuel and the deposit of carbon on the cylinder or piston.

It will be noticed by reference to the curves that the fuel consumption and cost per horse-power-hour is low at full load, with a slight increase as the load-factor decreases. The curve not having any practical significance below a load-factor of about ten per cent, it was not extended beyond this point. The explanation of this economy may be found by reference to Fig. 2, which is a typical indicator card taken from a Diesel engine.

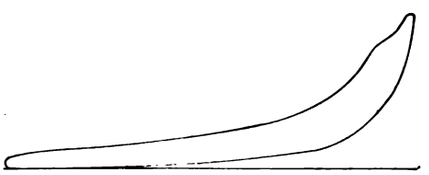


FIG. 2.—TYPICAL INDICATOR FOR DIESEL ENGINE.

It will be noted that the card resembles closely the ideal Carnot cycle. The compression starts on an isothermal—a line of constant temperature—following an adiabatic (a line of no transmission or reception of heat) at the higher pressures. What corresponds to the admission line of a steam engine is seen to be horizontal or slightly falling with no increase in pressure or temperature. It is therefore practically an isothermal. The expansion of the gases then follows, without addition of heat, in an almost perfect adiabatic. Thus virtually all the work stored in compression is given out on the power stroke with a minimum loss of heat to the cylinder walls and a minimum of internal friction.

As to speed regulations the Diesel engine is excellent, as the pistons receive no sudden impulses, back-firing is impossible, and the three cranks acting at angles of 120 degrees with each other maintain a constant torque on the crankshaft. It may be of interest to note that in several recent large installations Diesel oil engines are running alternators in parallel.

These engines are made by the American Diesel Engine Company, Indianapolis, Ind.

Yale & Towne Portable Electric Hoists.

Probably in no direction in the work of handling material has greater progress been made than in the design and construction of mechanical apparatus for eliminating large forces of laborers in transporting material from place to place. Particularly in warehouses and on wharves the portable electric hoist has achieved a remarkable development. The substitution of power for hand work is productive of very great economy, and because of the moderate investment of capital required, the low cost of operating and the facility for adaptation to existing conditions, the electric hoist is rapidly gaining in popularity.

When used in conjunction with a trolley, and on a system of tracks and switches, the uses to which the electric hoist may be put are almost numberless. The trolleys may be moved by pulling on the load, or where the load is considerable, the trolley can be furnished with gearing actuated by a hand chain. For longer distances the motor-driven trolley effects as great economy in horizontal transportation as does the electric hoist in vertical. An electric hoist equipped with a motor-driven trolley running on a system of tracks and switches, and with or without a simple cage for the operator, can be used to advantage in many places. As costly machinery and the lives of operators frequently depend upon the integrity of a hoist, the utmost care should be used in

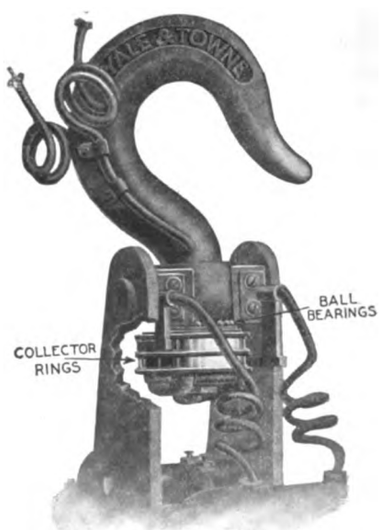


FIG. 1.—SWIVEL FOR ELECTRIC HOIST.

designing it. With the Yale & Towne electric hoist, attention has been given to every part of the apparatus to ensure proper distribution of strains. Tensile

Digitized by Google

strains on cast metal have been carefully avoided.

All parts are made to gauge, thus securing complete interchangeability, and all electrical parts are tested to 2,200 volts.

The load is taken on wire rope of tough steel, wound on grooved drums of large size.

The Yale & Towne electric hoist will swivel a full turn in either direction, but where it is necessary for the hoist to swivel continuously, turntable collector rings can be supplied, as is shown in Fig. 1. The terminals pass into the top hook, and thence to insulated rings, as shown in the illustration. The hoist is equipped with either a plain controller having two speeds, and suitable for the majority of uses, or with a foundry controller for five speeds, and used where delicate handling of the load is necessary.

Pendant rods are generally supplied for operating the controller on all hoists up to and including fifteen-foot lifts. On higher lifts pendant cords are adopted.

The rod is telescoping, universal-jointed, swings in all directions, has a jointed T-handle to prevent catching on obstructions, and enables accurate handling of the load. The rod may be manipulated with one hand. The pendant cords are used where the hoist is required to traverse the length of the works over high obstructions.

The solenoid brake is shown in Fig. 2. By means of the solenoid brake, hoists can be controlled from a distant point, permitting the controller to be detached and mounted independently of the hoist at any convenient place.

A special feature of the Yale & Towne electric hoist is its single-point suspension. Hanging over a single hook, swiveling on ball bearings, it will swing in line with the direction of its lift. Its radius of action is thus increased.

Fig. 3 shows the hoist fitted with a chain in place of a wire rope. This type is desirable when the bottom block is exposed to much heat. As the chain is not wound on the drum like the rope, the height of the lift which this type of hoist can make is not limited.

The main office of the Yale & Towne company is 9-15 Murray street, New York city.

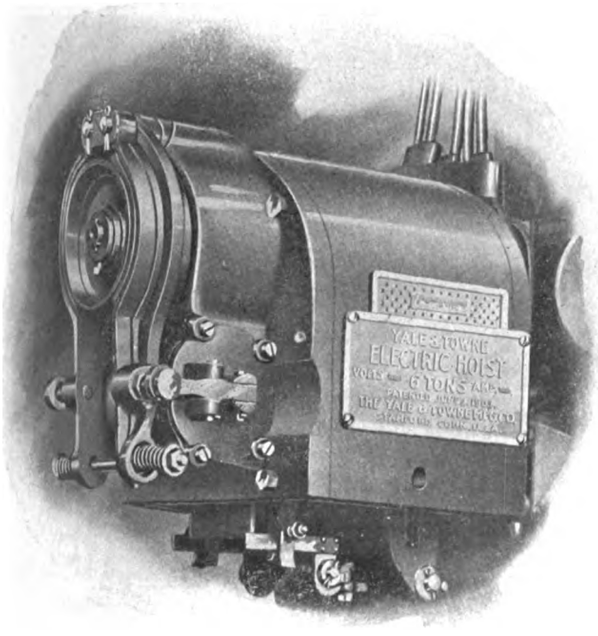


Fig. 2.—Solenoid Brake for Electric Hoist.

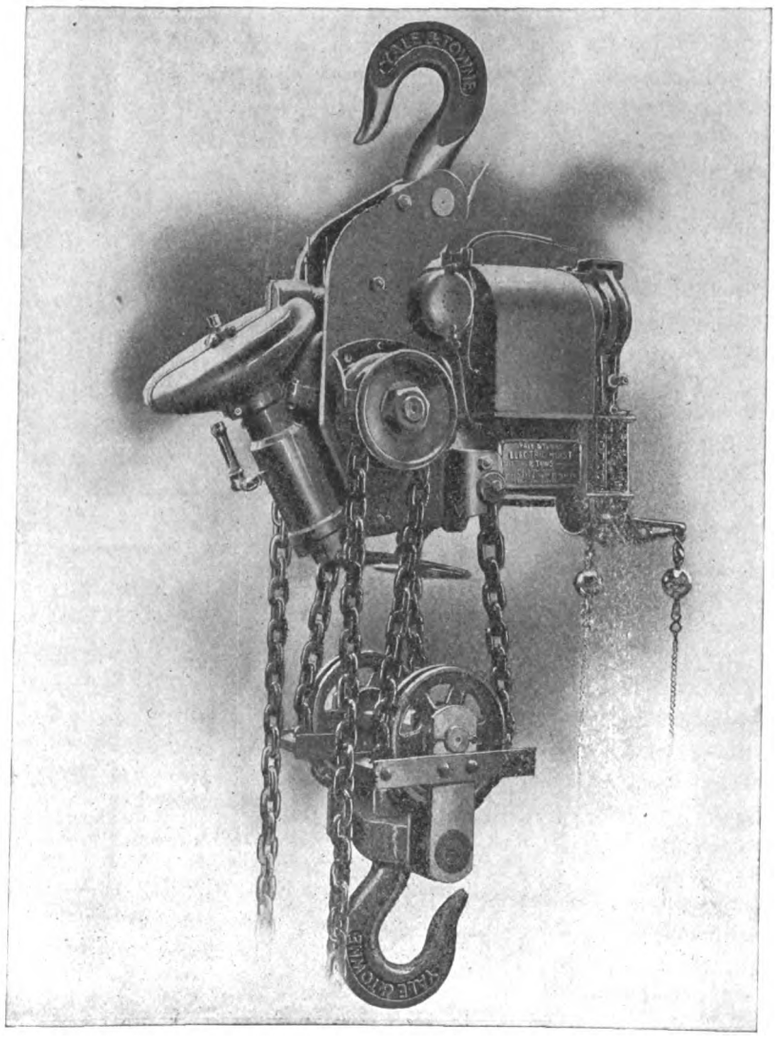


Fig. 3.—Electric Hoist Fitted with Chain.

New Outdoor Lighting Specialties.

The Ajax Line Material Company, Chicago, Ill., has been organized by Albert Scheible to design and manufacture an improved line of outdoor lighting specialties. Associated with him as secretary and treasurer of the company is John F. Turner, president and treasurer of the Sanitary Feather Company.

The president of the new company, Albert Scheible, graduated at the head of the original class at the Chicago Manual Training School. He took honors at Purdue University, and received a degree from Cornell. He spent a year at Cleveland as assistant to the superintendent of the Swan Lamp Manufacturing Company, and joined forces with George Cutter in Chicago in May, 1890, taking charge of the company's advertising, including devices for outdoor lighting, the prospects of which so impressed Mr. Scheible that he made this part of the general line his especial study, ultimately developing many ingenious and practical ideas in this direction. When the George Cutter Company was organized, Mr. Scheible was made secretary and treasurer, which position he held until he sold his interest a few months ago. The Ajax Line Material Company has leased an entire floor of the building at 12 and 14 South Jefferson street, where it will manufacture improved forms of outdoor lighting specialties originally designed by Mr. Scheible, together with the new types which are being brought out under his own patents.

Digitized by Google

Electrical Machinery in South America.

The growing use of electrical machinery in South America is illustrated in the following notes. The Empresa Electrica de Santa Rosa, Peru, which already operates a large generating station on the River Rimac, is extending its service to such a degree that an additional powerhouse is necessary. This will be operated in parallel with the present station. The equipment for the new station has been ordered from the General Electric Company, Schenectady, N. Y. It includes two three-phase, sixty-cycle, revolving-field, alternating-current generators, each rated at 1,200 kilowatts and operating at 2,300 volts. The generator voltage will be stepped up in three 750-kilowatt water-cooled transformers to 33,500 volts, and transmitted to a substation where distribution will be made from water-cooled step-down transformers at 2,300 volts. The order also includes switchboards and auxiliary apparatus.

In Brazil the Sao Paulo Tramway, Light and Power Company is also making additions to its present equipment. At the generating station another General Electric three-phase, revolving-field, 2,000-kilowatt, 2,300-volt generator is about to be installed with necessary switchboards for the operation of the new machine. In addition, the equipment will be increased by three sixty-cycle, 666-kilowatt, 24,000/2,000-volt transformers and three sixty-cycle, 666-kilowatt, 20,000/2,300-volt transformers of the same type. The railway equipment is being increased by ten double-motor car equipments, and one four-motor equipment. This machinery also has been ordered from the General Electric Company.

Another interesting installation about to be made in Peru is at the mines of the Inca Mining Company. The location of the properties of this concern makes transportation very difficult, and all material has to be packed up the mountain trails on mules. The electrical equipment includes a General Electric three-phase, 200-kilowatt, 6,600-volt alternating-current generator of the revolving field type. In addition, there will be four sixty-seven-kilowatt transformers as well as several induction motors for hoisting work and the necessary switchboards, also furnished by the same company. In order to facilitate transportation all the apparatus will be constructed in parts, none of which will weigh over 350 pounds, except the alternator shaft. The work of assembling the machinery will be done at the mines.

"Keough" Cord-Grips.

The accompanying illustrations show two cord-grips made by Keough Brothers & Company, 79 North street, Boston, Mass. Fig. 1 shows the cord-grip handle for use with reenforced cord and for a one-eighth-

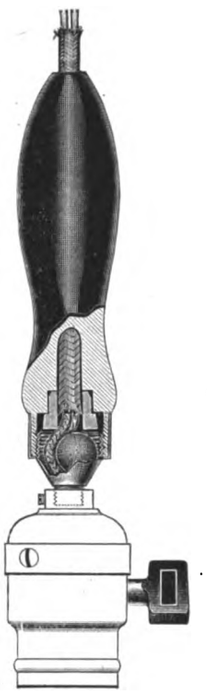


FIG. 1.—CORD-GRIP HANDLE.

inch socket. This is strongly built, and the grip holds the cord so that there is no chance of its being pulled away from the terminals. Fig. 2 illustrates the cord-grip for use with show-windows or reen-

FIG. 2.—"KEOUGH" CORD-GRIP.

forced cord. This grip also permits a one-eighth-inch socket to be used with the largest size of cord.

The method of gripping the cord is clearly shown in the illustrations. It is accomplished by means of a ball placed in a somewhat tapering receptacle. In this way both strands of the cord are tightly held, and there is no danger of cutting or piercing the insulation. Although the device attaches to small sockets, any size of cord may be used, and all will be held equally secure. It does away with the somewhat undesirable practice of tying a knot in the cord in order to remove the strain from the terminal screws. Moreover, if this cord-grip be adopted, the contractor is not compelled to carry two sizes of sockets in stock, for the one fixture permits the use of large and small cords.

Second Annual Conference of the Franklin Electric Manufacturing Company.

The Franklin Electric Manufacturing Company, Hartford, Ct., held the second annual conference of its manufacturing and sales departments during the week beginning June 25. On Monday an enjoyable smoker was held at 8.30 in the evening. Tuesday morning and afternoon were given up to conferences at the factory, the evening to an excursion to Hartford Luna Park. Wednesday morning was taken up in conference, and the afternoon by the annual baseball game. Thursday conferences were held in the morning and in the afternoon. In the evening the annual dinner was given at the Farmington Country Club. An excellent menu had been provided, and practically all the officers and representatives of the company attended. The final conference was held on Friday morning. In the afternoon a party left for New York by boat and spent Saturday at Manhattan Beach.

The Franklin company has found that a great deal of good was accomplished at the conference held last year, and judging from the success of the present one, anticipates still more benefit.

Production of Asbestos in 1905.

A bulletin from the United States Geological Survey states that the output of asbestos in the United States for 1905 was 3,109 short tons, valued at $42,975. This exceeds the production of any previous year, both in tonnage and value, and represents an increase of more than 100 per cent in quantity and of about sixty-seven per cent in value over the output for 1904. Georgia, Virginia and Massachusetts produced 2,995 tons of this material, the remainder coming from California, Michigan and Wyoming. The increased output was due principally to Georgia and Virginia.

Digitized by Google

A New Line of Stanley-G. I. Arc Lamps.

A new line of arc lamps has been put upon the market by the Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass. These lamps were designed some time ago, and several thousands of them have been in service for about a year, so that the good qualities of the design are now known. This line, which is designated as the type "K," includes direct lamps for voltages from 100 to 125, and from 200 to 250.

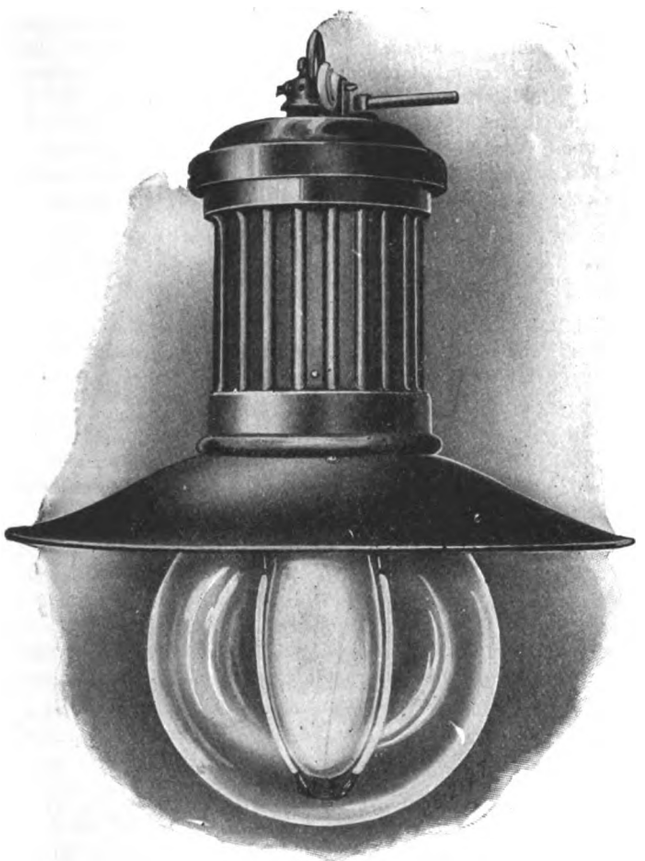


Fig. 1.—Outdoor Type "K" Lamp.

The general appearance of the lamps is shown in the accompanying illustration (Fig. 1), which is from a photograph of a lamp designed for outside use. In this particular lamp a great deal of attention has been paid to the selection of the glassware, and the combination shown includes an opal inner globe surrounded by a clear outer globe, and the latter surmounted by an enameled reflector, which has been found to give excellent distribution of the light. When the lamp is used for interior lighting this reflector may be removed and the clear outer globe replaced by an opal outer, which gives a very soft, pleasant light. All of these globes and reflectors have been carefully designed, with a view to obtaining the most effective distribution of light, for upon this factor depend largely the satisfactory results of any system of illumination.

The shells of these lamps are made of either copper or steel, and are given a number of finishes. The copper shells are either mottled or oxidized black, and the steel shells are furnished either with a dull or bright black enamel, or with the two copper finishes, the last two being obtained by electroplating upon steel. The company, however, recommends that copper shells be used for lamps intended for outdoor service. The tops of the lamps are made from one-eighth-inch thick, cold rolled sheet steel, finished in dull black. When copper shells are used a ring covers the top, making the finish match the shell.

Fig. 2 shows the simplicity of the type "K-31" lamp, the style employed for multiple direct-current systems. It will be noted that there is no inflammable material employed here. The insulation of the flexible leads is formed of glass beads, and the resistances, which are four in number, are wound on porcelain. The design of this lamp makes the centre tube unnecessary, and only one lead is required. A simple and reliable clutch is employed, and all parts are designed to be easily replaced. The resistances can be taken out separately or in sets and replaced by new ones in a few moments. All that is required is the removal of two clips. The regulating magnet is wound with specially treated wire, rendering it practically indestructible.

The lamp just described is intended for five amperes and any voltage from 100 to 125. The style "K-41," which resembles closely the one just described, has five resistance coils, and can be adjusted to any current value ranging from three to six amperes, and any voltage from 100 to 125. A third style, designated as "K-22," is identical in mechanical construction with the regular direct-current, 110-volt, type "K-31" lamp, but it is provided with six resistance bobbins, enabling it to be used on any line voltage from 200 to 250. Adjustment is easily made by means of movable clips on the bobbins. In this lamp the magnet spool also can be removed easily and replaced by one intended for 110 volts, thus converting it into a type "K-31" lamp.

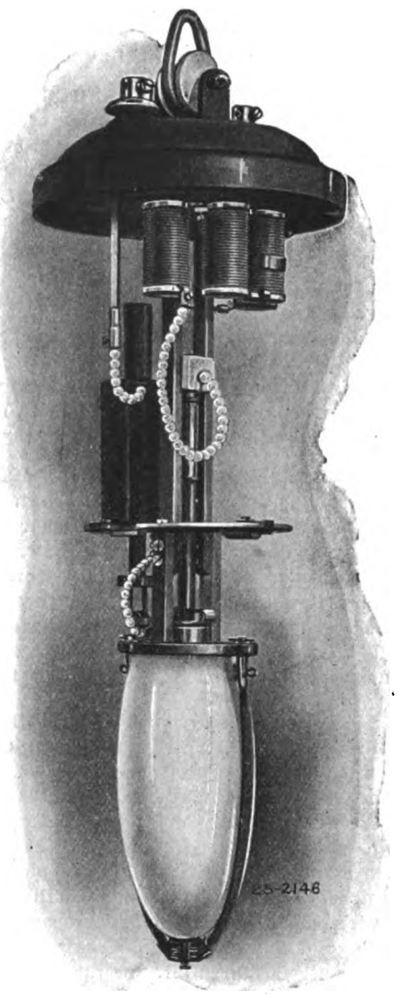


Fig. 2.—Showing Mechanism "K-31" Lamp.

The Importation of Asbestos.

The importation of asbestos into this country increased in 1905. In value it amounted to $845,479, as compared with $751,862 in 1904. Most of this asbestos is imported from Canada, as this country takes approximately two-thirds of the Canadian output. In 1905 Canada produced 50,670 tons. This was valued at $1,486,359. The principal countries for producing asbestos, in addition to that mentioned, are Italy, Russia, Australia and South Africa.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

LARGE BOND ISSUE—The New Castle & Harmony Street Railway Company, which proposes to build a road from Pittsburg to New Castle, Pa., *via* the Ohio river, has arranged for a bond issue of $3,500,000 with the Union Trust Company, of Pittsburg, as trustee. The latter company will also underwrite the issue.

POWER COMPANY CHANGES HANDS—The International Power and Transmission Company, of Niagara Falls, capitalized at $2,000,000, has passed into the hands of Lockport capitalists. The company was organized by S. P. Franchot, J. S. Simmons, F. J. Brown, James H. Lynch and Findlay & Tower, and was later acquired by the Niagara, Lockport & Ontario Power Company.

NEW POWER COMPANY FOR LOCKPORT, N. Y.—The formal transfer of the heating plant of the American District Steam Company, Lockport, N. Y., to the Economy Light, Fuel and Power Company has been made, and the latter company is now actively engaged in getting ready to supply Lockport with electricity by October 1, for lighting and power purposes. Workmen are engaged in razing the old machine shop and boiler-house of the steam company, and a new plant will be constructed, entirely of steel and brick.

NEW ST. LAWRENCE POWER PLANT PROPOSED—H. H. Warren, of Massena, N. Y., and Smith L. Dawley, of Ogdensburg, have made application for permission to construct a power canal in Long Sault channel in the St. Lawrence river. It is planned to develop a maximum of 25,000 horse-power, which would necessitate the building of a dyke along the northerly shore of Long Sault island. The estimated cost of the system is $1,500,000. A meeting will be held in Toronto on July 24, when the International Waterways Commission will consider the matter.

POTOMAC ELECTRIC POWER COMPANY FILES DEED OF TRUST—The Potomac Electric Power Company has filed with the recorder of deeds a deed of trust upon all its property rights and franchises to secure an issue of $7,000,000 in bonds. The bonds are of the denomination of $1,000 each and are payable July 1, 1936, with interest at five per cent. The object of the issue, it is stated, is to furnish funds with which to purchase additional real estate, construct a new power-house and otherwise better the condition of the company's property. The property pledged consists of all the holdings of the company in Washington and Georgetown, as well as the recently acquired site for the new power-house on the Benning road. The Commercial Trust Company, of New Jersey, is the trustee named in the mortgage.

CHICAGO TRACTION RECEIVERS—Application has been made in the United States Circuit Court by counsel for the Guaranty Trust Company, of New York, for the appointment of receivers to take over the combined properties of the Chicago Union Traction Company, the North Chicago Street Railway Company and the West Chicago Street Railway Company. The application is made in an amended and supplemental bill, which is to take the place of the original bill of complaint upon which receivers were appointed separately for the three companies some time ago. The desire for the administration of the three companies by one set of receivers is due to the necessity of lowering the tunnels and supplying electrical power for the various cable lines. It will mean, should the petition be granted, that the present receivers administering the properties separately will be removed and some, if not all, reappointed as receivers for the combined lines.

APPLICATION OF ELECTRIC LINES COMPANY DENIED—Supreme Court Justice Bischoff has denied the application made by the New York Electric Lines Company for permission to construct conduits throughout the city of New York. In so deciding Justice Bischoff approves the stand taken by Commissioner Ellison of the water supply, gas and electricity department, who denied the company's requests for permits to open streets for the construction of conduits in which to lay telephone and other electric wires. Justice Bischoff holds that the company lost its right to open streets by the action of the legislature of 1885 in passing the subway act. The company got its franchise in 1883, and actually began work within the following year. By the subway act it got sixty days within which to assert its right to construct subways independently of the commissioner of public works or other municipal authority. Having failed to so assert its rights within that prescribed time it came within the provision of the law, and as the present application is based merely upon the company's franchise Justice Bischoff finds that there is no apparent reason for overturning the existing legislation, under which the company has lost its rights.

ENGINEERING SOCIETIES.

AMERICAN ELECTROCHEMICAL SOCIETY—The American Electrochemical Society will hold its tenth general meeting in New York city during October, 1906.

ILLUMINATING ENGINEERING SOCIETY—The first three numbers of Volume I of the transactions of the Illuminating Engineering Society have been issued. These contain, respectively, the papers and discussions of the February, March and April meetings of the society.

SEATTLE BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The Seattle (Wash.) branch of the American Institute of Electrical Engineers made a trip to British Columbia, June 9 to 11. The trip included a visit to the hydroelectric plant and street railway system of the Vancouver Power Company and an inspection of the 23,000-volt transmission line at Burrard inlet.

NEW PUBLICATIONS.

A 10,000-HORSE-POWER SINGLE-WHEEL TURBINE—Arthur Giesler has published, in pamphlet form, a reprint of his article entitled "A 10,000-Horse-Power Single-Wheel Turbine at Snoqualmie Falls, Wash.," which appeared in the *Engineering News*.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Vol. XXVI of the transactions of the American Society of Mechanical Engineers contains papers and discussions of the fiftieth meeting held at New York in 1904, and the fifty-first meeting held at Scranton, Pa., in 1905.

NOTES ON POWER GENERATION IN IOWA—A bulletin recently issued by the Iowa State College Experiment Station deals with the Iowa coal fields and describes the quality of these coals and their calorific value. Results are given also of tests made of this coal for use in gas producers and in raising steam.

NEW MANUFACTURING COMPANIES.

TRENTON, N. J.—The Electric Service Supplies Company has been incorporated with a capital of $450,000, to deal in electrical and mechanical apparatus and supplies. The incorporators are: Edwin B. Ross, John McSorley and A. H. Englund.

ATTLEBORO, MASS.—Incorporation papers have been filed of the A. R. Macomber Company, manufacturer of electrical supplies, and to engage in electrical construction and general electrical work. The company has been organized with a capital stock of $10,000. A. R. Macomber is president and treasurer, John E. Wilmarth, of Taunton, clerk, and Elwood F. Macomber, of Swansea, is vice-president. The company will absorb the business formerly conducted by A. R. Macomber.

Digitized by Google

TELEPHONE AND TELEGRAPH.

BEATRICE, NEB.—The Bell Telephone Company has a force of men at Wymore rebuilding its system there.

BEATRICE, NEB.—Work has been started on a new telephone plant at Wymore by the Nebraska Telephone Company, to cost about $23,000.

DARIEN, N. Y.—The Darien Telephone Company has entered upon a contract for long-distance service with the Inter-Ocean Telephone Company.

MINNEAPOLIS, MINN.—The Northwestern Telephone Exchange Company is now engaged in reconstructing a number of its pole lines in various parts of Minneapolis.

PLAINFIELD, N. J.—The New York & New Jersey Telephone Company is building a new line from Bound Brook to Pluckamin, all of the rights of way having been secured.

LITTLE ROCK, ARK.—An amendment to its articles of incorporation has been filed by the Automatic Home Telephone Company, of Jonesboro, increasing the capital stock from $25,000 to $100,000.

SANDPOINT, WASH.—The Rocky Mountain Bell Telephone Company will proceed with the building of toll lines to Bonners Ferry and Hope. It will also install a new line between Rathdrum and Coeur d'Alene.

GUTHRIE, OKLA.—The Pioneer Telephone Company, with headquarters at Guthrie, has purchased the Independent exchange at Cleveland for $11,500. The Pioneer controls practically all the telephone business in the two territories.

BURLINGTON, IOWA—The contract for a new building for the Bell Telephone Company has been awarded to the Concrete Construction Company, of Rock Island, Ill. The new building will cost about $16,000, to be completed by the middle of October.

NEW WESTMINSTER, BRITISH COLUMBIA—The British Columbia Telephone Company is about to lay a new cable across the Fraser river. It will be 2,500 feet long, and is for the further improvement of the Chilliwack, Blaine and Ladner service.

BELLINGHAM, WASH.—The Home Telephone Company has let a contract for the preliminary work on the new exchange building. Excavation work will be commenced at once. The management expects that the greater part of the summer will be required to get the system completed.

TECUMSEH, NEB.—At a meeting of the stockholders of the Johnson County Home Telephone Company it was decided to double the capital stock of the organization. It is now $50,000 and will be made $100,000. The funds will be used in establishing a complete county service.

TOLEDO, OHIO—At a special meeting of the directors of the American District Telegraph Company, the company was reorganized, and the following directors elected: Mrs. Carrie McNamar, Charles S. Northup, Dr. John S. Pyle, Clarence Brown, L. T. Williams and Martin J. Carney.

BINGHAMTON, N. Y.—Certificates of incorporation of the East Richford Telephone Company and the East Berkshire Telephone Company have been filed with the county clerk. The line of the Richford company will extend from Lisle to Richfield and the other line will run from Lisle to Berkshire.

LAS VEGAS, N. M.—The Colorado Telephone Company has closed a deal for the franchise, telephone system and property of the Las Vegas Telephone Company. The price which the Colorado company will pay is $18,000, the property to be transferred January 1, 1907. The Colorado company will extend the lines and service.

LINCOLN, NEB.—The capital stock of the Fillmore County Telephone Company has been increased to $100,000. Of this amount $60,000 is to be preferred stock, bearing interest at the rate of ten per cent, payable semi-annually. The directors of the company are: M. Bolton, John Barsby, E. K. Cobb, A. G. McGreevy and G. E. Beaman.

CHESTER, PA.—The Delaware & Atlantic Telephone Company has a large section of its conduits laid through Chester, and it is expected that connections will be made with both the Delaware and Philadelphia sections early in the fall. The conduits between Darby and Wilmington, including the direct system through Chester, will put more than 100 miles of wire under ground.

CHICKASHA, I. T.—The residents of the district between Pocasset and Dutton are forming local companies for the erection of telephone lines with the expectation of consolidating the local companies into one larger organization, taking in some 200 telephones. The line will run through Pocasset and thence to Chickasha, where it is proposed to establish a central office.

DILLON, MONT.—The Southern Montana Telephone Company will greatly extend its system in the Big Hole basin, building about 200 miles of line and adding 100 new telephones. An extra line will connect Jackson and Wisdom, and the main offices will be at these two places. Work will be started on the extensions as soon as material and supplies can be secured, and the company expects to have all the lines completed within two months.

STILLWATER, MINN.—The Northwestern Telephone Company is making extensive additions to its system connecting with the exchange in Stillwater. A force of men has almost completed a two-circuit addition direct to Minneapolis. Crews are at work on additions as follows: a three-circuit system to the lake Elmo region, a two-circuit system to the Square lake region, an addition to the Houlton (Wis.) service, a two-circuit system in the town of Grant and a circuit to the Big lake country.

NEW YORK, N. Y.—Plans have been filed for remodelling the six-story Gramercy exchange of the New York Telephone Company at Irving place and Eighteenth street. The improvements include the making over of the ground and second floors, which were formerly the offices of the Tenement-House Department. The old entrance on Eighteenth street is to be removed and an ornamental window installed in the place. The changes are to cost $23,000. The architects are Eidlitz & McKenzie.

YUBA CITY, CAL.—Dr. E. V. Jacobs, of Meridian, representing capitalists, has made application for the privilege of maintaining and operating a telephone system through Sutter county. The franchise is to run for fifty years from date of its authorization, and the grantee of the franchise is to deposit a $500 bond that the conditions of such franchise will be truly and fully kept and maintained according to agreement. Four months' time is to be given after the franchise is granted in which to commence work, which must be completed within three years.

MONTREAL, QUEBEC—With the stringing of an additional copper wire from Winnipeg to Montreal, five through wires are now in service over the Canadian Pacific Railroad telegraph system. One of the five is a direct wire between Vancouver and Montreal. Construction has been very heavy for several years past, but this year will be largely in excess of previous years. About 850 miles of pole line will be constructed, over half of which will be along new lines of railway. A line will also be constructed between Vancouver and Revelstoke, the length being about 360 miles.

DENVER, COL.—The Northwestern Telephone Company has been organized to operate in Boulder, Routt, Larimer, Arapahoe and Denver counties. Headquarters will be at Longmont. The capital stock is placed at $50,000. The incorporators are: M. H. Spere, J. K. Brown, E. V. Bowles, J. A. McCollister and W. W. McCollister. It is the intention of the company to string telephone wires into Steamboat Springs and Hayden in Routt county, and work will be begun at once. All of the principal towns along the line of the Colorado & Southern Railroad in northern Colorado will be on the lines of this system.

WASHINGTON, D. C.—Preparations are being made by the war department for the extension of the Alaska cable, $179,000 having been made available for the purpose by a recent act of congress. It is proposed to attach the branch to the loop between Juneau and Sitka in Frederick sound, extend the line to Petersburg, thence to Wrangell, thence to Hadley and thence to Ketchikan. Plans are also nearing completion for installing duplexing machines in connection with the Alaska cable. This will increase the capacity of the line by about seventy-five per cent. The net receipts of the Alaska telegraph system in May broke all records since the installation of the telegraph in the territory, and the cable is crowded with commercial business. The May receipts were $21,300, which is said by the war department to be the largest net amount on record.

Digitized by Google

ELECTRIC RAILWAYS.

PORTLAND, ORE—Active preparations are now in progress for the resumption of work on the Salem-Portland electric road, which was suspended some time ago.

WHEELING, W. VA.—The Belmont county commissioners have granted a franchise for the extension of the Wheeling traction lines from Bellaire to Shadyside.

SEDALIA, MO.—The property of the Sedalia Railway and Electric Company, of Sedalia, Mo., has been sold to Edward M. Deane & Company, of Grand Rapids, Mich.

DETROIT, MICH.—The electric railway line, planned to run from Detroit to Lansing, by way of Plymouth, Brighton and Howell, will be in operation by January 1, 1907.

GOSHEN, IND.—The Winona assembly has formally opened its trolley line from Warsaw to Goshen. The Warsaw-Peru line, also owned by the assembly, will be opened November 1.

WARREN, OHIO—A contract has been entered into by the Eastern Ohio and the Mahoning & Shenango Valley roads for the construction of a line from Leavittsburg to Chagrin Falls.

RED BANK, N. J.—The Monmouth county board of freeholders has granted a franchise to the Monmouth Electric Company, permitting it to build an electric railroad along the public road from Red Bank to East Oceanic.

MENOMONIE, WIS.—A survey is being made from Eau Claire to Menomonie by the Chippewa Valley Electric Railway Company with a view to determining the feasibility of extending its trolley line to the latter city.

PHILADELPHIA, PA.—Work on the proposed trolley line from Newtown to Hatboro will be begun within the next few weeks. All rights-of-way have been granted for the upper route, which crosses the Neshaminy at Richboro.

SUFFOLK, VA.—After being discussed for several months, the street railway franchise has been adopted by the Suffolk council. This insures local trolleys and interurban service between Suffolk and Norfolk. The lines will be run by the Norfolk & Portsmouth Traction Company.

BALTIMORE, MD.—The second branch of the city council has passed finally the ordinance granting a twenty-five-year franchise, renewable for another twenty-five years, on the St. Paul street, Merryman's lane boulevard, to the United Railways and Electric Company's subsidiary concern, the Maryland Electric Company.

TROY, N. Y.—The contract for building the electric road from the Massachusetts state line to Bennington, Vt., has been awarded by the Consolidated company, which controls the franchise. The road will be finished not later than December 1, and will give a line into North Adams. About $500,000 will be spent in building and equipping the road.

NEW YORK, N. Y.—At a conference between the state railroad commissioners, Borough President Haffen and President Maher, of the Union Railway Company, the railway agreed to begin work at once to put the Broadway and Kingsbridge line in condition for the operation of cars. The work is to be completed by August 1. It will then be possible to go from the Battery to Yonkers, *via* the Union Railway, for ten cents.

BIRMINGHAM, ALA.—The Birmingham Railway, Light and Power Company has made public improvement plans that call for the expenditure of hundreds of thousands of dollars on the street railway system of Birmingham and the district. Four of the present lines will be double-tracked, a new line will be built to Avondale, another to South Highlands, and a network of tracks will be built in the vicinity of the new union passenger station.

JANESVILLE, WIS.—A new independent movement to build an interurban railroad from Janesville to Madison has been launched by local business men, headed by H. H. Clough, of Elyria, Ohio, former superintendent of the Rockford, Beloit & Janesville line. The project contemplates the securing of a fifty-year franchise with liberal freight-carrying privileges, and it is expected that the actual work of building will be commenced before the fall.

CINCINNATI, OHIO—The Cincinnati, Milford & Loveland Traction Company has inaugurated a regular passenger service over the extension of the line that has been built from Milford to Blanchester in Clinton county. Blanchester is about forty miles east of Cincinnati. The new road that has just been completed between that city and Milford is twenty-five miles long. The extension will bring a rich farming section in close touch with Cincinnati.

TOLEDO, OHIO—The Toledo Railway and Light Company is spending about $700,000 on improvements and extension. A large new power-house as well as a union electric station are under construction, while a line fifteen miles out of Toledo is now nearing completion to Ottawa Beach. All three lines, Detroit, Toledo, and Northern Ohio Traction, are benefiting very much by the development of the interurban business, and there is a steady increase in the electric business from Cleveland to Detroit through Toledo.

DANBURY, CT.—Governor Higgins, of New York, has signed a bill extending to January 1, 1907, the time for the completion of the interstate trolley line which the Danbury & Harlem Traction Company is building from Danbury to Goldens Bridge, N. Y. Part of the road has been constructed from Danbury to North Salem, N. Y., but west of that point practically nothing has yet been done. The officers say that the cars will be in operation between Danbury and North Salem in July. The work of equipping the power plant will shortly be undertaken.

GOSHEN, IND.—It is announced that work on the Indianapolis, Huntington, Columbia City & Northwestern Electric Railway will be begun in Goshen within thirty days. The construction contract has been let to Ryan Brothers, of New York. The capital stock of the company has been increased from $50,000 to $1,500,000. Most of the stockholders are wealthy men living in the section through which the road is to pass. As surveyed, the line will connect Goshen with Syracuse (Lake Wawasee), Churubusco, Columbia City, Huntington, Portland and Indianapolis.

DES MOINES, IOWA—Richard R. Rollins, president of the Des Moines-Indianola Interurban Company, says that grading for the road will probably start in about thirty days. It is the plan now to build south from Fort Des Moines, a distance of twelve or fourteen miles, and to use the Fort Des Moines line into the city. The maximum grade will be one and one-half per cent. The plan of extending the line from Indianola to Chariton, Corydon and Centerville is being considered. At Chariton it would cross the main line of the Burlington, a distance of some thirty miles from Indianola.

PITTSBURG, PA.—The Bessemer Contracting and Ballast Company, of Pittsburg, has been awarded the contract by the Pittsburg, McKeesport & Connellsville Railway Company for the grading and masonry work on the new traction line to be built from Lecterone to Masontown, Pa. The contract includes the work on four and one-half miles of single track. It will be necessary to construct five bridges on the line, which has its right-of-way entirely through private property. Upon the completion of this line the Pittsburg & Western Railways Company will have direct connection with traction lines from Pittsburg to Masontown.

PITTSBURG, PA.—Announcement has been made of the sale of the Pittsburg & Allegheny Valley Street Railway Company to M. K. McMullin. The purchase price was reported as being $2,000,000. When the company was organized a bond issue of $1,100,000 was provided to construct the entire road of twenty-five miles. But eight miles are built at this time. The line now extends from Apollo to Leechburg, and it is proposed to extend it to New Kensington and Parnassus. This will permit it, by means of a short branch, to connect with the Verona line of the Pittsburg Railways Company. O. W. Kennedy was the former president and Colonel F. M. Jackson, treasurer of the company.

CARTHAGE, MO.—R. C. Rawlins, of Chanute, Kan., who is promoting the proposed Missouri-Kansas electric railroad, has completed arrangements for the road. He states that the money has already been subscribed by St. Louis and Philadelphia capitalists, and actual work will begin in several places within a month. It is proposed to start building from both Coffeyville and Chanute, the two lines converging at Parsons and then running direct to Carthage, taking in Webb City, Joplin and other cities and towns in the zinc-mining district. The company will furnish service on a thirty-minute schedule between Carthage and Joplin, and fifty minutes between Carthage and Galena, Kan. Sixty-foot cars will be used for the interurban traffic and forty-foot cars in the towns.

Digitized by Google

PERSONAL MENTION.

MR. J. J. GHEGAN, president of J. H. Bunnell & Company, has been spending several weeks in Europe, enjoying a tour and rest in that country. Mr. Ghegan expects to return to New York the latter part of this month.

MR. GEORGE A. McKINLOCK, president of the Central Electric Company, Chicago, passed through New York last week *en route* for Europe, where he will spend six weeks in touring the Continent in an automobile of the latest design.

MR. HERBERT G. WILLIAMS, for some years superintendent of the Port Chester (N. Y.) branch of the Westchester Lighting Company, has resigned to assume the management of the Schuylkill Light and Traction Company, Philadelphia, Pa.

MR. DAVID GAEHR, Cleveland, Ohio, who opened offices about one month ago at 1201 Schofield Building as an agency for the C & C Electric Company, Garwood, N. J., manufacturer of dynamos and motors, reports an especially successful commencement of his work.

MR. EDGAR C. BRADLEY, for fifteen years past a prominent official of the Postal Telegraph-Cable Company, resigned as vice-president last week with a view to entering other business. Mr. Bradley is one of the foremost telegraph men of the country and is energetic, broad-gauged and tactful. He will carry with him into his new field the best wishes of a large number of friends.

DR. RICHARD TETLEY GLAZEBROOK, the president-elect of the Institution of Electrical Engineers, of Great Britain, was born in Liverpool, September 18, 1854. He was educated at Liverpool College and Trinity College, Cambridge, graduating in 1876 with the degree of B. A., and being Fifth Wrangler. He commenced the study of physics under Clerk Maxwell at the Cavendish Laboratory, and at the death of the latter in 1880 was appointed demonstrator there. Later he was made a lecturer and assistant tutor of his college, and assistant director of the Cavendish Laboratory under Professor J. J. Thomson, holding the latter position until, in 1898, he was appointed principal of University College, Liverpool. Shortly after the latter appointment he was made director of the National Physical Laboratory, taking up his work there in 1900. This position he still holds. Dr. Glazebrook is a frequent contributor to the scientific journals, and is the author of numerous textbooks on physics. He is a Fellow of the Royal Society, a past-president of the Physical Society, and holds the honorary degree of doctor of science.

MR. CHARLES P. BRUCH, formerly assistant secretary and assistant general manager of the Postal Telegraph-Cable Company, has been elected one of the vice-presidents of this company, and assumed office the first of July. This is a very proper recognition of long and intelligent service as a member of the staff of the Postal company. Mr. Bruch was born in Louisville, Ky., in 1860. When he was eighteen years of age he entered the employ of the Western Union company at Canton, Ohio, as a student. Coming to New York in November of the same year he entered the New York office of the company, finally being placed in charge of the complaint bureau of the operating room. In 1883 Mr. Bruch resigned his position with the Western Union company to become clerk of the Telegraphers' Mutual Benefit Association, and was made secretary of this organization in November of the same year. At the end of five years Mr. Bruch took charge of the office of the Edison Phonograph Company. In 1891 he was made assistant to the vice-president of the Postal Telegraph-Cable Company, and was elected assistant secretary and assistant general manager on January 1, 1893. Mr. Bruch has a wide circle of friends. He is the fortunate possessor of a nature that is not easily ruffled, and carries through important executive work easily and efficiently.

MR. CHARLES P. BRUCH.

OBITUARY NOTICES.

MR. GEORGE FARRELL, chief operator of the Fire-Alarm Telegraph Bureau at fire headquarters, New York city, died at his home, 155 East Eightieth street, on June 30. Mr. Farrell was fifty-eight years old, and has been connected with the fire department since 1873.

MR. JOHN E. McDONALD met his death in the train wreck at Salisbury, England, July 1. Mr. McDonald was for a number of years connected with the firm of W. & J. Sloane, New York city, but later interested himself in telephone and real estate enterprises, becoming president of the New York Telephone and Telegraph Company, of the Knickerbocker Telephone and Telegraph Company and of the Thomson Hill Land and Improvement Company, and treasurer of the Massachusetts Telephone and Telegraph Company and of the Telephone, Telegraph and Cable Company of America. Mr. McDonald was thirty-eight years of age and resided at 216 West Seventy-second street, New York city. He leaves a widow.

LEGAL NOTE.

SERIES-PARALLEL CONTROLLER LITIGATION—In the United States Circuit Court of Appeals for the Third Circuit, sitting in Philadelphia, Pa., a decision was handed down on June 11 in favor of the General Electric Company against the Garrett Coal Company, alleging the use of series-parallel controllers manufactured by the Morgan-Gardner Company, Chicago, Ill. These controllers, it was alleged, were an infringement of the plaintiff's patents Nos. 587,441 and 587,442, August 3, 1897.

NEW INCORPORATIONS.

CHESTER, PA.—Upper Darby Light, Heat and Power Company, of Upper Darby. $5,000.

ALLENTOWN, PA.—South Bethlehem Street Railway Company, of South Bethlehem. $42,000. President, Charles P. Hoffman.

MADISON, WIS.—Wisconsin Metropolitan Telephone Company. $100,000. Incorporators: John A. Wallis, Louis N. Brown and August C. Moeller.

FLINT, MICH.—Oak Park Power Company. $60,000. Incorporators: William G. Doolittle and C. S. Mott, of Utica, N. Y., and Charles M. Begole, of Flint.

GUTHRIE, OKLA.—The Carmen Electric Light and Power Company, of Carmen. $12,000. Incorporators: J. F. and S. A. Mott, of Carmen, and Z. B. Bird, of Enid.

CHATTANOOGA, TENN.—Jackson Railway and Light Company, of Madison county. $600,000. Incorporators: S. S. Bush, Atilla Cox, Jr., Alan MacDonald, John Wisdom and Charles D. Lehmkuhl.

HARRISBURG, PA.—People's Electric Light Company, Lebanon; $10,000. Bellevernon Electric Company, Pittsburg; $5,000. Houtzdale Electric Light, Heat and Power Company, Houtzdale; $10,000.

LYONS, N. Y.—Williamson Light and Power Company. To furnish light and power to the residents of Williamson. $10,000. Directors: Judson L. Transue, of Williamson, and Charles and Ray Milles, of Sodus.

GUTHRIE, OKLA.—The Farmers' Mutual Telephone Company, of Greggs, in Comanche county. $30,000. Incorporators: J. P. Lovinger, L. D. Marks, T. M. Brooks, James Gardner, A. H. Collins and T. M. Farris, all of Hasting, and W. W. Welcher, of Comanche, I. T.

COLUMBUS, OHIO—The Cincinnati Independent Telephone Company. $10,000. Incorporators: Charles H. Urban, William Klussman, Edward Puthoff, Arthur R. Morgan and George W. Griffith. Their purpose is the construction and operation of telegraph and telephone lines, either by pole lines or subways, in Cincinnati and the villages of Hamilton county.

DEFIANCE, OHIO—The Northwestern Electric Railway Company. To build an electric road from Defiance to Pioneer, Williams county, to intersect the Toledo & Western *via* Evansport, Bryan and Montpelier. $100,000. Directors: Mayor John F. Crowe, County Commissioner J. H. Miller, Dr. E. Bell, of Cincinnati; Dr. G. A. Rigrish, Judge J. H. Hockman, L. J. Weadlock and J. Harry Kinsley, of Toledo.

Digitized by Google

ELECTRIC LIGHTING.

LONDON, TENN.—M. R. Goans will install an electric plant at London.

FREDONIA, N. Y.—Fredonia will expend $10,000 in building and equipping a new electric lighting plant.

NORRISTOWN, PA.—Norristown's municipal electric light plant cost $12,800 during 1905, an average of $59.51 per lamp.

FREMONT, OHIO—The Yaryan Company has purchased the plant of the Fremont Electric Light, Power and Gas Company.

SYRACUSE, N. Y.—The transmission line of the Niagara, Lockport & Ontario Power Company has been completed to Syracuse.

PHILADELPHIA, PA.—The United Gas Improvement Company has purchased the electric light plants at Kingston, Nanticoke and Hazleton.

POTSDAM, N. Y.—Potsdam has voted to bond the village for $24,000 for the construction of a municipal lighting plant to supply street lights only.

PASADENA, CAL.—It is reported that the Pasadena city council expects to have the municipal lighting plant in operation before the end of the year.

MEMPHIS, TENN.—The LaClede Gas Company, of St. Louis, Mo., has purchased a site at a cost of $25,000, and will erect a $60,000 electric light plant in Memphis.

DAYTON, OHIO—The Dayton Citizens' Electric Company has filed a bond for $10,000 with the Dayton city auditor, and has begun work on its underground system.

ALBANY, N. Y.—The Hudson River Electric Power Company will be granted a franchise to enter Little Falls. The price agreed upon for street lights is $85 per year per lamp.

GRAND FORKS, MINN.—Edward L. Healy, of Red Lake Falls, has been granted a thirty-year franchise to transmit electric current for lighting and power purposes to Grand Forks.

LOS ANGELES, CAL.—A company, composed chiefly of Los Angeles capitalists, will install an electric light plant at Palms. It is hoped to have the system in operation within ninety days.

BENWOOD, W. VA.—Members of the Benwood council are considering the proposition of erecting a municipal electric light plant. It is purposed to secure a site and install a system at a cost of $10,000.

AURORA, ORE.—The Aurora Electric Company has received an offer for its plant from the Portland General Electric Company. The plant gives service to Aurora, Barlow, Canby, Hubbard and Gervais.

JAMESTOWN, N. Y.—Mayor Weeks has named for the new electric light commission: Louis C. Jagger, Warner F. Liedblad, Clayton E. Bailey and Fred Briggs. The council unanimously confirmed the appointments.

LOCKPORT, N. Y.—The International Power and Transmission Company has filed with the secretary of state a certificate announcing that its principal place of business has been changed from Niagara Falls to Lockport.

CRIPPLE CREEK, COL.—At a regular meeting of the Cripple Creek city council the Frye electric lighting and power franchise was passed with amendments. The franchise will materially cheapen the cost of lighting in the city.

LEXINGTON, N. C.—The Southern Power Company, of Charlotte, has made a proposition to furnish Statesville and other Iredell towns with electric power from Mount Holly, provided they take as much as 2,000 horse-power.

PITTSBURG, PA.—An agreement has been reached between representatives of Pittsburg and the Allegheny County Light Company, by which the company will supply the city with arc lights at $76 per lamp for a period of two years.

NORFOLK, VA.—C. H. Belvin and E. Maxwell have been named by Federal Judge Purnell to take immediate charge of the Cape Fear Power Company, on motion of the Schenectady Trust Company, to foreclose a $350,000 mortgage given in 1903.

BELOIT, WIS.—The Beloit Water, Gas and Electric Company has selected new officers as follows: president, C. B. Salmon, Beloit; vice-president, E. G. Cowdery, St. Louis; secretary and treasurer, Charles H. Deppe, Cincinnati.

BROOKLYN, N. Y.—Commissioner of Water Supply W. B. Ellison has asked the board of estimate to transfer $100,000 unexpended balance to the credit of Manhattan and the Bronx, to the Brooklyn account for an increase in public lighting there and in Queens.

PORTLAND, ORE.—A franchise has been granted by the County Court to the Portland General Electric Company, giving that corporation the right to erect poles along the county roads from Cazadero to Portland for the transmission of electricity from its new power plant to Portland.

WINONA, MINN.—An amendment to the articles of incorporation of the Minnesota Light and Power Company has been filed, increasing the capital stock of the company from $75,000 to $200,000. This provides money for the improvements now being made at the plant of this company.

YORK, PA.—A company to operate an electric plant at Castle Finn has been organized under the title of the Delta Water Company and a charter has been applied for. The incorporators are: J. Howard Stubbs, Robert L. Jones, John R. Williams, Edward W. Evans, Harry P. Reese and R. W. Ramsay.

RHYOLITE, CAL.—R. W. Van Norden, of San Francisco, representing eastern people, has been inspecting the site of a proposed plant that is to be built in Inyo county, California, 100 miles below Bishop, for the purpose of carrying electricity to Bullfrog. He states that work will be begun shortly on a 10,000-horse-power plant.

ACWORTH, GA.—The citizens of Acworth held an election recently to vote on bonds to the amount of $25,000 for electric lights and waterworks, the issue carrying by a good majority. The contract for the plant will be let at once. The bonds, bearing five per cent interest, will be taken principally by the Acworth banks.

SOMERVILLE, N. J.—The initiative has been taken by the new board of town commissioners of Somerville toward the establishment of municipal lighting and water plants. Committees have been appointed to enquire into the cost of lighting in other places of 10,000 inhabitants. The town is at present lighted by the Public Service Corporation.

SAN BERNARDINO, CAL.—The decision in the lighting case of G. E. Cady against the city council of San Bernardino, seeking to break the latter's contract for street lighting with the Lytle Creek Power Company, has been received from Judge Conrey of the Los Angeles Superior Court. The decision holds that the action of the councilmen in awarding the contract to the Lytle Creek company was legal.

ROCHESTER, N. Y.—The Seneca Edison Company has made application to the State Commission of Gas and Electricity for permission to consolidate with the Geneva Power and Light Company. It is understood that the Geneva Power and Light Company is under practically the same control as the Inter-Urban Gas Company which operates under the name of the Seneca Falls & Waterloo Gas Light Company.

DETROIT, MICH.—At a meeting of the Detroit public lighting commission Clifford Elliott was elected president; Marvin M. Stanton, vice-president; Frank T. Bowler, secretary, and William M. Daly, superintendent. Some $40,000 worth of contracts were given out. The Western Electric Company gets the contract for 900 arc lamps at $16,500, and the National Carbon Company will supply carbons to the amount of $10,134.76.

DALLAS, ORE.—The Willamette Valley Company is now operating the Dallas electric light plant. C. B. Rhodes, manager for Dallas, says that the present plant will be rebuilt and remodeled on more extensive plans. The new plant will be built at the Cone mills, and construction will commence immediately. Three hundred horsepower will be the initial capacity, to be increased this fall to 1,000 horse-power. The Dallas plant will be a distributing station, and will furnish light and power to Monmouth and Independence. Mr.

Digitized by Google

Rhodes says his company will be in a position to furnish power for electric roads if desired.

BRYAN, TEX.—At a meeting of the Bryan city council a franchise was granted Fritz Braatz to install an electric plant.

FREDONIA, N. Y.—The Fredonia village board has decided to expend $10,000 in building and equipping a new electric light plant.

WAYNESBORO, GA.—Waynesboro has voted to issue bonds to the amount of $60,666 for an electric light plant and waterworks system.

CINCINNATI, OHIO—The Cincinnati Gas and Electric stockholders have ratified the plan to lease to the Union Gas and Electric Company.

ALBANY, N. Y.—The trustees of public buildings have awarded to William M. Sheehan & Company the contract for an electric lighting plant in the capitol at a cost of $43,100.

PALESTINE, TEX.—The Palestine Electric Light Company has been awarded a fifty-year franchise and a five-year contract for street lighting. The city pays $7 per month for first fifty arc lights and $6 for all above that number, the city hall to be lighted free of charge.

GALLATIN, TENN.—At a recent meeting of the Gallatin board of aldermen it was shown that Gallatin's electric light plant was a paying investment. The report showed the net earnings for the past twelve months to be $355.81, after deducting all expenses, salaries, repairs, etc.

MEMPHIS, TENN.—Contingent on the passage of an act by congress allowing the construction of locks and dams in the White river in Arkansas is the expenditure of perhaps $1,000,000 for transmitting electrical power for commercial purposes to Memphis. Local capital is interested, and a company may be formed to carry out the plan. The distance of transmission would be about 100 miles.

MIDDLETOWN, N. Y.—The West Branch Light and Power Company has been granted a certificate of authority by the commission of gas and electricity to supply lights in the villages of South Kortright, Hobart and Stamford, Delaware county. Bonds to the amount of $45,000 may be issued by the company, and capital stock to the amount of $5,000. The company also received permission to purchase the stock of the Stamford Electric Light Company.

GAZELLE, CAL.—The survey for a power line from Montague to Dunsmuir has been completed for the Squaw Creek Mining Company. This company will build the power line for the purpose of serving its own mine and mill and the towns of Gazelle, Edgewood, Igerna, Weed, Upton, Sisson, Mott and Dunsmuir with light and power. The Squaw Creek company will not generate its own power, but will purchase it from the Siskiyou Power Company, whose field lies between Yreka and Ashland and beyond into southern Oregon.

RICHMOND, VA.—The joint committees on finance and electricity adopted a motion laying the proposition to establish a municipal lighting plant on the table. The committees decided by a vote of ten to eight that the plan was not practicable, and will ask the council to call for bids for lighting the city by electricity for three or five years, from July 1, 1907. Three propositions were considered. One was the report of the subcommittee, which favored a commercial plant at about $400,000. The second was a substitute, which called for a municipal plant to cost $195,000. A substitute for the whole, which was adopted, was the third.

COLUMBUS, OHIO—Columbus men will take about $100,000 of the underwriting of the Evansville Light Company, a new corporation which has been organized by E. W. Clark & Company and Hodenpyle, Walbridge & Company. The company controls the gas and electric light plants of Evansville, Ind., and has a capitalization of $1,500,000 of common stock and the same amount of six per cent cumulative preferred stock, of which $1,000,000 has been issued. The property is subject to a bonded indebtedness of $1,250,000. The net earnings of the company for the year ending March 31, 1906, were $129,788. The earnings so far this year show a good increase over the same period of last year. The preferred stock will be sold at par with a bonus of thirty-five per cent of the common stock.

ELECTRICAL SECURITIES.

Following a decline on Monday, there was a general rally in the stock market during the balance of the week, and the closing prices showed a net advance as compared with a week ago. In fact, it is believed by many that prices have touched bottom and that liquidation has ceased. A development of much importance has been the renewed interest taken by the outside public, which has for some time held aloof. While buying in this direction has not been heavy, it has nevertheless had a tendency to improve the situation. The money market continues to be a factor. Rates have been firm, though the belief is general that some relaxation may be looked for soon. Crop reports are good and are expected to exert a favorable influence on the stock market, particularly in connection with continued public buying.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JULY 7.

New York:	*Closing.*
Allis-Chalmers common	17½
Allis-Chalmers preferred	46½
Brooklyn Rapid Transit	74⅞
Consolidated Gas	139¼
General Electric	164
Interborough-Metropolitan common	36¾
Interborough-Metropolitan preferred	74¼
Kings County Electric	165
Mackay Companies (Postal Telegraph and Cables) common	72¾
Mackay Companies (Postal Telegraph and Cables) preferred	73
Manhattan Elevated	140
Metropolitan Street Railway	103
New York & New Jersey Telephone	120
Western Union Telegraph	92
Westinghouse Manufacturing Company	151

The first quarterly dividend of 1½ per cent upon the stock of the Third Avenue Railroad Company will be payable on July 31. Books closed July 13 and reopen August 1. The placing of the stock upon this dividend basis at this time was one of the conditions of the lease to the Metropolitan Street Railway Company. This rate will continue for four years, after which the rate must be raised to 7 per cent per annum.

Boston:	*Closing.*
American Telephone and Telegraph	132
Edison Electric Illuminating	240
Massachusetts Electric	69
New England Telephone	130
Western Telephone and Telegraph preferred	91
Philadelphia:	*Closing.*
Electric Company of America	11⅝
Electric Storage Battery common	67½
Electric Storage Battery preferred	67½
Philadelphia Electric	8
Philadelphia Rapid Transit	25
United Gas Improvement	84¼
Chicago:	*Closing.*
Chicago Telephone	116
Chicago Edison Light	138
Metropolitan Elevated preferred	67
National Carbon common	85
National Carbon preferred	119
Union Traction common	4
Union Traction preferred	14

Oak Park Elevated for the year ended June 30 carried a daily average of passengers, including transfers, of 47,256, an increase of 1,357.

Metropolitan Elevated June daily average was 133,974, an increase of 9,395.

The South Side Elevated daily passenger average for June was 101,770, an increase of 7,829.

Northwestern Elevated daily passenger average for June was 80,165, an increase of 4,328. The total number of passengers carried during the year ending June 30 was 29,132,871, an increase of 2,320,046. The revenue from the traffic was $1,456,643, an increase of $116,002.

Digitized by Google

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1051 describes Allis-Chalmers alternating-current generators, belted type.

THE SEYMOUR MANUFACTURING COMPANY, Seymour, Ct., is able to supply for prompt shipment German silver, wire, rods, sheets, blanks, etc., also phosphor bronze.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY has opened a sales office, under the management of C. A. Mann, at 822 New York Life Building, Omaha, Neb.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has removed its Salt Lake City (Utah) office to 212-214 South West Temple street. The Dallas (Tex.) district office has been removed to 418 Main street.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburgh, Pa., has issued a folder containing letters commendatory of the performance of the company's transformers when subjected to lightning discharges. There is also being distributed the July calendar card.

THE SOLAR ELECTRIC COMPANY, 161 South Canal street, Chicago, Ill., offers a color cap made of natural colored glass, which slips on the large end of any ordinary incandescent lamp and gives an attractive color effect for lighting electric signs and store windows.

THE PRINGLE ELECTRICAL MANUFACTURING COMPANY, INCORPORATED, 1906-1908 North Sixth street, Philadelphia, Pa., is the new title of a company formed from the business previously conducted by W. T. Pringle. This company manufactures electrical specialties.

THE GAIL-WEBB MANUFACTURING COMPANY, Buffalo, N. Y., is marketing a new holder for incandescent lamps which is particularly desirable for shops, draughting houses, etc., as the adjustments are such that the lamps may be placed in any position and held rigidly in place.

THE CHICAGO PNEUMATIC TOOL COMPANY, Chicago and New York, is now placing a great many of its air-cooled "Duntley" electric drills. These drills are wound for 110 and 220 volts, direct current only, and the company claims to consume less energy and develop more power than any other portable drill on the market.

THE AMERICAN TELEGRAPHONE COMPANY has begun the erection of a manufacturing plant at Wheeling, W. Va. For some time a corps of experts has been perfecting the company's apparatus for commercial purposes, and it expects shortly to be in a position to meet the demand, which, it is stated, is at present greatly in excess of the supply.

THE BECK FLAMING LAMP COMPANY, 58 West Fifteenth street, New York city, is now well equipped with laboratories and offices at this address, and a factory is being established at Weehawken, N. J. Louis J. Auerbacher is president of the company. The Beck form of electric arc lamps was illustrated and described in the ELECTRICAL REVIEW some weeks ago.

THE DE LA VERGNE MACHINE COMPANY, New York city, has published a forty-eight-page pamphlet describing various types of horizontal and vertical ammonia compression refrigerating machines and equipment for ice plants, breweries, packing houses, etc. The book is illustrated by a number of half-tones, a feature of the illustrations being the arrangement of composite views of plants installed in various parts of the world.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards at the following places: Knox, N. D.; Lowville, N. Y.; Adams, N. Y.; Paola, Kan.; Fort Wayne, Ind.; Camillus, N. Y.; Superior, Wis.; Holloway, Minn.; Pine Bluff, Ark.; Sioux City, Iowa; Chicago, Ill.; Louisville, Ky.; Ravenswood, W. Va.; Dundas, Ill.; New York, N. Y.; Kansas City, Mo.

THE HARTMAN CIRCUIT-BREAKER COMPANY, Mansfield, Ohio, is now manufacturing an electrically controlled high-tension oil switch. In operation the current is derived from the exciter, a storage battery or any convenient source of direct-current supply, and the operating solenoids may be wound for any standard voltage. This type of switch has some individual characteristics of which the bulletin published by this company gives an excellent description.

THE NEW YORK TELEPHONE COMPANY announces a record-breaking increase in business for the month of June. This company, with the New York & New Jersey Telephone Company, has gained in the five boroughs of Greater New York 3,591 new telephones, which is 1,374 more subscribers than they gained during June a year ago. The total gain for the first six months of the present year is 21,057, which makes a total of 263,000 telephones now in service and under contract in Greater New York.

THE PACIFIC ELECTRIC AND MANUFACTURING COMPANY, Napa, Cal., has been organized to manufacture and sell high-tension switches for indoor and outdoor use, and also high-tension line appliances. Arrangements have been made with F. G. Baum for the right to manufacture the oil switches and outdoor switches designed by him. These, it is stated, have given remarkable satisfaction in service. A bulletin describing the product is being prepared, and the company will be pleased to send full information upon request.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., reports the following orders for generators: Emfield Construction Company, Windsor Locks, Ct., one 180-kilowatt, three-phase, sixty-cycle, 2,300-volt, and one belt-type, 165-kilowatt, three-phase, sixty-cycle, 2,300-volt alternating-current machines. Warwick Iron and Steel Company, Pottstown, Pa., one direct-current generator, 150 kilowatts, 250 volts, for additional power for shop equipment. Fitchburg & Leominster Street Railway Company, Fitchburg, Mass., one 100-kilowatt, direct-current generator at 550 volts.

THE DE VEAU TELEPHONE MANUFACTURING COMPANY, 27 Rose street, New York city, will be represented at the convention of the National Electrical Contractors' Association by its president, Albert S. De Veau. This company is said to be the oldest independent manufacturing telephone company in this country, as it was established when the industry was in its infancy, and has been continued without interruption. The company makes an especially complete line of interior and intercommunicating telephone apparatus, and its equipments for the various interior services are now recognized as accomplishing the highest rating of success.

THE ELECTRIC SERVICE SUPPLIES COMPANY, Chicago, Ill., is issuing a unique little house organ known as "The Keystone Traveler," and it is its purpose to issue this booklet at intervals in the future. As recently published, this company is a consolidation of the business of Mayer & Englund, Philadelphia, Pa.; Porter & Berg, Chicago, Ill., and the Garton-Daniels Company and Electric Devices Company, Keokuk, Iowa. The first issue of the new publication has excellent pictures of the personnel of the new organization, and a general description of the products manufactured, which include street railway equipments and the Garton-Daniels lightning arrester.

THE CUTTER COMPANY, Philadelphia, Pa., in order to more advantageously handle its foreign business, has established offices and stores at 20 Great Russell street, London, W. C., England. W. E. Gibson will be resident manager. Mr. Gibson is well known in this country, having been associated with Robert W. Blackwell & Company. Mr. A. Edward Newton, president of the Cutter Company, will sail for Europe very shortly in the interests of the English branch. The Cutter Company's apparatus, it is stated, has met with a high degree of success abroad. There is now being distributed the 1906 edition of the company's "I-T-E" circuit-breaker catalogue. This contains 196 pages, nine by eleven inches, and very completely illustrates and describes the company's product, giving prices, code words and ratings. It will be sent free of cost, expressage prepaid, on request, to patrons and consulting engineers. To others the price is $1. Bulletins Nos. 99 and 100 describe and illustrate, respectively, the application of storage batteries to railway car lighting, and their application in railway electric signal and interlocking devices.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 3. NEW YORK, SATURDAY, JULY 21, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. L. W. MARSHALL, Manager
BOSTON OFFICE: Delta Bldg., 10 Post Office Square, M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad St., London, E. C., HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.
Copyright, 1906, by Electrical Review Publishing Co.
Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

CONTENTS.

EDITORIAL:
International Electrical Standardization . . . 85
A Rival of Electrical Transmission . . . 86
The Electrical Manufacture of Nitrites . . . 87
The Annual Convention of the National Electrical Contractors' Association . . . 88
The Meeting of the American Association for the Advancement of Science . . . 88
International Association of Municipal Electricians . . . 88
Bust of Volta Presented to the Institution of Electrical Engineers, of Great Britain . . . 88
New York Telephone Company's Bid to the City . . . 89
The Efficiency of Steam Plant . . . 89
Tests of Turbo-Generators . . . 90
Spier Falls Power-House, by C. J. Hopkins . . . 91
The Bunsen Society Meeting at Dresden, by John B. C. Kershaw . . . 94
Importation of Cryolite . . . 96
Power Transmission by Means of Gas . . . 96
Novel Cable-Laying Apparatus . . . 97
Society for the Promotion of Engineering Education . . . 98
Report Relating to Trolley Construction, Underground Conduit Construction and Subways for Chicago . . . 98
The World's Coal Supply . . . 98
Balancers, by J. W. Shuster . . . 99
Electric Pumping at Collieries, by Gerald H. J. Hooghwinkel . . . 100
The Engineering Experiment Station of the University of Illinois . . . 103
BOOK REVIEWS . . . 105
ELECTRICAL PATENTS . . . 107
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 108
METHODS OF GETTING NEW BUSINESS . . . 110
INDUSTRIAL SECTION:
"American" Portable Voltmeters and Ammeters . . . 111
Safety System for Elevators . . . 111
A Busy Erecting Shop . . . 112
Watertight Telephone System for Battleships . . . 113
Applying the Vacuum Impregnating Method with "Voltax" . . . 114
Steam Turbine Installations . . . 114
CURRENT ELECTRICAL NEWS . . . 115

INTERNATIONAL ELECTRICAL STANDARDIZATION.

At the recent electrical congress held during the Louisiana Purchase Exposition, St. Louis, 1904, there were two distinct bodies—the congress, an unofficial body composed of all who desired to join it; and another body, the senate, made up of delegates from a number of governments. One of the important actions taken by the latter body was the resolution passed unanimously that it be recommended by the delegates to their several governments that an international commission be formed which should study the problem of bringing about uniform practice in electrical matters. So far as the science is concerned, electrical units are international, but it was thought that great good could be accomplished if simpler methods of rating and testing electrical apparatus should be adopted. This recommendation has been adopted by the governments interested in the matter, and as a result a preliminary meeting was held in London during the latter part of June. The delegates met at the Hotel Cecil on June 26, and Mr. Alexander Siemens occupied the chair. The main business was to organize and formulate the rules which should govern the commission. A draught of rules had already been prepared for the commission by a committee of the Institution of Electrical Engineers, of Great Britain, and these were taken up on the day of the meeting and the following day, when, after some important amendments, they were adopted. These rules can not be made public until they have been submitted to the various governments concerned. Since, however, they have been carefully considered and accepted by the delegates, it is very probable that they will be satisfactory. It is said, however, that much care has been taken to prevent government interference with the work of the commission. The election of Lord Kelvin as first president of the commission will be hailed with gratification and pleasure throughout the world. It is a well-deserved recognition of his invaluable services both to science and industry, for there is no one to whom the electrical world is more indebted than to Lord Kelvin.

Now that these steps have been taken to secure coordination in the work of standardization, the question of how far such standardization should go becomes exceedingly important. There is no doubt that various national organizations of the countries whose governments are cooperating through this commission will bring their individual rules into agreement with those of the international body. In fact, it seems safe to assume that these governments will be largely guided by the recommendations of their local bodies and will select, as has been done already, their delegates from such organizations. The problem therefore narrows itself now to bringing about agreement among the electrical societies. Such rules as are adopted are likely, for this reason, to be conservative, and their extension will be slow. It is probable that this is a good feature, for it is better in such matters to go a little too slowly than a little too fast. An ill-advised rule is apt to injure and retard the industry, and to have a wider effect than a good one.

It will be remembered that at the recent convention of the American Institute of Electrical Engineers, at Milwaukee, this question of standardization was brought up by the presentation of a report by the Institute committee and during the discussion a good deal of disagreement was expressed, some members holding that the committee had gone entirely too far; others that parts of the rules were bad. The report was accepted, however, with the understanding that the rules were not

Digitized by Google

final, but were merely offered as suggestions, and that the whole subject would be gone over most thoroughly before they were brought up again for final adoption. If there is any doubt about the length to which it is desirable for our own committee to proceed in this work of standardization we may expect considerable divergence of opinion regarding the international rules. It will therefore be interesting to await the publication of the international committee's rules, to see whether they purpose merely laying down broad lines for the guidance of engineers and manufacturers, or if they intend specifying more definitely methods of testing, the performance of electrical apparatus and other matters of detail. If the former plan is the one proposed not much difficulty need be expected in obtaining an agreement, but should the commission have the latter idea in view its work will be slow and subject to much discussion and criticism.

A RIVAL OF ELECTRICAL TRANSMISSION.

Probably nine persons out of ten if asked what is the best way of transmitting power will say, "by means of electricity," and the tenth person will also give the same reply, unless he happens to be a gas engineer. Until very recently the problem of transmitting power in large quantities over great distances was considered almost purely electrical, and although text-books on power transmission and generation touched upon the possibilities of other means, such as compressed air and gas, these did not receive very much attention. Recently, however, power transmission by means of gas has been under discussion, particularly in England, where the local conditions at London may possibly have had something to do with the respectful consideration the proposal has received. It should be pointed out that these plans do not contemplate abolishing the electric motor. The gas is to be used for transmission only, and not for distribution, for in the latter use the motor is unrivalled. In fact, this fact is recognized by the gas engineers themselves, as is shown by the following quotation from Mr. C. A. Smith, when urging, in the *Electrical Times* (London) for June 21, power transmission by means of gas: "Of recent years a good deal has been said about generating electricity at the pit's mouth and transmitting it to various industrial centres, but it will be considerably cheaper to manufacture producer gas at the pit's mouth and transmit it through pipes to the industrial centres, there to use it in driving gas engines for generating electricity, and also for heating and furnace work. The question of distribution and transmission of power must not be confused. For the former it is agreed that there is no agent to compare with electricity; for the latter purpose it is suggested that it is more economical to employ producer gas and piping than electricity and cables." The emphasis is laid here upon the transmission of the cheapest form of gas, which is not only to bring cheap power to the city, but to do away with smoke.

This same problem is gone into with a little more detail by Mr. H. A. Martin in a paper before the Society of Arts, London, an abstract of which will be found on another page of this issue. Mr. Martin looks at the economical side of the problem, and proposes the use of gas because it will conserve the British coal supplies and prevent smoke. He gives figures showing that this can be done and the gas sold for about twenty-five cents per thousand cubic feet, and still bring a profit. Mr. Martin also dwells upon the transmission part of the work, presumably leaving the distribution of power to local electrical generating plants.

Mr. Martin's plans seem rather complicated. The system itself is simple: the gas is to be generated at the mines and transmitted under high pressure—about 500 pounds per square inch—to the power centres, where it will be used for heating and in internal-combustion engines. But to do this requires not only a producer plant at the mine, but a large compressor plant, otherwise the cost of pipes would swamp the undertaking. But this high pressure calls again for reducing-pressure plants at the receiving station, and it is proposed here to utilize the remaining gas pressure—which will be about half the initial—directly in expansion engines, which, in turn, drive dynamos to furnish electric power for lighting and other purposes. In other words, the gas transmission system, as well as the high-tension electrical system, requires a step-up-transformer station and a substation at which the pressure of transmission may be lowered to that at which it is to be utilized. Stress is also laid upon the by-products of the gas system—the production of fertilizer and the utilization of the cooling action of the expanding gas in refrigerating plants. The question seems at first sight to narrow itself down merely to a transmission problem, and this is the way in which it has been viewed in the two papers referred to above. But there are other considerations: the conversion from gas transmission to electrical distribution would probably not be as simple as has been assumed. The economic generation and distribution of electricity requires a fairly large power-house supplying a large district, and such a system must utilize a high potential and be equipped with substations. Moreover, it is probable that smoke legislation will, in the future, deal not merely with the production of soot, but with the setting free of large volumes of burned gases. It is likely therefore that the power stations will be located on the outskirts of a town, and will, for this reason, employ substations scattered throughout the various sections of the district supplied. It is such a system, using transmitted gas, which must be compared with an electrical system with a large generating station at the mine, and a number of substations in the city. Transmission by gas will not eliminate any part of the electrical system except the transmission lines, and hence, when figuring the cost of power transmitted electrically, the cost and the losses of the substations must not be considered.

Transmission by gas, it is true, will solve some of the problems not solved up to the present time by electrical transmission. While all admit that no small motive power can compare with the electric motor, and that electric lamps are the best illuminating agents yet devised, when it comes to heating, the electrical system is at a disadvantage. Electrical heaters are per-

Digitized by Google

fectly efficient—that is to say, all the energy supplied to them is converted into heat, but the losses which have taken place before the energy reaches the heater are very great, while in the gas system all of the energy of the gas is converted into heat, though all may not be utilized. In other words, we start with our energy in the form of heat, which is obtained by burning the gas. In the electric system we must carry this through a number of transformations, one of which is not very efficient. This disadvantage applies only to electric energy generated from fuel. When obtained from other sources the transformation ratio is high, and the cost depends mainly on the cost of the apparatus.

Since the introduction of electrical power into industrial and commercial life there has been a marvelous development. Methods of communication have been vastly increased; the efficiency of the worker and the electric motor is revolutionizing our methods of applying mechanical power either for transportation or manufacture. It is becoming such an important agent that all water powers have taken on a new significance and are rapidly becoming one of the most coveted of a state's resources. The utilization of these powers has been by electrical means, and while we have divided this process into parts—generation, transmission and distribution—we have considered these divisions rather from the standpoint of convenience. In this work we have had no rivals, but now the gas man would have us believe that when it comes to transmitting power obtained from fuel that all of our work has been vain and that we must fall back upon other methods. The proposal is interesting, and it will be carefully analyzed; but until further evidence is produced the nine out of ten will still retain their original opinion.

THE ELECTRICAL MANUFACTURE OF NITRITES.

At the annual meeting of the German Bunsen Society, which was held at Dresden during May last, the report of which appears on another page of this issue, a most satisfactory discussion took place upon the manufacture, by means of the electric discharge, of compounds of nitrogen and oxygen. This is a subject which has been referred to frequently during the past five years, and upon which a number of papers have been read. Generally, however, such discussions have considered merely one phase of the problem, or have dealt with but one proposed solution. At the Bunsen meeting, to the contrary, various phases of this matter were considered. It was attacked from the chemical side with a lecture upon the physical properties of nitrogen, delivered by Professor F. Foerster, of Dresden. The physico-chemical side was presented by Dr. W. Nernst, of Berlin, who read a paper upon "The Equilibrium and Reaction Velocity Ratios of Nitric Oxide Formation." A second paper by Professor Foerster described the Birkeland and Eyde system, which is now in actual operation in Norway. Professor M. Le Blanc, of Karlsruhe, discussed "The Estimation of Nitric Oxide in Air;" Professor J. Klaudy, of Vienna, the technical methods for converting the nitrous gases into nitric acid and its salts; and Professor Adolf Frank, of Charlottenburg, in the last paper of this series discussed the fixation of atmospheric nitrogen by means of calcium carbide. This list of papers, as well as the names of their authors, show how thoroughly the matter was threshed over.

It seems that the chemistry of the process has been neglected, as have also the thermal relations, but these two phases were well treated in the two papers by Nernst and Le Blanc. The latter showed that the methods generally employed in estimating the nitric oxide are inaccurate, as there are a number of conditions which influence these determinations greatly.

The discussion by Nernst was particularly valuable. As is well known, the formation of nitric oxide is an endothermic reaction, as energy must be supplied to the two gases before they will combine; but if the product of the reaction be heated somewhat higher, it will decompose again. Hence it is necessary to remove the products of the reaction from the ozone in which the combination takes place quickly. A rapid circulation of air through the furnace would seem desirable for this reason, but a rapid movement of the air will give a product dilute in nitric oxide. It is therefore highly essential that the rate at which air is forced through the furnace should be determined. This rate, of course, depends upon a number of things—on the time during which the air is exposed to the action of the flame, and upon the temperature within the furnace. It is this important part of the problem that was dealt with by Nernst. He obtained an equation enabling him to calculate the speed at which the reaction takes place, from which it is possible to compute the time required and any given temperature to reach a given saturation of nitrous oxide. His computed concentrations agree well with those found experimentally.

The discussion of the technical methods for carrying out this reaction indicates that the Birkeland and Eyde process is in successful commercial operation. This, it seems, is the only one of the many processes which has survived the test of actual operation. The process, it will be remembered, is that in which a wide electric arc is produced by drawing an alternating arc between the poles of a powerful electromagnet. The air to be treated is passed through the furnace in which this flame is maintained. According to Foerster, this furnace takes 500 kilowatts, ten per cent of which is used in producing the magnetic field. Through this furnace twenty-five cubic metres of air are passed per minute, giving a concentration of two per cent of nitric oxide. Expressed in another way, the furnace produces from seventy to eighty grammes of nitric acid per kilowatt-hour, equivalent to from 1,100 to 1,300 pounds per kilowatt-year. The cost of power is put at a little less than 0.15 cent per kilowatt-hour, corresponding to 3.1 cents per pound of nitrogen in the form of nitric acid. The same amount of nitrogen in the form of Chili saltpetre costs, in Europe, over four times as much. The first figure, it must be remembered, takes in only the cost of power and considers nothing in regard to the cost of operating the plant. It was pointed out that during last year 1,500,000 tons of nitrate of soda were used, to produce which by the electrical method just described would require about 2,500,000 horse-power. One-third of this material was consumed by Germany alone, where, it is said, there are waste gases from blast furnaces now in operation which would produce 500,000 horse-power, which might be used to supply part, at least, of Germany's demand.

Digitized by Google

THE ANNUAL CONVENTION OF THE NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

CLEVELAND, OHIO, JULY 18, 19 AND 20.

Special Telegram to the Electrical Review.

CLEVELAND, OHIO, JULY 18.—The sixth annual convention of the National Electrical Contractors' Association was held in Cleveland, Ohio, July 18, 19 and 20. All of the members of the several committees arrived in Cleveland for conferences on Monday, July 16, and on Monday morning a meeting of the board of the national association was held. On Monday afternoon the Electrical Contractors' Association of Ohio held its annual meeting, this being a formal meeting, as its interests were merged with the national association's meeting.

About 450 men, representing the electrical contracting industries of the country, and a number of representatives of manufacturing companies and supply houses were present when the convention of the National Electrical Contractors' Association was called to order by A. Oppenheimer at 10.30 o'clock Wednesday morning. The first session was an open meeting, though the later meetings were participated in only by members of the association. An exception to this rule was the session on the third morning, to which all the visitors and attendants were invited.

At the opening meeting Chairman Oppenheimer introduced the Hon. Tom L. Johnson, mayor of Cleveland, whose witty and brilliant remarks elicited a great deal of enthusiasm. Other addresses were made by W. B. McAllister, president of the Builders' Exchange; F. M. Lawton, state director for Ohio, and a very graceful response was made by President James R. Strong. Frank E. Patterson, of New York city, then read a paper entitled "Engineering Problems." The opening session was attended by a number of ladies.

Among those in attendance were the following gentlemen, many of whom are well known in manufacturing and commercial lines: V. C. Gilpin, R. G. Kennedy, L. H. Keller, O. C. Turgeon, Robert Garland, H. C. Adams, H. B. Kirkland, E. J. Kulas, M. C. Morris, J. M. Fullman, Bailey Whipple, C. R. Sloan, Thomas T. Richards, Thomas G. Grier, F. M. Harrington, I. A. Bennett, E. R. Dull, P. H. Hoven, R. L. J. Fortune, A. O. Einstein, Francis Raymond, F. Trumbel, David Aiken, C. H. Haddiel, C. M. Crofut, F. F. Skell, George F. Searing, W. P. Crockett, J. B. Olson, Charles Auth, Warren Ripple, O. R. Woodock, E. W. Rockafeller, B. F. Bechtel, H. M. Gail, Charles W. Webb, M. F. King, W. Brewster Hall, Thomas J. Ryan, D. J. B. Baldwin, W. S. Greene, H. D. Betts, E. S. Ford, D. L. Markle, R. B. Bragins, F. M. Swan, William Ennis, L. P. Sawyer, W. Dusenberry, William Mill, John W. Brooks, A. W. Little, F. W. Bliss, C. E. Corrigan, W. J. Barr, W. E. Phelps, Thomas E. Barr, R. A. Schoenberg, C. O. Baker, Alex Henderson, Alpha H. Kling and W. G. Tingley. S. H. G.

The Meeting of the American Association for the Advancement of Science.

The fifty-sixth meeting of the American Association for the Advancement of Science was held at Ithaca, N. Y., June 28 to July 3. This was an extra summer meeting, the winter meeting at New Orleans, La., having been held six months previous, and the next winter meeting being planned for New York six months later. In consequence there were no presidential addresses and no election of officers, except to fill vacancies, and but little action of any kind was taken by the council.

The societies in session were as follows: American Physical Society, American Chemical Society and the New York chapter of the Society for Chemical Industry, Society for the Promotion of Engineering Education and the American Microscopical Society. Sessions were held by Section B, Section D, Section E and Sections F and G.

Cornell University placed its buildings at the disposal of the association, and each day furnished a mid-day lunch to the members. An informal smoker was held on the evening of Thursday, June 28, at the Town and Gown Club. The formal opening and dedication of Rockefeller Hall, the new physical laboratory of Cornell University, on the afternoon of Friday, June 29, included addresses by President Schurman, Professor E. L. Nichols, Dr. Elihu Thomson, Dr. W. H. Welch, and a letter from Professor W. A. Anthony read by Professor E. Merritt.

On Saturday evening, June 30, an address was presented by Professor Henry S. Carhart, of the University of Michigan, on "The South African Meeting of the British Association for the Advancement of Science," illustrated by a series of lantern slides.

On the afternoon of Monday, July 2, a reception was given at the residence of Dr. and Mrs. Andrew D. White.

International Association of Municipal Electricians.

The eleventh annual convention of the International Association of Municipal Electricians will be held at New Haven, Ct., August 15, 16 and 17. An excellent programme of papers has been arranged, the following having been promised:

"History of the Fire and Police Telegraph," by Adam Bosch, Newark, N. J.

"Details of Certain Auxiliaries to Fire-Alarm Apparatus," by J. B. Yeakle, Baltimore, Md.

"Advisability of Protecting Municipal Electricians by the Civil Service Laws," by Jerry Murphy, Cleveland, Ohio.

"Comparison of Underground and Overhead Wiring, and of the Relative Values of Single Rubber-Covered Wire and Lead-Encased Cable for Underground Construction," by W. H. Thompson, Richmond, Va.

"Conditions Surrounding the Inspection of Wires in the Southwest," by Clarence R. George, Houston, Texas.

There will also be a question box, which has been compiled by W. M. Petty, Rutherford, N. J.

Bust of Volta Presented to the Institution of Electrical Engineers, of Great Britain.

On Monday, June 25, the electrical engineers who were visiting England were entertained by the Institution of Electrical Engineers at the Hotel Cecil, London. There were about 500 persons present, among them being Mr. J. Gavey, president of the institution; Lord Kelvin, and Sir Joseph Swan. A feature of the reception was the presentation to the institution of a bronze bust of Allessandro Volta by the Associazione Elettrotecnica Italiana. The presentation was made through Mr. E. Jona, president of the associazione. A number of prominent electrical engineers took part in the speech-making, among them being Mr. Gavey, Professor J. L. Farney, representing the Association Suisse des Électriciens; Mr. E. Hospitalier, past-president of the Société Internationale des Électriciens; Dr. E. Budde, president of the Verband Deutscher Elektrotechniker; Dr. Emil Naglo, representing the Elektrotechnicher Verein; Dr. S. S. Wheeler, president of the American Institute of Electrical Engineers, and Mr. Guido Semenza, honorary general secretary of the Associazione Elettrotechnica Italiana.

Digitized by Google

New York Telephone Company's Bid to the City.

The New York Telephone Company has partly accepted and partly refused the terms proposed by New York city as the basis of an arrangement for the continued operation of its system in the city without competition. The company has made answer in a letter sent to the Board of Estimate, replying to a resolution passed by that board on June 15, which was practically to the effect that if the company did not ask for a franchise which would carry with it the payment of a percentage of its yearly revenues to the city, and would not confess judgment in the matter of $6,000,000 rental claims which the city has brought against the Empire City Subway Company, the board would proceed to consider the advisability of granting a franchise to the Atlantic Telephone Company to put in operation a competitive telephone system. The letter is signed by Charles F. Cutler, president of the New York Telephone Company, and U. N. Bethell, president of the New York & New Jersey Telephone Company. In effect, the company offers the city the payment of $3,500,000, to be paid in twenty-five years, and $200,000 a year thereafter. It will make still further reductions in its rates for service, and it will make a fifty-per-cent reduction in its charges for municipal telephone service.

The company will not surrender its franchise rights, as it believes that it would be impossible to continue a sound development of its system, and would be impossible to make further reductions in rates unless the company was in a position in the future to deal freely with the constantly changing conditions.

The total compensation offered by the Atlantic Telephone Company for a twenty-five-year franchise amounts to $2,680,000 for the twenty-five years, while the total compensation offered by the New York Telephone Company for the same period is $3,500,000. The Atlantic company has offered an additional $100,000, to be paid within thirty days after the granting of the franchise. The Bureau of Franchises has suggested an initial cash payment of $250,000. If this sum should be agreed upon the total payments of the Atlantic Telephone Company would be brought up to $2,930,000.

The company announces that it is impossible for it to confess judgment involving a forfeiture of its subways, and it will consent to do everything possible to expedite the trial of the action, or that if it should be deemed desirable it will consent to the settlement of the question by arbitration.

The Efficiency of Steam Plant.

Two papers upon this important subject were read and discussed in London on Friday, June 22, at the eleventh annual gathering of that very exclusive and select body known as the Incorporated Municipal Electrical Association. Abstracts of the more important portions of the two papers will appear in a later issue.

The first of these papers dealt with the use of live steam for heating the feed-water of boilers, and was contributed by George Wilkinson, chief electrical engineer of Harrogate. The live steam feed-heating apparatus used in these experimental trials was constructed by Messrs. Dales and Braithwaite, of London, and is based upon the principle of spraying the feed-water into a chamber which is connected with the steam portion of the boiler. This system of preheating differs from the much-discussed thermal storage system of Drewitt Halpin in that all the feed-water used in the boiler is passed first through the economizer and then through the live steam feed heater, and is thus raised nearly to the steam temperature before it enters the boiler. Mr. Wilkinson has failed to state, however, that this system of working is no new proposal, the raising of all the feed-water to the steam temperature having been recommended by Mr. Hamilton and also by Messrs. Booth and Kershaw, in their much-discussed Institution paper read in London on January 26, 1905. The experiments made at Harrogate by Mr. Wilkinson were carried out with an ordinary type Lancashire boiler, provided with a Green type of economizer of 288 pipes. The economizer alone raised the feed to a temperature ranging from 213 degrees Fahrenheit to 265 degrees Fahrenheit. The Dales and Braithwaite apparatus added from eighty-three degrees Fahrenheit to 120 degrees Fahrenheit to this temperature, and the feed-water in these experiments could thus be raised to a temperature ranging from 333 degrees Fahrenheit to 348 degrees Fahrenheit. The temperature of the steam during these tests of the live steam feed heater was between 353 degrees Fahrenheit and 360 degrees Fahrenheit. Six steam-raising tests were made during the trials of this system at Harrogate—one with cold-water feed, two with economizer feed and three with both the economizer and the live steam heater in operation. The results showed a gain of 12.7 per cent in the combined efficiency of the plant, when the live steam heater was in operation and the consumption of coal was at the rate of 27.31 pounds and 29.53 pounds per square foot of grate area per hour; while at the lower rate of fuel consumption the gain by the use of the live steam feed heater was 7.0 per cent. If the tests carried out by Mr. Wilkinson are correct (there appears no reason for doubting their accuracy), the gain in the thermal efficiency of a boiler by use of a live steam feed-water heater has been clearly proved under working conditions. The claims made by Drewitt Halpin, by Mr. Hamilton, by Messrs. Booth and Kershaw, by Colonel Crompton and others, for the advantage and economy of hot feed-water, are therefore at last likely to receive recognition and application from the branch of the engineering profession engaged in the generation of electricity.

Perhaps the most suggestive portion of Mr. Wilkinson's paper, however, is that in which he asserts that a much higher evaporative duty than at present is usual may be obtained from steam boilers by the use of hot feed-water and intensive combustion. He considers that a coal consumption treble or quadruple that at present considered good work is possible, with a boiler plant properly designed and equipped for the new system of working. A method of trebling or quadrupling the steaming power of their present boiler plant by comparatively simple means would thus seem to be within reach of all steam users. Possibly Mr. Wilkinson will follow up this suggestion by carrying out at Harrogate some tests of the live steam feed heater, with still higher rates of fuel consumption than the 29.5 pounds per square foot of grate area, given in number four of his boiler tests. A boiler with a specially large fire grate and combustion chamber would be required to give this method a fair trial, but the cost of providing this would be saved, we believe, in the reduced consumption of fuel; one of the most interesting of Mr. Wilkinson's observations being that at these high rates of combustion the whole flue space of the boiler becomes filled with incandescent gas. A considerable portion of Mr. Wilkinson's paper is devoted to the theoretical side of the subject, and an attempt is made to answer the question, "Why should a boiler show a higher thermal efficiency when fed with water at or near the temperature of ebullition?" The experiments of Sir William Anderson, Sir Frederic Bramwell, Miss Bryant, Mr. Dales and A. W. Hamilton are referred to in this connection. These all prove that the higher the temperature of

Digitized by Google

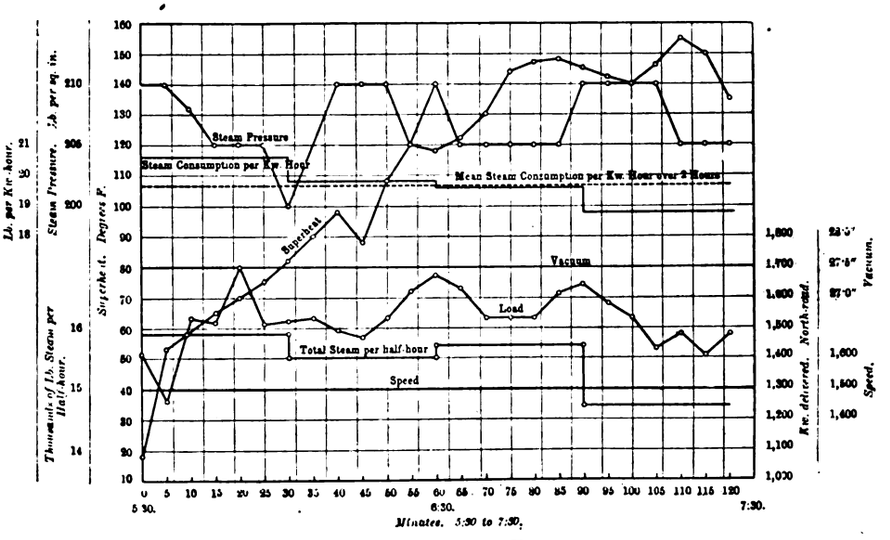
the water on the one side of the boiler plate, the greater is the rate of heat transmission from the source of heat on the other side of the plate, and that the maximum of heat transmission occurs during ebullition. Many theories have been advanced by boiler engineers and others to account for this fact. The theory which finds most favor with the author of the paper we are discussing is the following: At the moment of its conversion into steam, the water takes up from the plate, with great rapidity, the whole of the thermal energy represented by the latent heat of steam (or about four times that required to raise the temperature of the same volume of water from zero degree Fahrenheit to 212 degrees Fahrenheit). Therefore, at those portions of the boiler where ebullition is occurring, the rate of heat transmission must necessarily be much higher than at those portions where water is being raised to the ebullition point. The objection usually advanced to meet this theory is, that the production of steam from water at the temperature of ebullition does not occur instantaneously at the surface of the plate. A small bubble of steam forms here, it is true, but this detaches itself from the plate almost as soon as it is formed, and as it rises up through the heated water it gains enormously in size. The formation of steam is occurring, in fact, at all stages of its upward journey, and not only at the surface of the boiler plate; and this formation of steam and absorption of heat only ceases when the bubble arrives at the surface of the water and escapes as wet steam. Another objection to the theory advanced by Mr. Wilkinson is that, if true, boilers would produce steam with almost explosive violence, for all the water in contact with the boiler plates would be converted into steam instantaneously. A theory which is proof against all hostile criticism has, in fact, yet to be formulated, and it would be of much assistance in this matter if one could construct a high-pressure boiler of glass or of some other transparent material, which would allow one to see what was occurring during ebullition. Until this is done we fear the exact cause of the gain in thermal efficiency of boilers fed with water at the temperature of the steam will remain unexplained. However, while we thus dismiss the theoretical side of Mr. Wilkinson's paper as of little value, its practical importance is great, and we hope all engineers interested in boiler working and management will read and study the abstract which will be published in a later issue.

Walter A. Vignoles, the author of the second paper, is chief electrical engineer of Grimsby, and his paper entitled "The Efficiency of Steam Plant" is an attempt to explain why the coal consumption is much higher in central generating stations than in marine work. Upon the subject of boiler-house economy, Mr. Vignoles has nothing novel to say, and as he evidently never makes any tests either of his fuel or of his waste gases, we can not regard the plant under his charge as one which is being worked to the fullest advantage. The figures given in Table 4 of Mr. Vignoles' paper confirm this opinion. Under "Plant Economy," Mr. Vignoles tabulates the results of tests made at the Grimsby works, showing the extra steam consumption due to the stand-by and other losses. These losses and the diagrams given in Mr. Vignoles' paper are chiefly interesting to electrical engineers, but his remarks concerning the wasteful steam consumption of the auxiliary engine plant have a more general application. In the tests made at Grimsby, Mr. Vignoles found that the auxiliaries consumed 5.1 pounds of steam per kilowatt-hour as compared with 31.6 pounds for the main engines. Thus nearly one-seventh of the steam generated was used for the auxiliary engine plant. Mr. Vignoles recommends the use of electrically driven pumps in order to reduce these losses.

The two papers which have been discussed above show that electrical engineers are taking an intelligent interest in their steam-raising plant, and are beginning to realize that it is in the boiler house, rather than in the dynamo room, that the greatest scope for improvement and economy lies. Messrs. Booth and Kershaw, in their paper entitled "Fuel Economy in Steam Power Plants," read before the Institution of Electrical Engineers in January, 1905, emphasized the importance of the boiler in the economical generation of electricity, and suggested experiments upon the lines of those carried out by Mr. Wilkinson at Harrogate. It is obvious that both Messrs. Wilkinson and Vignoles have been close students of that paper.

Tests of Turbo-Generators.

In an interesting article appearing in the London *Electrician* for June 22 and 29, the equipment of the new Brighton electric power station of the Brighton corporation is described. This power station is equipped with turbo-generators rated at 1,800 kilowatts. They are of the double-flow Westinghouse-Parsons type, in which steam enters an annular chamber at the centre of the cylinder, first expands



TURBO-GENERATOR TEST.

in nozzles, and impinges against blading of the compound De Laval type. The steam then continues to flow towards each end of the turbine and enters the Parsons portion, from which it finally finds its way to the condenser. The pressure employed is 180 pounds, with 150 degrees of superheat. The condensers give a vacuum of not less than twenty-seven and one-half inches. The actual conditions during the test are shown graphically in the accompanying diagram, which is reproduced. On an average they are: steam pressure, 206 pounds per square inch; superheat, 123 degrees Fahrenheit; vacuum, twenty-seven and one-half inches; load, 1,780 kilowatts; steam consumption per kilowatt-hour, 19.67 pounds. Although during this test the steam pressure was somewhat above the guarantee, both the superheat and the load were considerably below that called for—factors which count more than steam pressure in turbine operation. Allowing for the conditions, the contractors compute that the steam consumption per kilowatt-hour would be 19.3 pounds, under the guaranteed conditions.

Digitized by Google

Spier Falls Power-House.

By C. J. Hopkins.

THE Spier Falls power-house is at present the largest and most important of several operated by the Hudson River Electric Power Company. While the name of this place is familiar to many, yet, on account of its secluded location on the upper Hudson river—about ten miles west of Glens Falls—its characterizing features are not generally known and will undoubtedly be of interest to those unacquainted with them.

That portion of the building which houses the present plant at Spier Falls, having an aggregate capacity of 14,300 kilowatts, was completed in 1905, and extensions to this power-house for the installation of four additional units, which are already well advanced, will give an ultimate capacity of approximately 25,000 kilowatts.

The nominal water head is eighty feet. The present transmission voltage is 30,000 at a frequency of forty cycles per second.

The issue for June 30 of the ELECTRICAL REVIEW contains an article entitled "Towers for the Transmission Line between Ballston and Amsterdam, New York," describing what is perhaps the most recent progress in electrical transmission, that of a 60,000-volt transmission line supported from steel towers spaced 550 feet apart. The development of this line, which is being constructed by the Hudson River Electric Power Company, will attract considerable attention, as the practicability of the 80,000-volt line, designed to transmit power from the Zambesi falls has received severe criticism.

It was not until the year 1900 that, as a result of organization under the direction of Eugene L. Ashley, president of the operating company, now known as the Hudson River Electric Power Company (but for some time after its formation titled the Hudson River Water Power Company), that Spier Falls began to have a commercial value in the eyes of consumers of power. On April 1 of that year the International Contracting Company, with a force of some 600 men, commenced work for the construction of the large dam and power-house now existing, their preliminary operations comprising the digging of test holes, ten feet square, to locate the rock. The contracting company worked till about November 15, 1900, when difficulties arose causing work to be suspended. After some weeks of delay construction was again resumed with renewed energy, the promoting company itself taking charge, employing some 1,100 hands and working day and night. The nature of this undertaking may be partly comprehended by the fact that thirty-three arc lights and twenty Well's lights

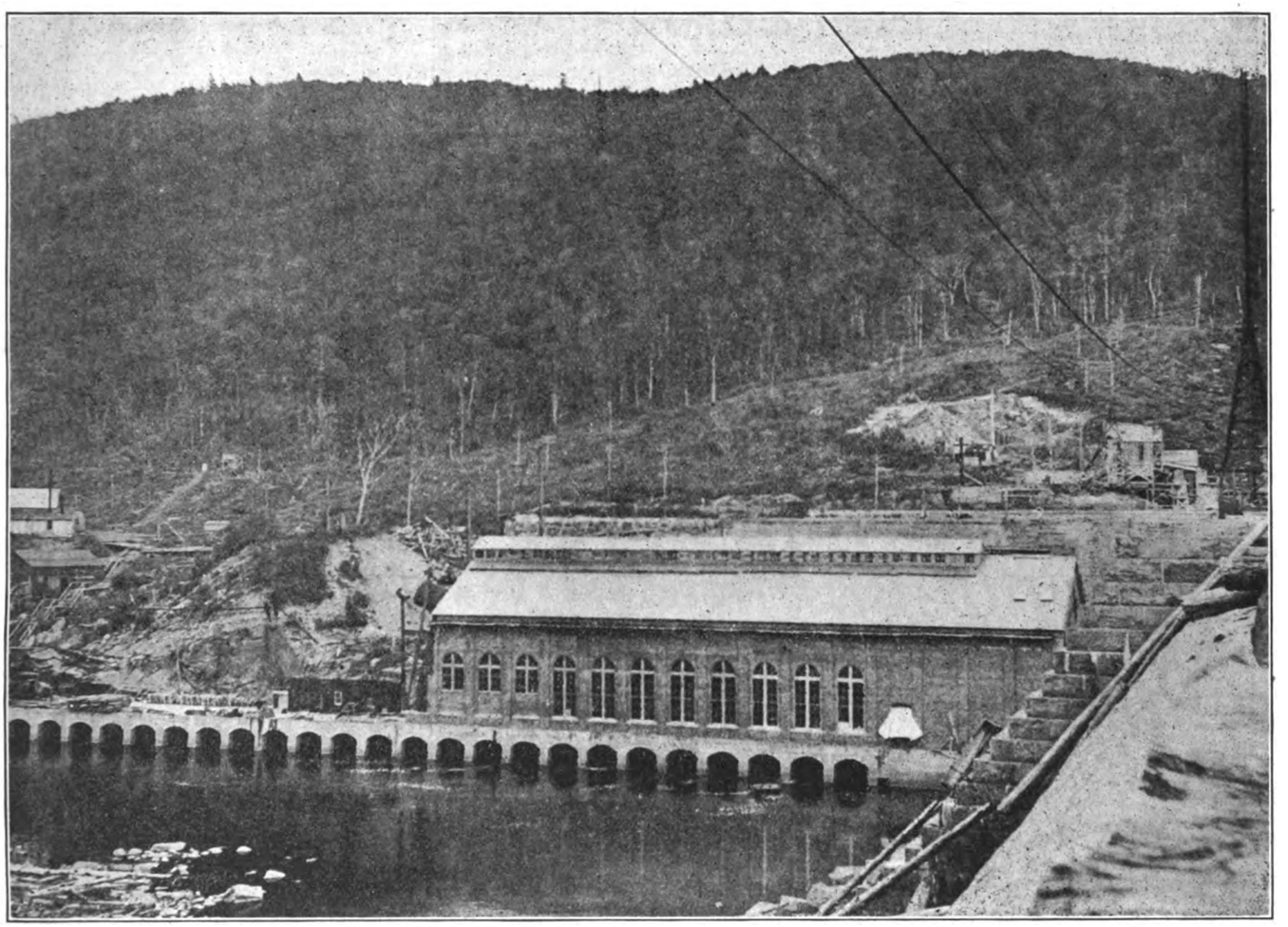


FIG. 1.—GENERAL VIEW OF THE SPIER FALLS POWER-HOUSE AND THE TAIL-RACE. TAKEN DURING A PERIOD OF LOW WATER.

Digitized by Google

were used throughout the nights. This force of labor was dismissed during the year from the fall of 1903 to that of 1904. Continuous operation of the plant was started in September, 1903, although at this time the dam was incomplete, and a head of sixty-four feet only instead of eighty feet was available, nevertheless, owing to the fact that the turbine ratings are forty per cent greater that the rated capacities of their respective generators, the wheels were able to develop full-rated output and maintain normal speed. At this early stage the protection provided for the apparatus was of a very temporary nature—which together with a somewhat congested arrangement of switch gear did not fail to bring its troubles, especially during electrical storms, or to place the operators in a somewhat nervous state of mind during these periods in particular. This temporary switch house may be seen in Fig. 3.

Power was originally supplied at 15,000 volts. The transmission line in its first stage was not capable of satisfactorily withstanding the higher pressure (30,000 volts) as intended, the insulators being perhaps the weakest link in the chain and accounting for this condition. These insulators were replaced as early as possible by a porcelain type of more liberal design consisting of three sections, having a maximum diameter of eight and one-half inches and an assembled height of seven and one-quarter inches, approximately.

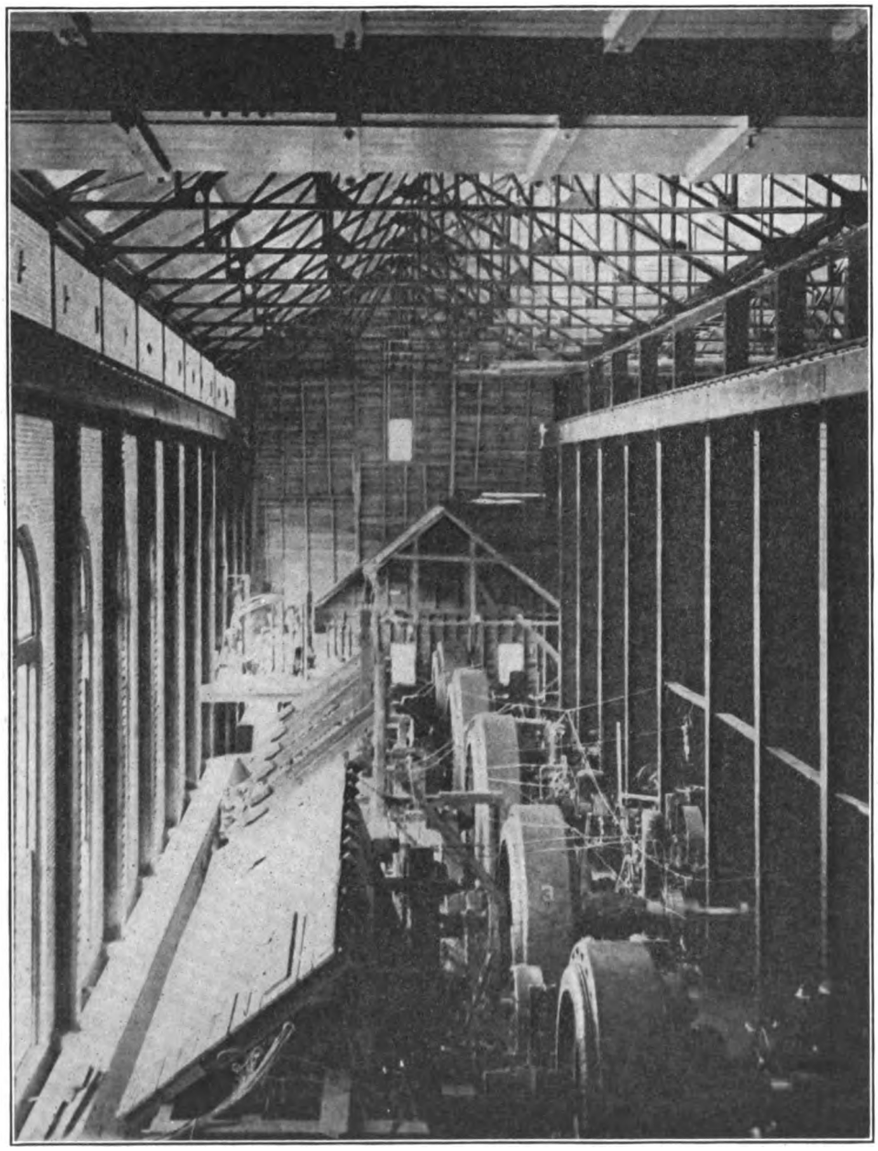


FIG. 2.—INTERIOR VIEW OF SPIER FALLS POWER-HOUSE, SHOWING FIVE OF THE SIX LARGE GENERATORS.

Fig. 1 is a general view of the power-house and tail-race taken from the centre of the dam during a period of low water. The width of the river near the top of the dam is about 1,500 feet, while the highest portion of the dam is about 100 feet above the bed of the river. Before the construction of this dam the fall of the water was slight, assuming more of the nature of rapids; so that the building of this large water barrier necessarily produced a considerable flooding of the country above it, increasing the width of the river some three or four times, and forming a most valuable reservoir, which on account of the formation of the adjacent land did not require any additional lateral fortifications. The property owned by the company in this vicinity is extensive, amounting to some 800 acres. The course of the water which passes over the dam has been diverted from its original channel, now occupied by the tail-race, by a rock partition shown in the lower portion of Fig. 1, thus preventing its interference with the tail-race. It may also be seen from this figure, by comparing the number of arches in the tail-race over which the building stands to the total number, that the ultimate capacity to which it is anticipated the power-house may be extended is about twice its present size; on the other hand it follows from the fact that this photograph was taken from the spillway that there are times in which the water is not too plentiful, thus indicating that unless very extensive reservoirs were provided such a plant could only be operated in its entirety for a few months in the year.

Fig. 2 is an internal view of the power-house taken in the fall of 1905, showing five of the six large generators, No. 1 being excluded.

The entire electrical equipment of this station was manufactured by the General Electric Company, Schenectady, N. Y. It comprises six large units, four of 2,500-kilowatt and two of 2,000-kilowatt capacity each; there is also a small unit of 300 kilowatts. The generated voltage is 2,000 at a frequency of forty cycles per second. The hydraulic plant consists of six large and three small turbine water-wheels, the latter operated as parasites of the large penstocks. The accompanying table gives the types and sizes of these wheels.

Those who are familiar with the operation of hydraulic plants realize the importance of the water-wheel governors in this undertaking. Spier Falls is provided with two types—the Lombard and Sturgess. Experience shows that while similar types of governors may perform their duty satisfactorily in parallel, such is not

Digitized by Google

necessarily the case when it becomes imperative to run two or more types in a similar manner.

Considering the actuating principles of different types to governors, the reason for the above fact is not difficult to comprehend. The one type being more sensitive than the other tends to take up all the regulation, while the more sluggish will hold its machine at a constant load. Adjustments might possibly be made to offset this difference, but, again, experience shows that owing to the complicated mechanism involved in these machines such manipulations are not very permanent in their effect.

Referring to Fig. 2, the outline of the original temporary wooden structures may be discerned from the remaining portion of the roof in the further end of the building and over the switchboard then in operation. In the far corner of the building is the new switchboard gallery. The new permanent switchboard since completed was damaged by fire a few months ago.

Designation.	Type of Turbine.	Size. Inch Diameter.	Capacity. Horse-Power.	Speed. Revolutions per Minute.
No. 1	Swain, double wheel	54	5,250	240
Nos. 2, 3	McCormick " "	42	4,000	300
Nos. 4, 5, 6, 7	" " "	54	5,250	240
For 300-kilowatt generators	" single "	22	....	400
Exciters 1 & 2 (150 kilowatts each)	" " "	15	....	....

Note—The installation of No. 7 turbine is in progress.

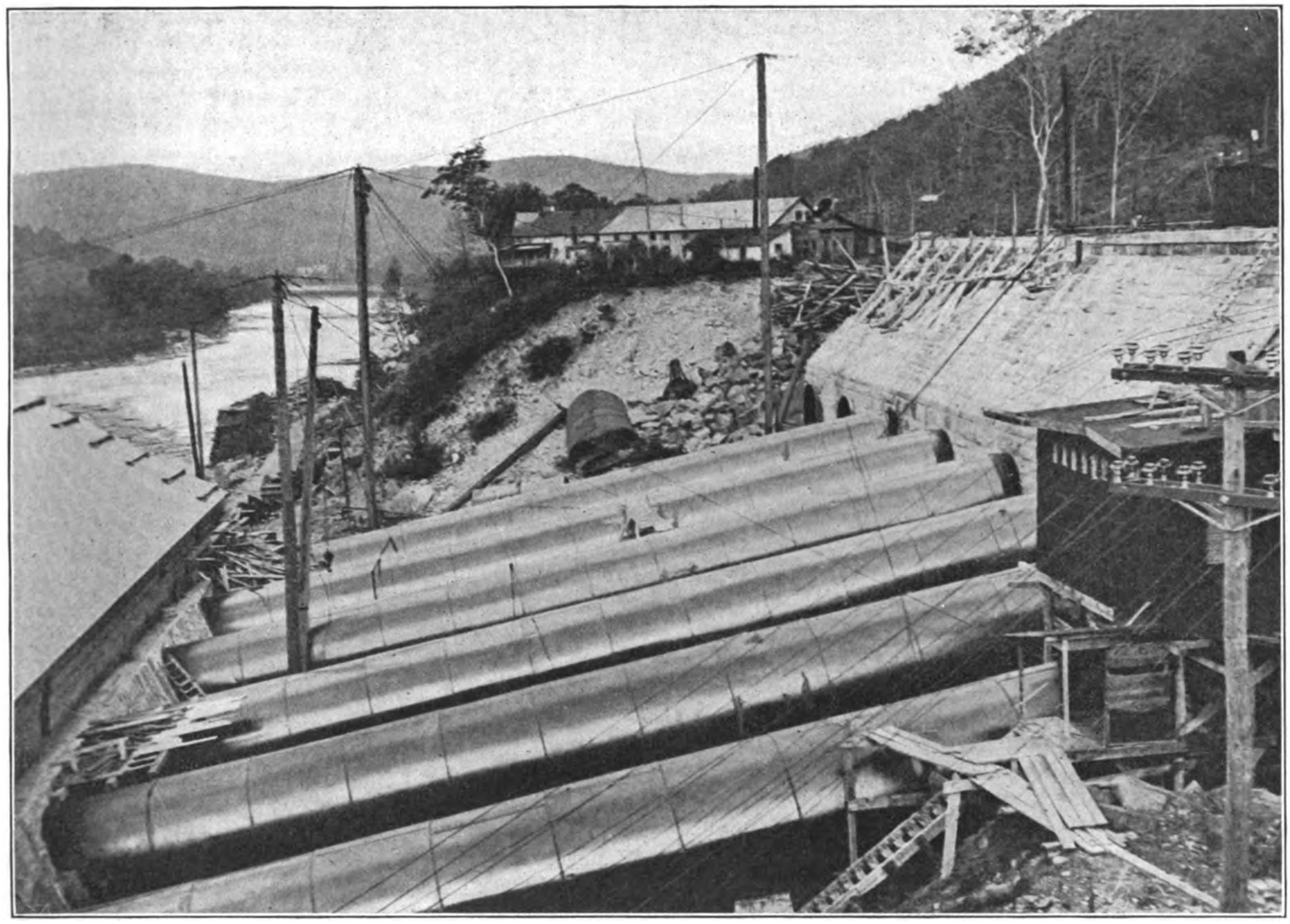


FIG. 3.—SHOWING THE SIX COMPLETED PENSTOCKS OF THE SPIER FALLS POWER-HOUSE AND PROVISION FOR TWO ADDITIONAL IN THE REAR.

Fig. 3 shows six completed penstocks with provisions for the addition of two similar ones; these are six feet in diameter and about fifty feet in length. In the centre of Fig. 3 may be seen a piece of collapsed penstock—this is of particular interest, as it indicates one of the calamities that may befall such apparatus as the result of atmosphere pressure should the penstock be emptied when the air vent at the head of this enclosed water channel is frozen up or otherwise choked with foreign matter.

The four three-phase transmission lines, which leave the power-house, are shown in Fig. 3, passing over one pole and attached to the same by a double set of insulators—beyond this point the transmission lines are carried on two pole lines, one supporting a No. 000 B. & S. transmission line to Glens Falls and the other two No. 000 lines and one No. 0 line, which after passing through a switch-house in Saratoga, are continued to Ballston substation, whence two lines continue to a terminal at the General Electric Company's works *via* another switch-house at Alplaus, to which point the Mechanicsville power-house feeds direct.

The fact that the Hudson River Electric Power Company owns and operates plants at Mechanicsville and Schoharie Falls, in conjunction with that at Spier Falls, is connecting its recent installation at Utica with this station, has a power-house in course of development on the Sacandaga river, and is also interconnected with the General Electric Company's power-house at Schenectady, makes the supply of power furnished by them most reliable, so much so that a complete shutdown might be termed impossible.

Digitized by Google

The Bunsen Society Meeting at Dresden.

Important Papers upon the Fixation of Atmospheric Nitrogen.

By John B. C. Kershaw.

THE thirteenth annual meeting of the German Bunsen Society was held at Dresden from May 20 to 23, and was attended by a large number of members of the society, including Nernst, Foerster, Le Blanc and other leading German electrochemists. The recently held International Congress of Chemists at Rome no doubt interfered to some extent with the attendance at this year's meeting of the Bunsen Society.

Following the plan adopted at last year's gathering, a number of papers upon one of the more important subjects of scientific and technical interest at the present time had been arranged, the subject selected for this year's meeting being "The Fixation of Atmospheric Nitrogen." These papers were read and discussed at the first business meeting of the members —on Monday, May 21. As this subject is one which is of considerable interest to chemists, electricians and engineers in all countries, the papers and discussions upon it have been dealt with somewhat fully in this report, and only very brief references to the other papers, likely to be of interest, have been given.

Professor F. Foerster, of Dresden, introduced the subject, "The Fixation of Atmospheric Nitrogen," with a lecture dealing with the chemical and physical properties of nitrogen and its oxides, and outlining briefly the nature and difficulties of the problem presented to electrochemists for solution. It was pointed out by the lecturer that nitrogen was one of the most inactive of the elements at the normal temperature, and that only at very high temperatures did it become chemically active and able to enter into combination with oxygen.

The importance of nitric acid and of its salts (sodium and potassium nitrate) in the arts and industries was next referred to, and the laboratory production of nitrogen oxides by Cavendish and Priestly in 1780, by means of electric spark discharges in air, was described. Bunsen also observed the formation of nitric oxide when exploding mixtures of hydrogen with excess of air. The experiment can be easily repeated and the formation of the brown N_2O_4 observed, when direct current at a pressure of sixty to seventy volts is allowed to spark in air, using iron-wire electrodes. The oxidation or combustion of nitrogen produces no heat, and in this respect it differs from the usual type of combustion. The flame is therefore extinguished unless fed with a continuous supply of electrical energy. The reaction is, however, a thermal and not an electrical one, and the only duty of the electric current is to maintain the nitrogen at the temperature at which it becomes chemically active toward oxygen. The fixation of nitrogen in the form of nitride, by passing the gas over heated cerium, boron, titanium, magnesium or calcium is another method of great chemical interest. Technically, however, it is of no importance, since the recovery of these elements in the metallic state is too costly. The fixation of nitrogen by means of calcium carbide—worked out by Franks—is a third method, of more promise. In this case calcium-cyanamide ($CaCN_2$) is produced, and the compound is of direct value as a manure—apart from its value as an intermediate product in the manufacture of nitrates and ammonia. Professor Foerster concluded with some figures showing the importance of nitrogen —to the agricultural industry. In 1900, 1,300,000 tons of Chili saltpetre were used; in 1905, 1,500,000 tons. Of this enormous total Germany consumed about one-third. In 1900, the total world production of sulphate of ammonia was 500,000 tons, to which total Germany contributed 150,000 tons.

Of this total world production of artificial nitrogen compounds—either in the form of nitrates or of ammonia—agriculture absorbs seventy-five per cent, and the total value of these artificial manures in 1900 amounted to 270,000,000 marks, or $67,500,000.

Professor W. Nernst, of Berlin, then read a paper upon the "Equilibrium and Reaction Velocity Ratios for Nitric Oxide Formation." A proof of the thermal nature of this reaction is found in the fact that the union of nitrogen and oxygen is observed as an explosion phenomenon, with the mixed gases. The chemical laws of mass reaction can therefore be applied to the problem involved in the calculation of the ratios desired.

These constants are of the highest importance for the technical industry, since it is requisite to obtain a concentration of nitric oxide as high as possible in the final gases in the minimum of time. For calculation of the equilibrium ratio the usual equation:

$$K = \frac{(NO)^2}{(O_2)(N_2)}$$

can be applied. In this equation K is a constant independent of the mass of the gases, but dependent upon the temperature; while the chemical symbols within brackets represent the pressures of the component parts of the gas mixtures. The larger the value of K the greater will be the amount of NO obtained from the same gas mixture. It is important for technical purposes to calculate the point at which increased value of K ceases to be remunerative, owing to the increased cost of the electrical energy required for producing the higher temperature which causes it.

In order to obtain the data required for calculating this value, Nernst led air through a platinum or iridium crucible, maintained at the desired temperatures by means of an electric furnace. The gases passing from the crucible were led through a platinum capillary tube in order to obtain rapid cooling of the gas mixture, and were then analyzed to ascertain the NO contents. This rapid cooling is of importance, since otherwise a portion of the already formed NO would be again decomposed: a result due to the declining value of K as the temperature fell.

By rapid cooling of the gas mixture, however, there is what may be called a "freezing in" of the value K, and the composition of the cooled gases is practically the same as at the moment they issued from the heated crucible. From the data obtained by this method, the value of K can be directly obtained.

Another method used for checking the results rests upon the observation of the influence of pressure upon the time of explosion and temperature obtained in "Knallgas" explosions.

Using x to denote the percentage of NO in the exit gases for various temperatures, the values in the following table were obtained.

For calculating the speed of reaction ratio the following equation was used:

$$K = \frac{v_1}{v_2} = \frac{k_1}{k_2} = \frac{(NO)^2}{(O_2)(N_2)}$$

in which k_1 and k_2 represent the con-

Digitized by Google

stants for the speed of combination and dissociation of NO. Now k_1 can be calculated, K is known, and thus k_2 can be

TABLE 1.—PERCENTAGE OF NO IN EXIT GAS.

Calculated.			Values of X.	
			Observed.	Inter-polated.
T.	X.	T.		
1,500°	0.10	1,811°	0.37	0.35
1,800°	0.34	1,877°	0.42	0.43
2,000	0.61	2,023°	0.52	0.54
2,500°	1.79	2,033°	0.64	0.67
3,000°	3.57	2,195°	0.97	0.98
....	....	2,580°	2.05	2.02
....	....	2,675°	2.28	2.35

ascertained; and from these data the general equation $\log k_1 = AT + B + \frac{C}{T^2}$ was obtained. At high temperatures the last number of this equation disappears, and one thus obtains a straight line ratio between the value for k_1 and the temperature. By use of this method one can therefore obtain the time required for the production of a given amount of NO.

The following are the values obtained for the establishment of a state of half equilibrium, for complete equilibrium—infinite time is, of course, required.

T Degrees.	k_1	t.
1,000	140	81.68 years.
1,500	37,800	1.2 days.
1,900	9.06×10^6	2.08 minutes.
2,100	1.40×10^8	5.06 seconds.
2,500	3.37×10^{10}	1.06×10^{-3} seconds.
2,900	8.07×10^{12}	3.45×10^{-10} seconds.

From this table one sees that the time required diminishes enormously with the increase of temperature. It is nevertheless impossible in actual practice to obtain a gas containing more than three per cent of NO, for the cooling of the gases can not be completed quickly enough to prevent dissociation entirely.

In the discussion upon Nernst's paper the question was raised whether a gas mixture containing fifty per cent each of oxygen and nitrogen would yield better results than ordinary air, for NO production.

Nernst replied that by this plan the yield could be improved by twenty per cent, but that the cost of preparing such a gas mixture would not be balanced by the gain in output of NO.

Professor F. Foerster, of Dresden, followed with a paper upon "The Technical Methods for Carrying Out the Combustion of Nitrogen." The author commenced by stating that theoretical considerations clearly indicated the lines upon which the technical methods must be developed. The gas mixture must be heated to the highest possible temperature, and then must be cooled with the highest possible rapidity.

Muthman and Hofer had found in their experiments that the yield of NO decreased with the increase of electric energy put into the arc. Researches by Brode helped to explain this anomaly. The electric arc consists of a very hot inner core, and of an outer "aureole" of flame, of lower temperature. This "aureole" increases in extent, however, with increase in the electric energy put into the arc. Now NO is only formed in the inner flame; the temperature of the "aureole" causes its dissociation. Therefore increase in the extent of the "aureole" causes increased dissociation.

For this reason better results were obtained in the early trials with spark discharges—as in the case of these, the second zone of flame is of small dimensions.

But an enormous number of sparking points is required, since each represents a very small amount of electrical energy. Bradley and Lovejoy attained this requisite by designing a drum covered with points, which revolved slowly inside another drum similarly provided on its inner surface. With this apparatus they obtained eighty-eight grains of HNO_3 per kilowatt-hour and a concentration of two to three per cent of NO in the issuing gases. Using current at 10,000 volts pressure, the apparatus required only one ampere, and attempts to use a larger current only produced the "aureole" of lower temperature, which it was necessary to suppress. To obtain a large amount of nitric acid from the air by this method would have required, therefore, the construction of many hundreds of these revolving drums, and as they were complicated and costly, the Bradley and Lovejoy process failed.

A sparking process for manufacture of nitric acid might be worked with the aid of condensers, but hitherto electrical condensers have not proved durable when in constant use. Inventors in this domain have, therefore, turned to "flame-arcs" for provision of the heat required, the essential condition of this use being that the arc should be continually in movement, or should be rapidly extinguished and remade. This condition can be best attained by means of a magnetic field, and by use of alternating current for forming the flame-arc. By this method of working, the flame-arc is made to take the shape of a disc, and it has been applied practically to NO production by Messrs. Birkland & Eyde. Their apparatus or furnace consists of a case, one metre high and one metre broad, within which, by means of an alternating current and a magnet, a disc of flame two metres in diameter is produced. The whole interior of the case is, in fact, filled with a sea of flame, and into this the air to be consumed is led. The furnace takes 500 kilowatts of electrical power, ten per cent of this being required for the production and maintenance of the magnetic field. The flame-arc is produced by an alternating current at 5,000 volts. Twenty-five cubic metres of air are led per minute through the flame, and a concentration of two per cent of NO is thereby attained in the issuing gases.

From seventy to eighty-three grams HNO_3 per kilowatt-hour are obtained with this furnace in constant work, this being equivalent to 500-600 kilogrammes per kilowatt-year. Taking the cost of the kilowatt-hour at .60 pfg., this is equivalent to .29 mark (6.8 cents) for the electrical energy required to produce one kilogramme of nitrogen in the form of nitric acid; whereas in sodium nitrate (the Chili saltpetre of commerce) the same amount of nitrogen costs 1.25 marks (thirty-one cents).

In Norway, the nitric acid is converted into calcium nitrate or into the basic nitrate of lime, the latter compound having proved a good fertilizer for agricultural purposes. The annual consumption of 1,500,000 tons of nitrate of soda would require 2,500,000 horse-power to produce by the method just described; but the waste gases of the blast furnaces now in operation in Germany alone would generate 500,000 horse-power if utilized for this purpose.

The author then discussed the theory of the above methods for producing nitrate from the air, and stated that from the results of experiments carried out by himself, with direct and alternating currents, he had concluded it was the amount of electrical energy and not the manner of discharge that influenced the results obtained. Haber had calculated that with a temperature of 4,200 degrees centigrade, and rapid cooling of the final gases, a yield of 212 grammes HNO_3 per kilowatt-hour might be attained; while with a temperature of 3,200 degrees centigrade only 93.5 grammes were attainable. The former figure of 212 grammes is in the author's opinion too high; but the lower limit of 93.5 grammes has already been nearly attained in practice, and an increase of this yield will only come by use of methods which can communicate a higher temperature to the air sent into

Digitized by Google

the furnace. Further progress in the industry is, therefore, a question for electricians rather than for chemists; although by use of a fifty per cent mixture of nitrogen and oxygen, under pressure, a slight increase in the yield might be obtained.

Such a fifty per cent mixture of oxygen and nitrogen might be won by distillation of liquid air, and the residue of pure nitrogen could then be utilized for preparation of calcium cyanamide by the Frank and Caro process.

Bodenstein, Eskales, Nernst, Brode and Stavenhagen joined in the discussion on this paper.

The next paper of this series upon the fixation of atmospheric nitrogen was contributed by Professor M. Le Blanc, of Karlsruhe, and dealt with the "Estimation of Nitric Oxide (NO) in Air." The author stated that the literature upon this subject was scanty and inaccurate. The method of estimating NO, usually described, was to lead the gas mixture through water, and to determine the nitrate and nitrite present after the absorption. According to the authorities, equivalent amounts of nitrate and nitrite would be produced—as shown by the chemical equation:

$$N_2O_4 + H_2O = HNO_2 + HNO_3$$

The author had found, however, that several conditions influence the results obtained, and that the character of the flame, the length of time during which absorption is occurring and the nature of the absorbent, each influenced the proportion of HNO_2 to HNO_3 obtained in the final solution. Although the difficulties in the way of obtaining a correct estimation are therefore great, by the choice of suitable conditions for the absorptions, a quantitative estimation of the nitrate present in solution is possible. The author finally gave reasons for believing that N_2O_3 and NO_2 were also present at times in the gases pressing from the inner zone of the arc.

The next paper, by Professor J. Klaudy, of Vienna, was upon "The Technical Methods for Converting the Nitrous Gases into Nitric Acid and Its Salts." The author stated that the results obtained in regular work by the larger installations for nitric-acid production from the air, gave a concentration of twenty-seven grammes of NO per cubic metre of air. This was equivalent to 21.6 litres of NO per 1,000 litres of air, or 2.16 per cent, and corresponded to a temperature of 2,600 degrees centigrade in the interior of the furnace. This yield of NO corresponds to 600 kilogrammes of HNO per kilowatt-year; but owing to the dilution of the escaping gas, only a portion of this total can be recovered as nitric acid.

In Norway, the kilowatt-year in certain localities can be obtained by water-power for twenty marks ($5), while in Switzerland and Austria it costs forty marks ($10), and at Niagara eighty marks ($20). Power-gas installations and small water-powers can not, therefore, compete in this new industry, although blast-furnace gases may have a future. Taking the above figures as basis of the calculation, the author finds that in Norway one kilogramme of nitrogen in the form of NO costs only .15 mark ($0.03), while in the form of sodium nitrate or nitric acid, it costs from 1.15 marks to 1.90 marks ($0.28 to $0.48).

The last paper upon this subject was by Dr. Adolf Frank, of Charlottenburg, and dealt with "The Fixation of Atmospheric Nitrogen by Means of Calcium Carbide." This paper covered very much the same ground as the lecture delivered by Dr. Frank before the Congress of Applied Chemistry at Rome on Tuesday, May 1, and a report of this lecture has already appeared in these columns. (See ELECTRICAL REVIEW, June 2.)

Other papers read at the Dresden meeting of the Bunsen Society which may be of interest were the following:

Professor Jäger (Charlottenburg), "Calorimetric Measurements by Means of the Platinum Thermometer."

Dr. F. Fischer (Berlin), "The Formation of Ozone."

Dr. Siedentopf (Jena), "A New Physico-Chemical Microscope."

Dr. Siedentopf (Jena), "Note upon Colloidal Alkali Metals." This paper is of interest in connection with the new method of producing metallic filaments from refractory metals, for incandescent lamps.

Dr. L. Doermer (Hamburg), "Note upon the Structure of Electrolytic Calcium."

Professor R. Lüther (Leipsig), "Note upon Electrolytic Cross-Currents." (Kreisströme.)

Importation of Cryolite.

The quantity of cryolite, a material used in the manufacture of sodium salts, imported during the year 1905 was, according to a bulletin issued by the United States Geological Survey, 1,600 long tons, valued at $22,482. For the preceding year the importations were only 959 tons.

Power Transmission by Means of Gas.

In a paper read recently before the Society of Arts, London, on "Coal Conservation, Power Transmission and Smoke Prevention," the author, H. A. Martin, had the following to say respecting the transmission of power by means of gas:

The cost of transmission will depend very materially on the scale on which it is undertaken. A supply of gas equivalent in heating value to the 15,000,000 tons of coal consumed by London every year can be conveyed from the South Yorkshire coal field, a distance of, say, 173 miles, by a single line of six-foot pipe, with an initial pressure of 480 pounds per square inch, or, not to depend on a single main, by four lines of pipe ranging from three feet to six feet in diameter, with a pressure of 510 pounds. It would not, however, be necessary to supply so large a quantity, for gas, by reason of its higher practical efficiency, would take the place of a much larger amount of coal than would appear from a comparison of their respective calorific values. The actual amount of gas which would be required depends on so many conditions, the effect of which can not be estimated with any approach to accuracy, that it is impossible to say even approximately what it is likely to be. In view of all the facts, however, it is reasonable to suppose that the consumption of gas in London might be increased to four or five times its present amount. Whether or not this rate is actually reached, or whether it is exceeded, the difference in the scale of operation will hardly be such as to make any material difference in the cost. For the sake of a tangible example, I have assumed a consumption of 180,000,000,000 cubic feet per annum, and a maximum demand of 900,000,000 cubic feet per day.

If it were necessary to keep down the cost of transmission to the lowest possible figure, the gas would be conveyed by a single line (or at most two) of steel pipes, increasing in diameter toward the point of delivery, so as to keep down the frictional loss, and to utilize the whole of the pressure for transmission. It will be prudent, however, to increase the number of pipes to four, and, for reasons which will be apparent later on, it may be desirable to deliver the gas at a fairly high pressure. Each main would then be laid with thirty-inch pipes throughout, the thickness varying from one end of the line to the other as the pressure dropped. The weight of gas conveyed per minute would be 4,637 pounds per main, or 18,518 pounds in all,

Digitized by Google

being about eighty per cent of the carrying capacity of the four mains, with initial and terminal pressures of 500 pounds and 250 pounds, respectively.

The weight of each line would be about 82,000 tons, or 328,000 tons for the four, and their cost at current prices would be about $35,160,000.

To this must be added Parliamentary and other expenses, such as right of way; allowing $5,000,000 for these brings the total cost of the lines up to $40,160,000.

The annual cost of transmission, allowing six per cent for interest, four per cent for depreciation of the pipes, and $75,000 for inspection, repairs, taxes, etc., would be $3,895,000.

To compress the maximum supply of 625,000 cubic feet of gas per minute to a gauge pressure of 500 pounds per square inch requires about 207,000 indicated horse-power. Under ordinary circumstances this power would be most economically obtained by means of producers and gas engines, which, at 0.8 pound of coal per indicated horse-power per hour, would consume some 355,000 tons per annum. There is little doubt that this is much less than the amount of coal consumed by all the coasting steamers, goods and shunting engines, which now carry the coal supply of London. In the present case, however, there happens to be a source of power already available in the gases of combustion from the coke used for carbonizing the coal. These gases leave the retort ovens at a very high temperature, the greater part, if not the whole, of the heat which they contain being generally wasted, whereas by means of suitably arranged boilers they might be made to furnish most, if not all, of the steam required to work the compressors.

It is estimated that the entire cost of the compressor plant would be $12,500,000. The annual cost of running it would be $1,450,000.

Spreading the annual costs of compression and transmission over 180,000,000,000 cubic feet of gas, the cost per 1,000 cubic feet for compression is 0.8 cent and for transmission 2.2 cents.

In transmitting air or gas in pipes there is very little gain in utilizing the whole of the pressure for transmission, because by expanding the gas down to atmosphere we increase its volume, and consequently its velocity, to a very great extent. It follows that the frictional losses in the last few miles of pipe are enormous, involving a corresponding drop of pressure in this part of the main. By delivering the gas under pressure this wasteful expenditure is avoided, and although the amount of gas delivered is, of course, reduced, a simple calculation shows that this reduction is very slight in comparison with the pressure saved.

On the other hand, the residual 250 pounds of pressure represent some three-quarters of the effective work of compression, and by means of suitable engines or motors, such as are used with compressed air, may be made to restore a great part of the power which was expended in this operation.

To compress 1,000 cubic feet per minute to a pressure of 500 pounds, with the moderate total efficiency of sixty-nine per cent, requires the expenditure of 331 indicated horse-power. By utilizing the expansion of the gas, from 250 pounds down to atmosphere, without addition of heat, in a suitable engine with direct-coupled dynamo, some ten kilowatts would be obtained per 1,000 cubic feet per minute, or from the daily supply of 900,000,000 cubic feet delivered, say, 1,000,000 kilowatt-hours. This is on the assumption that the gas expands adiabatically, in which case it would emerge from the motor at a temperature of about 200 degrees Fahrenheit below zero, and with only one-half its normal volume. It will therefore be desirable to heat the gas before it enters the motor, for which purpose from two to three per cent of the expanded gas may economically be utilized. The power developed may thus be increased by something like fifty per cent, giving a daily output of, say, 1,500,000 kilowatt-hours. This, at 1.5 cents per kilowatt-hour, would give a daily revenue of about $23,500, of which station costs would probably absorb one-third; and interest, depreciation and management another third; the amount of these charges depending on the load-factor obtained.

It might not be convenient so to arrange the transmission of the gas that the whole of the current generated therefrom could at all times be utilized, but there is little doubt that the profit on the year's working would yield a handsome return on the cost of maintaining a high terminal pressure.

From a comparison of the actual costs of manufacturing gas in various English towns an average figure of 11.3 cents per 1,000 cubic feet is reached. Adding to this the costs of compression and transmission, and allowing for leakage, costs of distribution, taxes, etc., the selling is found to be twenty-four cents per 1,000 cubic feet, if a profit of 4.4 cents is allowed.

There can be no question, however, that the reduction of the price of gas to anything like forty cents per 1,000 cubic feet would bring about so large an increase in the demand that further reductions would speedily ensue, with the result that nearly the whole of the coal at present consumed in London would be displaced by gas. Even for the generation of electricity, gas at thirty-seven cents would cost less than the coal now consumed by twenty-three out of the twenty-five London electrical undertakings, while Hackney's fuel bill (the lowest of them all) exceeds the equivalent of gas at twenty-five cents. These undertakings, however, would probably find it cheaper to obtain their current from the gas-expanding stations than to generate it themselves.

Turning now to the incidental consequences of gas transmission, and giving due precedence to the fog question, the general supersession of coal by gas would put an end, once for all, to the smoke nuisance, and the abnormal blackness and persistence of the London fog would become a memory of the past. There is no reason why gas should not be piped in the same way to every city and town in the kingdom. To inland towns, indeed, which pay $4.50 or $4.75 for their gas coal, cheap gas would be an even greater boon than to London, with its sea-borne supply. Nor need the benefits of cheap gas be confined to the towns, for there is no reason why the trunk mains should not be tapped at any desired point along the route. The cause of industrial decentralization could be given no greater stimulus than it would receive from the provision of light, heat and power at a minimum cost along every foot of the pipe-lines from the collieries to the metropolis.

Novel Cable-Laying Apparatus.

In Berlin, Germany, the telephone wires are formed into cables of large size, and are laid in cement conduits. To carry this out a gang of ten or twelve men is generally needed, so that a labor-saving device could be a great advantage here. This was found in the shape of a vertical drum operated by an electric motor, which is used for drawing the cables through the conduits. To make it easy of transport, the apparatus is installed upon two separate wagons. The first wagon which forms the current-generating plant contains a six-horse-power petrol motor coupled to a small dynamo. On the second and larger wagon we have a three-horse power motor mounted with the cable drawn. With this apparatus a great saving of time is effected, and in one case a cable of the heaviest type of 600 feet length was drawn through the conduit in seven minutes.

Digitized by Google

Society for the Promotion of Engineering Education.

The Society for the Promotion of Engineering Education held its fourteenth annual meeting at Cornell University, Ithaca, N. Y., June 28 to July 3. A number of interesting papers were presented, brief abstracts of some of which are given below.

John F. Hayford, in a paper entitled "Why Not Teach About Men, the Most Important and Difficult Tools an Engineer Uses?" said that this is a course which should be taught because of its importance in affecting the success of the man and therefore his usefulness to the community, because the subject matter can not be learned quickly or easily by mere experience, because there are fundamental principles to be followed, in using men, which are teachable, and because of the high cultural value of the course.

It is essential to the success of the engineer that he should know how to estimate the strength and recognize the peculiar properties of the men with whom he is associated, or whose energies he directs, for the same reasons that he must know the strength and properties of the materials with which he deals. A correct judgment of men is more difficult to attain, but is also more important than a correct judgment of materials. The engineer must have both.

James P. Munroe read a paper entitled "The Standards to Be Placed Before the Young Engineer." Much teaching is ineffective, because neither teacher nor pupil sees the true end of education, which is physical, mental, moral, and therefore social, efficiency.

Limiting ourselves to technological schools, few students look beyond the next examination, which they regard simply as an artificial barrier in their race for a degree. The schools of applied science foster this student attitude by multiplying examinations, overloading with "examinable" subjects, and permitting too much intensive specializing. As a result the minor processes often eclipse the major purposes of higher education.

Those major purposes, in the order of their importance, are: to develop manhood out of boyhood; to make men humanly broad-gauged, mentally quick and receptive, intellectually catholic, tolerant and modest; to train good citizens in the broadest sense, and to equip for industrial efficiency. Unless the fourth (and least important) purpose is achieved in such a way as to make for manhood, breadth and active citizenship, the technological school has failed of its educational duty.

The faculties of most schools of applied science have definitely succeeded, against great odds, in upholding the true aims and purposes of higher education. But with the greater speed and specialization of modern life, this will be increasingly difficult, unless they are supported and assisted by bodies of men near enough to understand the problem and yet far enough removed to gauge the final, broad results of technical teaching. Such bodies of men are the trustees and the alumni. Both could and should do more than at present toward making the undergraduates understand and follow those genuine, enduring standards of human efficiency by which the teaching and the lives of all educated youth ought to be governed and inspired.

Paul C. Nugent discussed "The Dual Degree for Engineering Courses." There are now three methods of graduating engineering students: graduation with honors as in colleges of liberal arts; graduation with full engineering degree; graduation with the degree of Bachelor of Science in Engineering, followed by the full degree for additional work. The systems all have their defects, and the author offers a fourth plan as follows: at the end of the regular four or three-year courses let two degrees be granted, the B. S., being given to those who have passed in all the required studies, but who have failed to attain a certain set grade. This grade to take into account (in the case of four-year courses) all the work of the last three years. The required percentage, while reasonably high, should not be as high as that demanded for graduation with honors in liberal arts. Students who attain the required percentage will be given the full degree. Details of the plan will have to be worked out, but it appears to offer no difficulty.

Arthur E. Haynes read a paper entitled "The Justification of the Use of the Expression 'Engineering Mathematics.'" The reasons for the use of this expression are at least three. (1) Because of the main object of study of mathematics in an engineering course—mathematics are to be used as "tools" by the engineer. (2) Because such an object requires a different kind of teaching. The teacher should have been trained as an engineer. (3) Because the content or extent of the field is different from that of ordinary mathematics.

Bassett Jones, Jr., presented a paper on "The Benefit of Philosophy to the Engineering Student." This is said to be the age of the specialist. That every man must devote himself to one thing, that he is only valuable in so far as he knows more about some one subject than any one else. To such a man success is possible, if by success one means that he is to be the slave of business, and that when all is said and done he leaves his business alone behind him.

The young people should at least have some training in those two most useful acquisitions of the mind, imagination and an appreciation of the beautiful. The world is nothing apart from our ideas about it.

To live in the broadest sense of the word; to live completely, that is the greatest thing that education has to teach, and failing in this education is itself a failure. The study of life then should constitute a part of our curriculum.

Report Relating to Trolley Construction, Underground Conduit Construction and Subways for Chicago.

A report has just been submitted by Bion J. Arnold, Chicago, Ill., to the committee on local transportation of the Chicago city council. This report deals with the construction of overhead trolley lines, of underground electric conduit lines and the subways in the city. It supplements the earlier report submitted by Mr. Arnold in 1902. After pointing out the various considerations which enter into these questions, Mr. Arnold recommends that the overhead trolley system be installed in the business districts of the city to such an extent that all through routes outlined in the earlier report can be put into effect. This is with the understanding that when the completed subway system is built the tracks in the business district will be modified to conform to the arrangement shown in the earlier report. It is not thought advisable to construct conduit systems through streets which will later be followed by the subway system. It is further recommended that immediate steps be taken for rehabilitating the present surface systems and for constructing a number of subway systems outlined in this report. Also, the river tunnels, which are to be reconstructed, should be placed at such a level that they can be used as part of the proposed subway system.

The World's Coal Supply.

The German periodical *Stahl und Eisen* estimates Germany's coal supply at 280,000,000,000 tons, and that of Great Britain and Ireland at 193,000,000,000 tons, the total for all Europe being taken as 7,000,000,000,000 tons.

Digitized by Google

BALANCERS.

BY J. W. SHUSTER.

The article with the above caption, which appeared in the ELECTRICAL REVIEW of March 10, from the pen of Mr. Budd Frankenfield, calls attention to a subject of more than passing interest, both from the operating standpoint and from the theory involved.

Mr. Frankenfield has drawn an interesting comparison between the motor-generator set when used as a balancer on direct-current circuits and the autotransformer when used for the same purpose on alternating circuits.

The fact that a transformer is usually placed on an alternating-current circuit near the point at which any considerable current is delivered, and that it is readily connected for three-wire distribution, has minimized the demand for the autotransformer as a balancer. There are, however, certain cases where this type of apparatus is a great convenience in taking care of the unbalanced load, and of the regulation of the system.

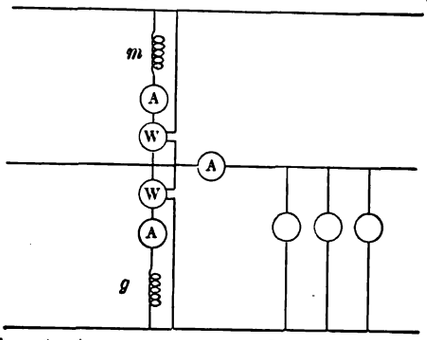


FIG. 1—ARRANGEMENT OF INSTRUMENT FOR BALANCER TEST.

Some of the students in alternating currents at the University of Wisconsin have made tests along the lines referred to by Mr. Frankenfield with results which correspond very closely with the theory as outlined in the above article.

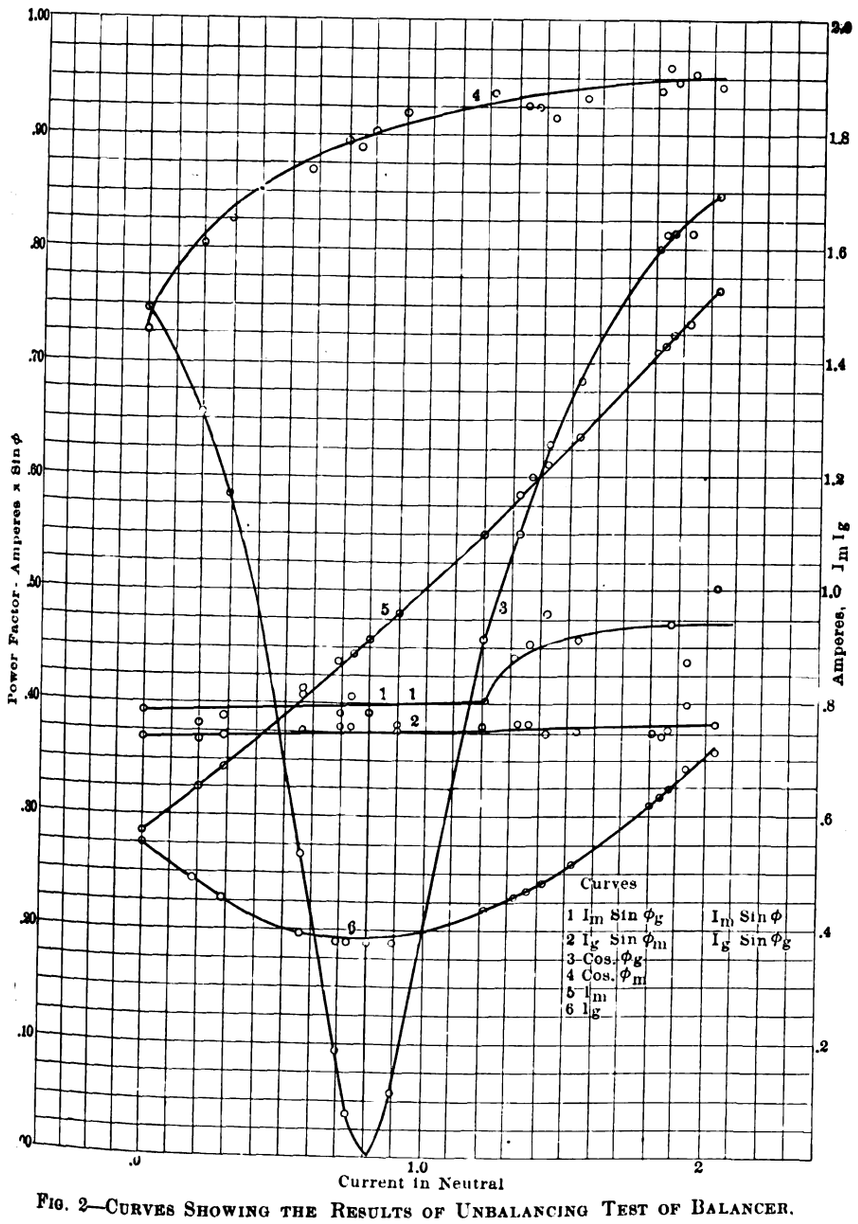


FIG. 2—CURVES SHOWING THE RESULTS OF UNBALANCING TEST OF BALANCER.

The appended curves are taken from data submitted by Messrs. Lewis Fussell and W. E. Wickenden, two of the above-mentioned students.

The observations were taken with no load on one side of the three-wire system and the load on the other side varied by small amounts to show the definite changes of current and power in the two halves of the autotransformer. The instruments were arranged to measure the current, pressure and power on the autotransformer sections as indicated by Fig. 1.

Following the system of nomenclature adopted for the direct-current balancer, the coil on the unloaded side is designated as m and that on the loaded side by g.

Curves 5 and 6, Fig. 2, show the one, the constant gradual increase of I_m as the unbalance of load increases, and the other, the decrease in I_g to the point where I_g equals the constant value of $I_g \sin \phi$, which is the magnetizing current of the autotransformer. From this point power is supplied to the load from g and the current increases.

Curves 1 and 2, Fig. 2, show the magnetizing currents in the balancer to be practically constant, while the core loss currents are varying on the two sides of the balancer.

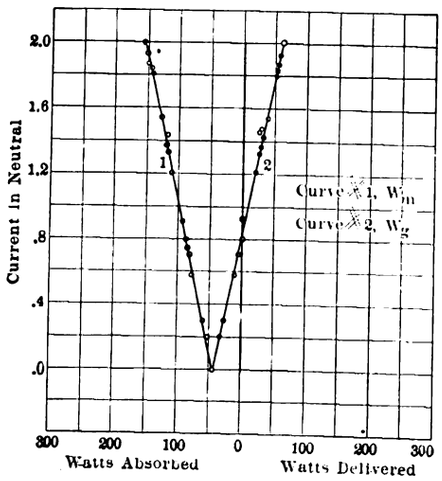


FIG. 3—CURVES SHOWING POWER ABSORBED BY BALANCER.

The power-factor curves 3 and 4, Fig. 2, are of interest, especially curve 3, in showing the point at which the power of g passes through zero.

From curves 1 and 2, Fig. 3, the amount of power absorbed by the balancer, and the power delivered by it as the unbalanced load is increased, may be seen, the watts absorbed and delivered being plotted against current in the neutral.

The erratic bend in the curve between I_m, sin ϕ and current in the neutral indicates an inaccuracy in one of the instruments used here. However, the remainder of the data is very consistent, showing not only a very close agreement with the theory as outlined by Mr. Frankenfield, but also the possibility of measuring the quantities entering and obtaining the relations accurately.

ELECTRICAL LABORATORY,
UNIVERSITY OF WISCONSIN.

Digitized by Google

ELECTRIC PUMPING AT COLLIERIES.[1]

BY GERALD H. J. HOOGHWINKEL.

One of the first applications of electric power to the driving of mining plant was the electrically driven mining pump. The only types of pumps available, until recently, were slow-speed ram, piston or bucket pumps, according to the lift required; but on account of the shorter strokes and smaller masses to be moved, underground direct-driven steam pumps were worked at higher speeds than surface pumps. However, even these comparatively low speeds were not very suitable for coupling to electric motors without the use of gearing. As gearing was thought to be objectionable by most mining engineers, a prejudice which is not shared by the writer, the electrical engineer was asked to reduce the speed of his motor to such a point that two of the great advantages of electric motors, namely, cheapness and small dimensions, almost disappeared. The writer has installed many geared pumps of large dimensions, and they are running satisfactorily and without noise. For small pumps, belt-driving with high-speed motors, which show a high efficiency at various loads, may be used, at least in pump rooms where the atmosphere is not too much saturated with moisture.

The desire to use moderately high-speed motors resulted in the design of high-speed pumps, such as the Riedler, the Bergman and several others, using mechanically aided valves, operated by levers, cams or eccentrics. These high-speed pumps were to be used for high lifts; but lately the speed has been reduced, so as to ensure absolute security from breakdowns, owing to valve troubles, etc. For pumping plant, especially at mines, safety from breakdown is the one and only condition which must be satisfied before everything else, even before high efficiency; and, as will be seen later on, the electric motor has been instrumental in bringing into favor a class of pumping machinery which fulfills this condition, and so far had been very rarely used for underground pumping. The first express pump of large capacity was run at 200 to 300 revolutions per minute, but this speed has been gradually reduced to 120 to 180 revolutions, which is an immense advance on the old-fashioned slow-speed pumps at fifty to eighty revolutions, and still allows of the use of electric motors of fairly economical design and low first cost.

For small pumps the speed may be somewhat higher, and for such pumps belt-driving is advisable, if there is enough space in the pump room: the loss in the belt being equalized by the higher efficiency of the motor.

The latest electrically driven mining pump (in the opinion of the writer, destined to supersede all other pumps and first of all the steam-driven pump) is the electrically driven high-pressure centrifugal pump. The centrifugal pump is, of course, an ideal mining pump, on account of its many and valuable qualities, namely: (1) cheapness, about one-sixth; (2) small dimensions and compactness; (3) strong construction and almost absolute security from breakdown; (4) possibility of pumping dirty and gritty water; (5) small pump room required. The commercial construction of high-pressure centrifugal pumps is of recent date, and is due almost entirely to Sulzer Brothers, of Winterthur, Switzerland. Now, any lift can be attained up to 750 feet with one pump only; and for higher lifts, with two or more pumps in series.

The first large installation erected on this principle was the pumping plant for the Hocayo mines, Spain. Small centrifugal pumps, driven by electric motors, were installed on each pumping-level as the workings increased in depth. The pumps needed no supervision, and the loss of energy, usually incurred by letting the water flow and accumulate in the sump at the pit-bottom, was avoided. Another advantage was that the capacity of the installation could be gradually increased with very little cost. With plunger pumps, either steam or electrically driven, a division of the pumping plant in this manner would be impossible, owing to the high cost and still higher working costs. The water pumped from its proper inflow-level is also much clearer, and has therefore a certain value when brought to the surface.

Modern high-pressure centrifugal pumps may be divided into two distinct classes, namely, the Sulzer pump and the Rateau pump. Various firms on the Continent and in the United States manufacture either of these types on license, or a pump of their own, which may be more or less a combination of both principles.

The Sulzer pump consists of one or more rotating impellers, containing spirally curved guide blades and fixed guide wheels, provided with spirally curved water passages. The water is thrown radially against the fixed guide wheels and through openings in the latter, back again against the blades of the next propeller, which throws it through openings in the periphery of the fixed guide wheel in the pressure chamber surrounding the guide-wheels. Thence, the water flows through channels to the next impeller system or to the discharge if it is a single-stage pump. Gradually the velocity is transformed into pressure by means of expanding channels. This pressure varies, of course, with the speed of the impellers, but it may be taken as about 225 feet of head per impeller stage.

The first important installation of centrifugal pumps of high capacity against a head of over 1,800 feet placed at the pit-bottom was carried out at the Victor-Rauxel colliery, Westphalia. Two pumps are installed in series, each having a capacity of 1,500 gallons of water per minute against a head of 900 feet. This plant has now been running for two years, night and day, without a single hitch. An official test showed the following results: steam engine, ninety per cent; generator, ninety-four per cent; cables, ninety-nine per cent; motor, ninety-three per cent, and pumps seventy-five per cent; the total efficiency being fifty-nine per cent.

The Rateau pump is built on another principle, as the water does not leave the impellers in a radial direction, but in an axial one. In the Sulzer pump the water flows on the impellers in an axial direction and is thrown out radially, but in the Rateau pump the water enters the passages of each impeller at the centre, and, by the rotation, is forced out to a collecting chamber surrounding the periphery of the impeller. The ducts which return the water back to the centre of the impeller are suitably curved to act as guide passages, similar in action to the guide buckets of a turbine. The water then enters the impeller in an axial direction, its rotary motion having been transformed by the guide passage into rectilinear motion.

The efficiency of the Rateau pump is slightly higher than that of the Sulzer pump, and may be taken as between sixty-five and eighty per cent. It can be used for pumping smaller quantities of water at greater heads, while the Sulzer pump is more adapted for large quantities and lower heads.

A recently installed Rateau pump in the Carmaux colliery, France, has a capacity of eighty gallons per minute to a vertical head of 1,350 feet at a speed of 2,900 revolutions per minute.

The electrical part should consist of a high-speed three-phase motor, because it is the cheapest and best-adapted electric motor for mining purposes, and may be

[1] Abstract of a paper read before the Institution of Mining Engineers of Great Britain, June 20.

Digitized by Google

worked up to an output of 100 horse-power without a starting switch. Instead of the latter it is equipped with a centrifugal compensator, which can be made completely gas-and-water tight, and it cuts out the starting resistances automatically. The point is to construct a motor running at a medium speed and well ventilated, so as to show no high temperature rise after a twenty-four hour's run. Another required condition is the possibility of regulating the position of the stator part of the motor, as the small clearance between the rotor and the stator with three-phase motors (continuous-current motors are not very suitable for underground pumping) soon necessitates a readjustment of the clearance, after continuous running, perhaps for months, without stopping. For large motors it is essential that they be constructed in many parts, so as to permit of easy transport in the shaft and narrow roadways. Motors of a capacity of 200 horse-power and more should be provided with slip-rings, and these can be completely enclosed, so as to be water-and-gas tight. They must be so well ventilated that, after continuous running for any considerable length of time, their temperature limit is not reached.

A three-phase motor of modern construction may be considered free from breakdown, and it is therefore not necessary to provide spare units. It is good practice to mount the motor between two pumps, one being a spare, or between the two cylinders of a two-cylinder pump. Direct driving, although not absolutely necessary, is to be preferred, especially for large sets. If gearing is used bronze wheels and raw-hide pinions should be employed in order to avoid noise, which is most objectionable in a mine, and constitutes a real danger. The motor may also be mounted side by side with a three-cylinder pump, but this arrangement has the disadvantage that all parts of the pump are not so easily reached as with the motor placed in the centre. In the former case, however, the motor should be provided with a revolving mass, either in the rotor or in the shape of a separate fly-wheel, so as to ensure an even turning moment.

Much depends, of course, on the regularity of the pumping. If the flow of water to be removed is constant, then the pumps can be run direct from the mains of a power station. In small pumping plants, if the flow varies very much, the pumps may stand idle during the hours of less flow, but with large installations this is hardly practicable. In the latter case the pumping plant must have its own electric generating plant at the power station, namely, its own dynamo and spare plant, so as to regulate the speed of the pump by influencing the generator field through a separate exciter, and also the steam engine speed. This ensures a speed regulation without incurring the losses of a speed control through resistances. This arrangement is only, however, to be recommended for large pumping plants (300 to 500 horse-power), as the generator-units in the power station will be about that size. In both cases, however, employing either a separate dynamo or direct driven from the mains there should be a starting arrangement in the mine as well, and the motor should be provided with slip-rings. In case of emergency the man in the pump room should not be obliged to ring up the power station, but he should be able to shut down the pumping plant himself.

The pump room in the mine should be built of stone or brick, and as near as possible water-and-gas tight, even in mines which are supposed to be exempt from fire-damp. This brick chamber must be well ventilated and lighted, and serve at the same time as a distributing station for the entire colliery from which the cables to the various workings will radiate inbye. This may seem expensive and wasteful, but the writer has found it to be a saving in the end, as it is so much easier to keep the electric and pumping plant in perfect order, and therefore to economize in repairs and minimize the chance of a breakdown. The longer life of the machinery and of the switch gear are also advantages not to be overlooked.

If the mine is fiery, the switch gear should be of the gas-tight enclosed type, in the case of starters of the liquid type, while switches and fuses, if any, should be of the oil type. The short-circuiting contacts of the liquid starters should be enclosed, and the starter itself provided with a dash-pot, so as to prevent it from being put in or opened too quickly. The switch gear should be protected from accidental contact on the part of the workmen, although the pump room should be closed to them.

A central telephone station should be installed, so as to enable the electrician in the pump room to be warned in time if any accident should occur inbye. The instruments must be made of a strong pattern, of the ironclad type, without flexible connections.

A traveling hand-crane should be provided for inspection and repairing purposes. With high-pressure centrifugal pumps, the dimensions of the pump room may be much smaller, and it is the writer's conviction that for underground pumping the centrifugal high-pressure pump coupled to a three-phase induction motor is the best combination that can be obtained and is bound to replace even modern steam pumps.

In order to show clearly the many advantages of electrically driven pumps placed at the pit bottom, it may be useful to discuss the claims which conservative mining engineers set up against the electric motor as compared with the steam engine. A common complaint is that what is gained by using a slow-speed pump is lost again in the high price of the slow-speed motor. As already pointed out, the pump makers have arrived at a speed for highly efficient pumping machinery (eighty-eight per cent of efficiency) varying between 100 and 200 revolutions per minute, this speed being high enough to enable the electrician to design an efficient electric motor at a reasonable price. This, of course, does not refer to centrifugal pumps, running at speeds which require a cheap electric motor.

Another remark which is often heard is that the electric motor can not be flooded. Of course, no one will claim for the electric motor, at least of any size, that it can work under water for any considerable length of time, this performance being also very difficult for a steam engine.

Sinking pumps can be made to work under water for any length of time, and are then in a very much better position than a steam pump, as the useful cooling effect of the water in the latter case acts as a condenser. But there should always be sufficient spare pumping plant at a mine to cope at any time with an increased volume of water, caused by one of the many mishaps which do occur in mines. If, therefore, the pump room be constructed in such a way as to be practically water proof for at least three or four feet above the bottom level, sufficient time will be afforded, in most cases, to lower the water level, by means of the spare pumps, before the water can enter the pump room.

With electric pumps it is possible to run them from a central power station, and to start or shut down in a few seconds without first communicating with the primary power-producing plant. With steam pumps, it is of course also possible to run several pumps from one battery of boilers; but, in the latter case, the whole of the long steam range must be kept under steam, which is a most waste-

Digitized by Google

ful process, and has many additional disadvantages, such as heating the shaft.

With hydraulic pumping plants, when starting or shutting down any pumps, the speed of the pressure pump must be regulated in the hydraulic station at the mouth of the mine.

Electric pumping is therefore more flexible and requires less spare plant, as in a central electric power station a reserve is kept for the whole of the electric mining plant. It is also possible to erect the central power station on the most suitable spot, and not necessarily near the mouth of the mine, as is required by steam plant, in order to have the boilers near the winding engine, the biggest steam user. Several incidental advantages can be added, namely, the absence of steam pipes in the shaft, where they are inconvenient and damage the shaft timbering; and the electric cables may be taken down the upcast shaft as well as down the downcast shaft, without interfering with the ventilation.

In the first place, it may be reckoned that a modern electrically driven pump does not cost more than a steam pump. Centrifugal electric pumps cost even less. Therefore, the figures for sinking fund and interest on capital outlay are not more, and if the cables are set against the steam pipes, certainly less, than with steam pumps. In the second place, the repairs of the motors and cables are practically nil, and compare very favorably with those of the steam cylinders and pipes of a steam plant. Further, the most important item in the working-cost figures is the amount of power taken by the pump, and, therefore, also the efficiency.

The losses caused by condensation of the steam in the pipes during stops are entirely avoided. When running, the combined efficiency of the pump and the motor is about the same as that of a steam pump. The same statement holds good if a centrifugal pump is used, as in the latter case the higher motor efficiency partly equalizes the lower efficiency of the centrifugal pump. The chief savings are of course effected in the electric station, where an economical high-speed condensing engine may be used, having a much higher efficiency than the pipes and boiler plant used in running a steam pump.

A practical average value for an electric pumping plant of medium size, calculated by the writer from observations of fifteen large electric plants, is sixty-five per cent from the steam side of the main engine to the water raised by the pump. This represents from sixteen to eighteen pounds of steam per horse-power-hour of useful load, an efficiency which is not often reached with steam pumps.

The individual efficiencies of the different sections of the machinery have been determined, and also constitute a fair average taken over a number of installations, namely, engines, eighty-eight per cent; dynamos, ninety-three per cent, cable, ninety-seven per cent; motor, ninety per cent, and pump, eighty-six per cent.

The efficiency of the express pump is the highest, rising to ninety-five per cent, this figure being the efficiency of the 500-horse-power Riedler pump at the Hausemann colliery. Other express pumps show from ninety to ninety-two per cent of efficiency.

Centrifugal pumps have a lower efficiency, being about seventy-five per cent for Sulzer-type pumps, and eighty per cent for Rateau-type pumps, but their motor efficiency is about four to five per cent higher, so that at the best, the total combined efficiency is always about five per cent less. The larger the capacity, however, the nearer the efficiencies of the two kinds of pumps approach each other.

The lower costs, however, of the combination motor and pump, the lower repairs and maintenance costs, the smaller space and security against breakdowns, are well worth the lower efficiency.

The conditions under which sinking pumps must be calculated to work are entirely different from stationary pumps, and therefore they have to fulfil other requirements. Moreover, very little has as yet been done in this particular branch, for which the adoption of electricity possesses some very marked advantages.

Steam is generally used and the disadvantage of steam pumps for sinking purposes is only too well known. There is the low efficiency and the difficulty in ventilating the shaft bottom and the shaft itself, the room taken up by frequently leaking steam pipes, which even obstruct the shaft to such an extent as to prevent the sinkers from doing their work efficiently.

All these disadvantages disappear at once with the introduction of electricity, and one wonders why any steam sinking pump is still used. One of the reasons is that ram-pumps driven by an electromotor through gearing are not only heavy and cumbersome combinations (not more so, however, than steam pumps), but are also more expensive. It is difficult to render the motor water-tight; and, altogether, when comparing them with pulsometers, where low lifts are concerned, the disadvantages of the steam pump are forgotten in face of the high cost of the electric pump.

The introduction of the high-pressure centrifugal pump, with its simplicity, small dimensions, lightness and high speed, has altered the case, and the writer contends that an electrically driven centrifugal pump is unrivalled for sinking purposes on all points.

The compact design and small dimensions of the electric sinking pump are readily recognized. The construction, though simple, must be carried out in a very thorough manner, and the writer is glad to say that many have now been built on the Continent which yield excellent results.

The motor, mostly three-phase, turns round a vertical axle and must, therefore, be carefully balanced and protected from the dripping water. The weight of the rotating part is carried on a ball-bearing protected by a tightly closing hood, which also encloses the starting device. The lower bearing is formed by the stuffing box of the centrifugal pump. The pump axle is made in one with the motor shaft, and is supported on another bearing fixed in the pump casing. The bottom part of the motor casing is shaped in such a way as to form one with the pump without, however, preventing access to the stuffing box. The top part of the motor casing protects the motor against any water spray. The windings are, of course, extra insulated, so as not to suffer from dampness in the shaft. The starting device is mounted on the pump, as it is found better to stop and start the pump in the shaft at will, without signaling to the surface. The simplest device is the centrifugal automatic starter, which may be used with motors up to 100 horse-power and can be easily enclosed so as to be air-and-water tight. For powerful pumps, in cases where variations of the voltage are not allowed, starting resistances must be used.

The pressure and suction pipes are doubled, while the suction pipe enters the pump from above, thereby partly doing away with the pressure due to the weight of the rotating masses. This arrangement practically removes all pressure from the ball-bearing.

The entire pumping set is slung on two chains, hooked into the eye-bolts, which connect the top and bottom parts of the set. The pump motor and pipes are kept rigidly in line through being connected to the covering of the motor. A steel protecting hood covers the whole pump, and under it are mounted the various regulating appliances, namely, an ammeter, a starter, a main switch and the stop-valve hand-wheel.

These pumps have a compact and mechanical appearance, and their advantages are calculated to bring them into use in a short time.

Digitized by Google

The Engineering Experiment Station of the University of Illinois.

ONE of the great objects always kept prominently in mind in the developing and directing of the state universities has been the building up of the state's industries. At the time these universities were founded agriculture was the chief industry in many of the states, and, naturally, aiding the farmers in solving the many, and sometimes difficult, problems presented to them became one of the duties of the university. The necessity, however, for encouraging manufacturing works was not forgotten, and but a short time passed before attention was given to preparing the youth of the state for such work. Instruction was given in various kinds of shop practice and in all the arts involved in the making and using of machinery and other materials. From these beginnings have developed the great engineering schools which to-day, in almost every state, form one of the important divisions of the universities.

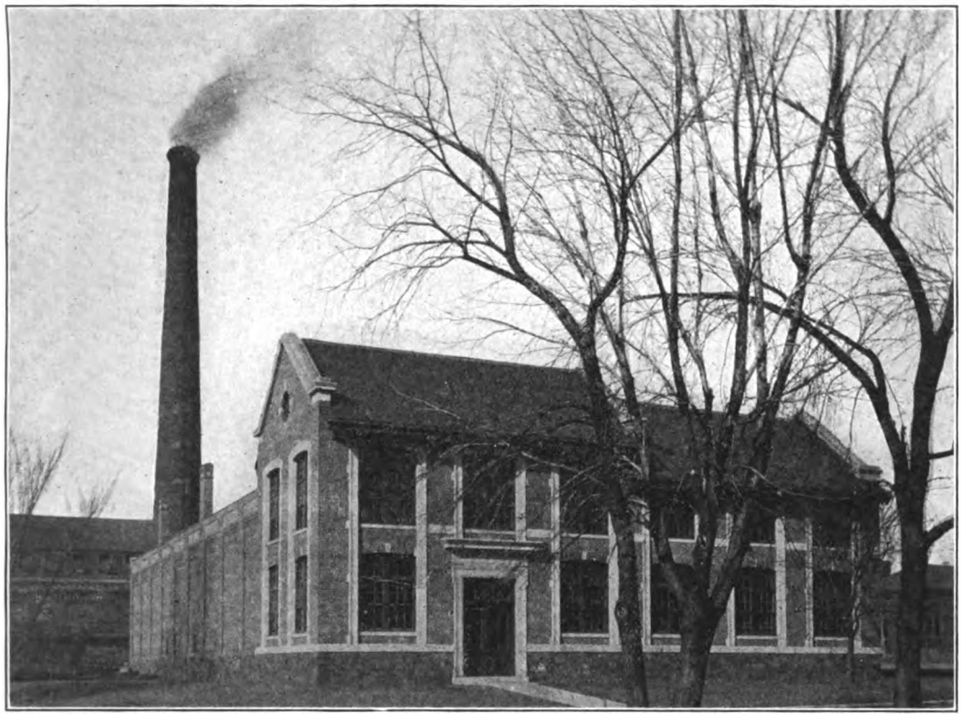


FIG. 1—THE MECHANICAL ENGINEERING LABORATORY OF THE UNIVERSITY OF ILLINOIS—BOILER HOUSES IN THE REAR.

In the endeavor to be of the greatest use to the farmers, agricultural experiment stations have been established at nearly all of these universities in connection with the agricultural schools, and from them a great deal of benefit has resulted. Indeed, the work done at the stations has, in some cases, been almost as important as that in the schools themselves.

Although this extension of the university was so successful it was not followed by the engineering schools for some years. Indeed, only within the last three years have engineering experiment stations been organized. While the members of the engineering faculty were free to consult and aid the state industries as much as possible, the energies of the college were mainly devoted to training young men, though it was the endeavor of the university to make this training the best possible for solving such problems as each man might encounter after graduation. Now a number of experiment stations have been established, with the idea of utilizing the university equipment for investigating such questions as are brought to them, and even for taking up on their own account such problems as seem to offer probabilities of important results.

The experiment station at the University of Illinois, which is believed to be the first of its kind, was established by action of the board of trustees in December, 1903. Similar action was soon taken elsewhere, and already excellent results have been accomplished and problems of considerable importance have been investigated with valuable conclusions.

At the University of Illinois the experiment station is under the control of a director and a station staff, consisting of the heads of the different engineering departments. A corps of assistants is retained, some of whom give all their time to the station work, while others divide their time between it and that of the school.

The equipment at the Illinois station is excellent for this purpose. There is not only a large main engineering building, with its fine draughting rooms and technical libraries, but there are three engi-

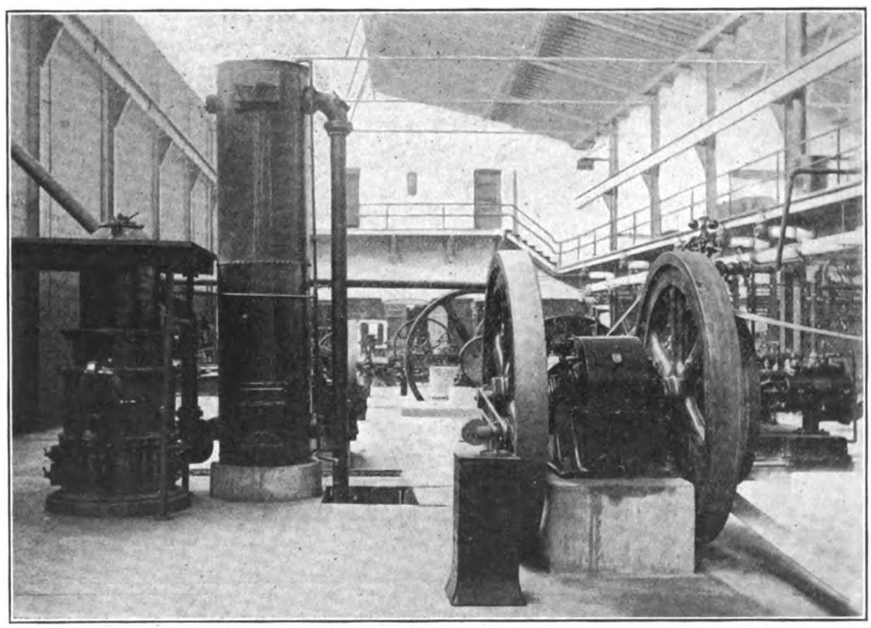


FIG. 2—INTERIOR VIEW OF THE MECHANICAL ENGINEERING LABORATORY—SHOWING POSITION OF THE EQUIPMENT.

Digitized by Google

neering buildings besides, and, in addition, a fine power plant and shops devoted to woodwork, machine and foundry work. The latest of these buildings to be erected is the mechanical engineering laboratory, completed last year. Fig. 1 gives an external view of this building and shows, just in the rear, the boiler house. In Fig. 2 is given a view of the interior of the laboratory, showing in the foreground a gas producer and gas engine used in experimental tests on Illinois coals. This laboratory equipment includes a 210-horse-power water-tube boiler, which is specially arranged for testing coal. It is fitted with a chain grate and induced draught. There are also a superheater and a number of other boilers, a refrigerating plant, a liquid-air plant, compressed air, various types of steam, gas and gasolene engines, and a steam turbine. The department also operates conjointly with the Illinois Central Railroad a railway test car which has already done valuable work. This is the car that was used in making tests on the New York Central lines preparatory to drawing up plans for electrification at the New York city terminus.

In 1901 the laboratory of applied mechanics was erected at the University of Illinois, an interior view of which is shown in Fig. 3. This laboratory is equipped with apparatus for testing materials and for investigations in hydraulics. The illustration shows a 600,000-pound Riehle test machine in use in testing a twelve-inch by twelve-inch concrete column. In this room there are a 200,000-pound Olsen test machine and three 100,000-pound test machines of different makes. There is also a 220,000-inch-pound-capacity Olsen torsion machine, a machine for making vibratory tests, and smaller apparatus of various types. The hydraulic laboratory, which is just in the rear of the room shown, is thoroughly equipped with pumps, pressure tanks, pipe lines, measuring pits, weirs, gauges and all the other apparatus which go to make up the equipment of such a laboratory.

The electrical engineering laboratory, shown in Fig. 4, contains very complete arrangements for testing all types of electrical machinery. The electric light and power plant of the university is installed in the rear portion of the building, the front part being given up to the dynamo laboratory and instrument rooms. In the basement there is a storage-battery plant, and on the second floor, photometric rooms and a specially equipped illumination laboratory fitted up for studying the effects of light distribution and color in illuminating problems.

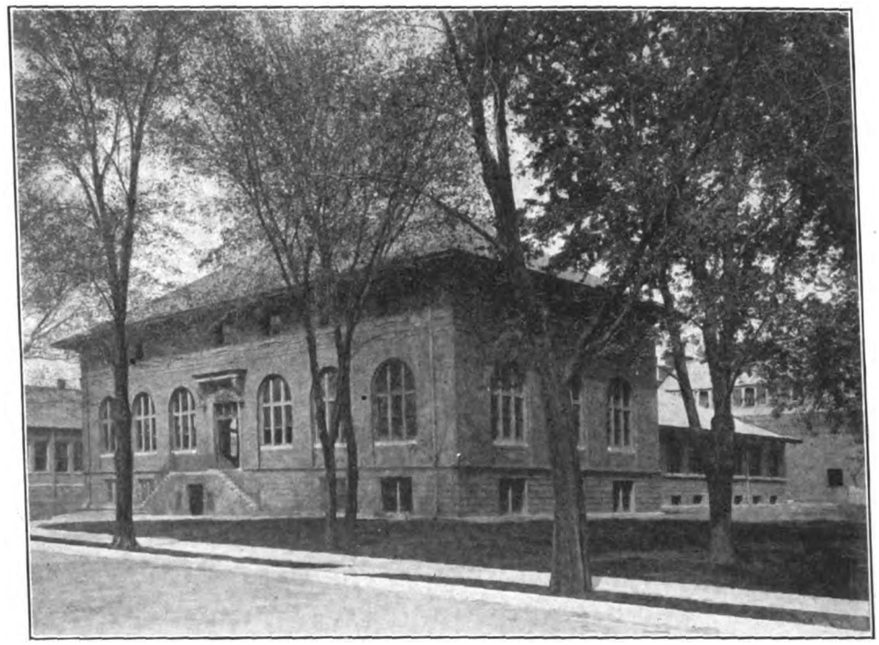


FIG. 4—EXTERIOR OF THE ELECTRICAL ENGINEERING LABORATORY OF THE UNIVERSITY OF ILLINOIS.

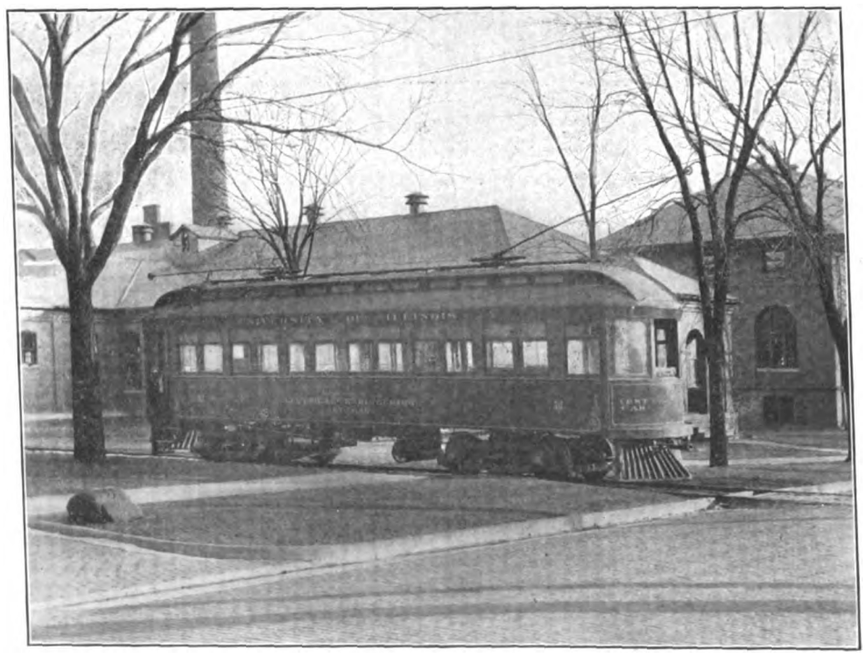


FIG. 5—THE TEST CAR FORMING PART OF THE EQUIPMENT OF THE ELECTRICAL ENGINEERING DEPARTMENT.

The electrical engineering department has recently acquired the electrical test car shown in Fig. 5. This is a car of the standard interurban type, fitted up with the latest type of multiple-unit control and equipped with all the necessary measuring instruments for determining the various factors entering into electric railway problems.

The civil engineering department maintains a laboratory for studying road materials, a subject to which the department has given a great deal of attention. This department also has a cement laboratory for studying questions involved in the manufacture and use of cement and concrete.

The machine and wood shops are well equipped with the modern machines for working metals and iron, which are available for assistance in the problems en-

Digitized by Google

countered in the work of the engineering experiment station. All departments are exceptionally well equipped with engineering apparatus and instruments, and, in addition, the fine equipments of the physical and chemical laboratory can be utilized when resort to them becomes necessary.

The work which has already been accomplished by the experiment station has been published in bulletins issued by the university. These have described experiments with high-speed tool steels, by L. P. Breckenridge, director of the station, who has been assisted by H. B. Dirks; a study of the drainage of earth roads, by I. O. Baker, professor of civil engineering, and tests of reenforced concrete beams, by A. N. Talbot, professor of applied mechanics. A series of tests on the collapse of boiler tubes has been carried out by the department of physics. A great deal of other work has been done and is now being carried on, the results of which have not been made public.

The station has laid out for itself a number of important problems, some of which have been proposed by the staff; others have been submitted to it. The Department of Agriculture has asked for investigations to be made on heat, light and sound-insulating materials, and on the strength of wooden beams and trestles. The department of civil engineering is extending its studies on road construction and is investigating various problems connected with structural ironwork. The electrical engineering department is making good use of its railway test car in studying railway problems and is studying questions of interior illumination. The mechanical engineering department is continuing the investigation of high-speed tool steels and of Illinois coals, and is also studying the effect of scale in boilers. It is experimenting with superheaters and gas producers, and with other problems connected with power stations. The department of railway engineering is conducting locomotive road tests, and the department of theoretical and applied mechanics is continuing the investigation of concrete beams and columns. It is studying problems involved in the construction of railway cars, is investigating the qualities of commercial mild steels and is carrying out a number of experiments on various hydraulic problems.

The above is but a brief outline of the equipment of the Illinois experiment station and of the work which it is purposed to carry on. There can be but little question of the value of these investigations, not only to the state itself, but to the country at large. In this way it is intended to make the greatest practical use of the excellent engineering equipments of the university, which heretofore have been devoted to the instruction of students only.

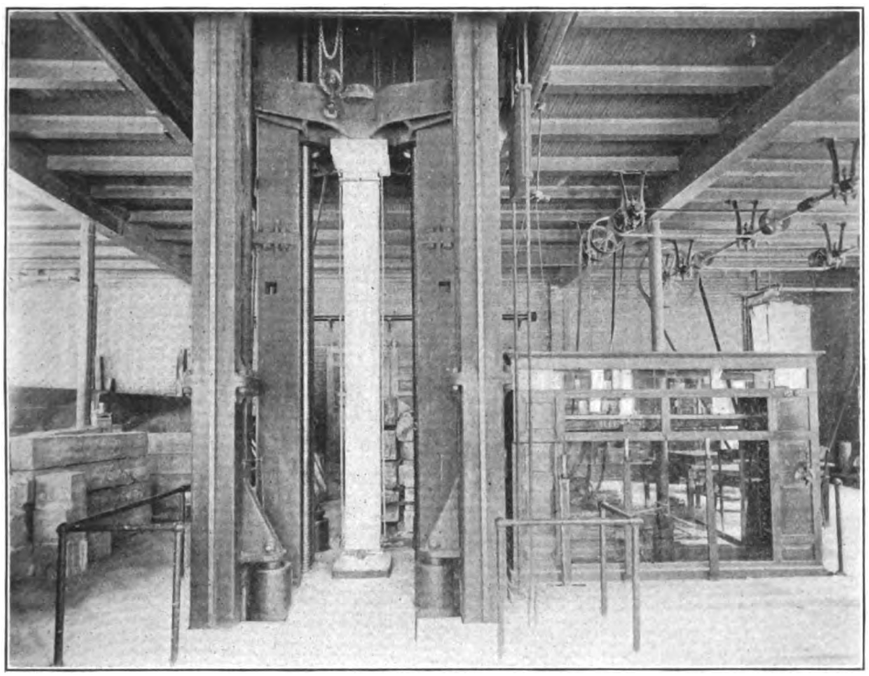


FIG. 3—INTERIOR OF THE LABORATORY OF APPLIED MECHANICS—TESTING A CONCRETE COLUMN.

BOOK REVIEWS.

"The Phantom of the Poles." William Reed. New York. Walter S. Rockey Company. Cloth. 284 pages. 5½ by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.50.

The title of this book would have been excellent for a novel, so that it is rather a pity that the author did not treat his subject in this way, for he could then have made an interesting and exciting story. As it is, however, while interesting in parts, as a whole it is disappointing. He seems to have been greatly attracted by the writings of Arctic explorers, and in pondering over the many puzzling natural phenomena observed there has evolved a theory of his own which, he believes, makes all clear. To the ordinary reader his ideas will not appeal, nor will his arguments convince. To adopt the idea of a hollow earth will upset too many physical theories not at all connected with Arctic eccentricities, and the looseness with which scientific expressions are employed seems to indicate a lack of understanding of them. The novelty of his ideas may, however, be interesting.

"Electricity Meters." C. H. W. Gerhardi. New York. The D. Van Nostrand Company. Cloth. 338 pages. 6 by 9 inches. 220 illustrations. Supplied by the ELECTRICAL REVIEW at $4.

In electrical engineering, perhaps more than in any other branch, attention has been paid to methods and apparatus for measuring. In fact, the instrument department of every operating company is of much importance for the success of that company both physically and financially. For this reason much attention has been paid to the design, the construction, the care and the testing of electrical instruments. The author of this book is the chief of the testing department of the Metropolitan Electrical Supply Company, of London, and he deals with the subject from the standpoint of the instrument user. He describes first the various types of alternating-current meters. Following this there is a description of continuous-current meters, in both cases taking up American and European types. This is followed by a chapter on meters suitable for both alternating and continuous-current supplies. Prepayment meters are then described—double tariff meters, maximum demand meters and tram car meters. He then takes up a consideration of choosing a type of meter, explains the best arrangements for a meter-testing room, describes the apparatus necessary, and the best way of installing it. Next, consideration is given to the matter of carrying out a test both in the laboratory and after

Digitized by Google

installing. Hints are given for the proper installation of meters, for correct reading, for cleaning and repairing, and for record keeping. A number of forms for such records are suggested. The book forms a thorough treatise on the subject of electricity, or, as they are incorrectly called in this country, wattmeters.

"Turbines." W. H. Stuart Garnett. New York. The Macmillan Company. Cloth. 284 pages. 6 by 9 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $2.75.

It is not the intention of the author of this book, who, it appears, is a barrister at law, to prepare a text for the designer of any of those prime movers which are grouped as turbines, nor to furnish a guide to the operating engineer which will enable him to run his plant with the most success. It has been his idea, rather, to prepare a popular work which would give to the public and to others interested an accurate discussion of the principles of the turbine and of the different types of construction which have been found successful. The ever-increasing importance of motors of this type seems to have made desirable a presentation of this kind. The first part deals with the historical development of the hydraulic turbine and the evolution of the three great types—the Fourneyron, or outward-flow turbine; the Jonval, or axial flow, and the Howd, though the latter is better known in the form due to Francis. A brief discussion of the theory of turbines is presented in a manner understandable by any one. This is followed by a discussion of impulse wheels and a description of modern designs of the three types of reaction turbines. This part of the book is concluded by a brief chapter on the erection and control of hydroelectric motors. Part II deals with the steam turbine, and after a very brief discussion of reciprocating engines, describes the various types of turbine which have been developed, dealing both with land and marine machines. This part of the work gives descriptions of practically all the steam turbines which have reached the construction stage. An appendix gives a brief consideration of the mathematical principles involved in this class of prime movers.

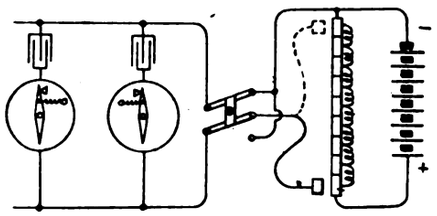
"Electric Machine Design." Horace Field Parshall and Henry Metcalfe Hobart. New York. John Wiley & Sons. Half morocco. 576 pages. 9 by 11 inches. 648 illustrations. Supplied by the ELECTRICAL REVIEW at $12.50.

The book entitled "Electric Generators," which was brought out some years ago by the authors of the present volume, was an amplification of a series of lectures delivered on this subject by them at the Massachusetts Institute of Technology. The excellence of that volume was well recognized, so that it took a prominent place in the literature of electrical engineering. The present work is really a second edition of the earlier book, though a change in title has seemed desirable. The old text has been revised and a good deal of new matter has been added. This has been necessary on account of the progress which has taken place in the art of designing, improvements not only having been made in the older types, but newer types of machines having been brought out. On account of this additional matter it has been necessary to cut out some parts of the older volume. This has been accomplished generally by omitting certain designs which have become more or less obsolete. The subject is divided into three main divisions. The first relates to the design of the magnetic circuit; the second considers the phenomena of commutation and the study of dimensions; the third relates to the rating of the machine, to determining what has been called the thermal limit of output. In the first part the study of materials is taken up carefully, dealing first with iron, methods of testing, and results of actual experiments are presented. This is followed with a study of insulating materials and methods of testing, and a description of the apparatus essential for this purpose. Following this the principles of armature winding of both direct and alternating-current machines are explained. This is followed by a discussion of formulae for electromotive-force for both classes of apparatus. In this chapter methods of determining the form factor are explained. The authors then take up a discussion of the rating of the machine with respect to the temperature rise, dealing here with the various losses which occur. Next, the design of the magnetic circuit is considered. The laws are applied to direct-current machines, to alternators, induction motors, and to transformers. The question of commutation is taken up in a study of constant-potential, continuous-current dynamos, and a large amount of experimental data is given here, bearing on this subject. This is followed by the specifications for a number of direct-current machines, some of which are very well known. The second part of the book deals with traction motors, direct-current types first being considered, and specifications for a number being given. A good many details in the design of these machines are included. Part III deals with rotary converters in the same thorough manner, designs of a number of machines being given and the methods employed in their operation. Part IV is given up to a consideration of alternators. It treats first of the regulation, then of the determination of the constants of the machine, showing how to predetermine the characteristic curves. Details of construction, as practiced by various builders, are shown here and discussed critically, and a number of noteworthy alternators are described. Part V deals with the design of alternators for steam turbine speeds. It describes a number of typical machines, going into a good deal of detail and including data obtained from actual tests. Part VI considers the design of continuous-current dynamos for turbine speeds, and includes complete specifications for a machine of this type designed by one of the authors. In an appendix to the book are given a copper wire table, showing the properties of commercial wires, and a table giving the electrical properties of various metals and alloys. There is a good subject index and an excellent portrait of Dr. John Hopkinson, to whom the book is dedicated, is given as a frontispiece. The object of the authors has been to furnish constants and formulate the general principles for the systematic design of electrical machines. With this idea in view they have avoided abstruse methods and complicated mathematical processes. In fact, the treatment in general is synthetic, it being thought that better results would be accomplished by following good practice rather than depending on cumbersome mathematical treatments. The particular designs which are described are all of machines which have given good results in practice. The preceding volume included a number of poorer machines, but these, due to a lack of space, have been excluded. Although perhaps unavoidable, this, in one way, is unfortunate, for the designer should know what is bad practice as well as what is good; and where all that is described is good there is danger that he may, when he branches out for himself, fall into pitfalls which might have been pointed out. It is not expected that any one can take this book and from it pick out designs which he can use. Although this might be done and a few good results be accomplished, the designer who adopted this practice would soon be left behind his competitors who were always seeking improvement; but if the principles which are laid down here are grasped thoroughly and then put into practice intelligently, the results undoubtedly will be satisfactory. Taken as a whole, the work is, undoubtedly, one of the best of its class that has even been published, and it will very probably find a place in every designing room.

Digitized by Google

Electrical Patents.

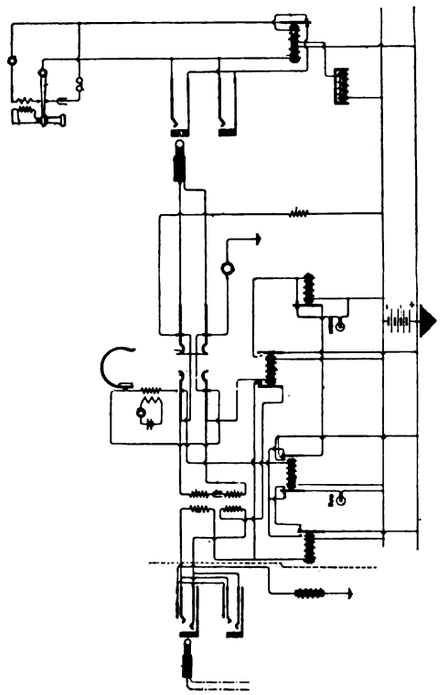
Sylvanus Albert Reed, of New York, has obtained letters-patent of the United States (824,206, June 26, 1906) for an improved selective system. This inven-



SELECTIVE SYSTEM.

tion relates to improvements in systems of electrical selective control capable of application with advantage to a variety of uses, and involves certain principles of operation, which are specially applicable to selective telephone signaling on party lines of the common battery type, wherein the line conductors are normally in open circuit, one of the primary objects of this invention being the production of selective signaling means for lines of this character, which will permit of the use of permanent ground branches from each conductor to contain the signal receiving annunciators and is otherwise capable of application to open circuit lines. The invention comprises two line conductors with open circuit subscribers' apparatus bridged there-across, a pair of polarized oppositely biased annunciators legged from each conductor to a common conductor or ground, condensers in said legs in series with the annunciators, and a source of current, in combination with means for establishing or removing a difference of potential between the opposed condenser surfaces of either line conductor at such rate as will correspond to a strength of current in the annunciators insufficient to overcome the tension of their respective biases.

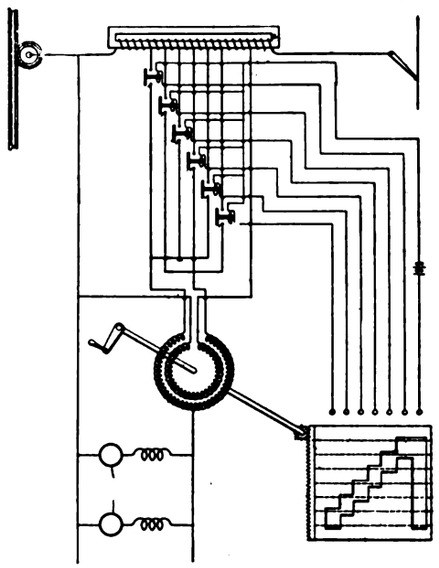
Harry G. Webster, of Chicago, Ill., has obtained letters patent of the United States, No. 824,767, dated July 3, 1906, for an improved telephone exchange system. He has assigned the same to Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y. The invention relates to telephone exchange systems, and more particularly to so-called "trunk circuits," for use in connection with such systems. The invention consists in the combination with a bimetallic trunk-line leading from an A exchange to a B exchange, of a spring jack at the A exchange to contacts of which the terminals of said line are connected, a repeating coil at the B exchange to the outer terminal of one winding of which said metallic line limbs are connected, a subscriber's line circuit connected to the terminals of the second winding of said repeating coil, subscriber's telephone apparatus connected with said line circuit, a subscriber's relay at the B exchange controlled by the operative condition of said telephone apparatus, the continuity of the trunk-line circuit through the first winding of said repeating coil being controlled by the subscriber's relay, an A operator's relay at the B exchange permanently connected to one limb of the line, a red and a white signal lamp at the B exchange each having a local illuminating circuit normally controlled by the A operator's relay, a source of current at the B exchange, and switching means



TELEPHONE EXCHANGE SYSTEM.

associated with the spring jack, whereby the insertion of a cord connecting plug within the jack causes the closure of an electric circuit through the source of current and the relay.

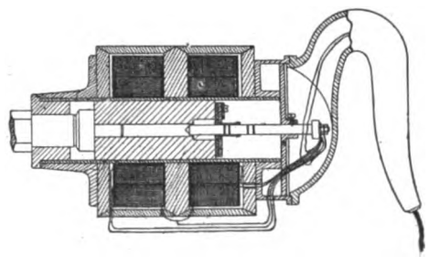
Ragnar Wikander, of Edgewood Park, Pa., has obtained letters-patent of the United States (824,225, June 26, 1906) for an improved voltage regulator, and he has assigned the same to Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. This invention relates to voltage regulators, and particularly to such regulators as vary the voltage applied to a circuit by varying the active length of a transformer winding. The object of the invention is to provide an improved form of regulator of the type specified whereby the voltage may be varied smoothly and gradually between minimum and maximum limits. The invention consists in successively connecting the respective terminals of the secondary winding of the induction regulator to consecutive leads from the transformer winding, a terminal of the distributing circuit being connected to approximately the middle point of the secondary wind-



VOLTAGE REGULATOR.

ing of the regulator. Therefore a smooth and steady variation of the voltage between the minimum and maximum limits is obtained without the occurrence of periods during which no variations in the voltage take place while the regulator is in operation.

An improved electric tool has been invented by Paul Schiemann, of Dresden, Germany. The number of his patent is 824,953, and it is dated July 3, 1906. The present invention relates to electric tools driven by the electromagnetic effect of coils, and its object is to avoid the loss of energy, which is considerable with this class of tools and which is due partly to excessive sparking when switching the



ELECTRIC TOOL.

coils in and out, partly to the excessive heat generated in the tool, partly by eddy currents and partly by the large number of coils necessitated. The invention consists of an electric tool driven by solenoids and having subdivided solenoid coils the parts of which are consecutively short-circuited.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Drawing Submarine Cable with a Locomotive.

A description is given here by Mr. J. Putnam of the laying of a telephone cable across the Connecticut river at Middletown, Ct. On account of the congestion in the four cables owned by the Southern New England Telephone and Telegraph Company it was necessary last spring to lay an additional one. It not being convenient to obtain a tug and lighter from New London, forty-five miles distant, as the ice was at that time going out of the river, another method of laying the cable had to be devised. Nor was it possible, as was done on a former occasion, to lay the cable across the ice, and then, cutting a slot in the ice, allow it to drop through to the bed of the river. The method adopted in this case was to draw the cable through the river from one side by means of a locomotive placed on the other bank. The cable consists of fifty pairs of No. 19 B. & S. copper wire. It is 1,640 feet long and weighs a little over 10,000 pounds. The conductors were insulated first with silk, then with two wrappings of paper. The pairs were twisted together, formed up into a cable, and insulated with paper and sheathed with lead, as is customary. In addition, three layers of jute were laid over the lead, and outside of this an armor of No. 4 Birmingham iron wire. Over the armor were laid two layers of hemp saturated with a preserving compound. To lay the cable, the reel was jacked up in the car on which it was delivered, and to the end was attached one end of a three-eighths-inch seven-strand messenger wire. This wire was then carried out to the middle of the river in a rowboat, where it met another boat coming from the other side with a similar messenger wire. The two ends were then spliced together. The section of the wire from the far side passed through a block attached to a telephone pole, thence through a second block attached to the railroad track, and was fastened to the drawbar of the locomotive. The locomotive then was moved along the track, drawing the cable through the river by means of the messenger wire. Sufficient tension on the cable was maintained by means of brakes on the cable reel, and an emergency brake formed by pressing the cable firmly against a smoothly sawed tree stump with a lever of iron pipe. These precautions were necessary to prevent the current of the river from carrying the cable down stream. Sixteen minutes were required to draw the cable across the river after the first end had entered the water. The work was done without any mishap.—*Abstracted from the American Telephone Journal (New York), July 7.*

High-Speed and High-Voltage Continuous-Current Dynamos.

The rapid progress in the development of the steam turbine has renewed interest in the design of high-speed, direct-current dynamos. The lowest speed at which the steam turbine designer will agree to work is generally higher than that best suited for these generators. It therefore becomes necessary to modify their construction to enable them to utilize the new prime mover. In this article H. M. Hobart describes a 1,000-kilowatt, 1,000-volt, six-pole, direct-current generator designed to run at 1,000 revolutions per minute. A feature of this design is the use of commutating poles to overcome the reactance voltage. This pole is designed without reference to overcoming armature interference. For this reason it is as short in the direction of the shaft as is permissible. On account of the high speed of the machine the diameter of the commutator must be small to avoid immoderately high peripheral speeds. While this low speed is desirable when carbon brushes are to be used, it necessitates a longer commutator in order to keep down the current density at the brush. The author has worked out a number of high-speed, direct-current machines for various voltages and outputs, and has found that the difficulties of the design decrease with increasing voltage. He believes that it is possible to design a 4,000-kilowatt, 2,000-volt generator to run at 500 revolutions per minute which would be a sound machine. In the particular machine described in this article the peripheral speed of the armature is about 160 feet per second. The conductors are held in place by means of hardwood wedges. The commutator is built up on a cast-iron sleeve, permitting access of air through the interior, and the segments are secured against centrifugal force by three steel rings shrunk on over mica bands. The peripheral speed of the commutator is about eighty feet per second. The yoke is of cast iron and the magnet core is of cast steel of elongated cross-section, with rounded ends. A diverter rheostat is connected in parallel with the windings of the commutating poles, enabling them to be adjusted to give good commutation at all loads. The principal dimensions are: diameter of armature, forty inches; length of core, twenty inches; depth of slot, one inch; width of slot, one-quarter inch; average width of tooth, two-tenths inch. The pole faces are twenty inches long, parallel with the shaft, and the mean length of the polar arc is seven and one-quarter inches. The length of the reversing pole parallel to the axis is ten inches and its polar arc is four inches. The radial depth of the air-gap is two-tenths inch, which is a trifle more than that of the main poles. The estimated commercial efficiency of this machine is ninety-six per cent.—*Abstracted from the Electrician (London), June 29.*

Measurement of Alternating Currents.

A method of measuring weak alternating currents has been proposed by Klemencic, which depends upon the heating effect of the current upon a thermo-couple. Two thin wires of iron and constantin were soldered together, and the current passed through these. The heating then set up a thermoelectric force, which could be measured. In amount it depended upon the square of the current, and hence the method is sensitive. This simple arrangement is not thought by Herr J. K. A. Wertheim-Salomonson to be sufficiently accurate, because the junction loses sensitiveness when solder is used, and unless the two wires be soldered together the contact is uncertain. He has devised an improvement in this method which overcomes the difficulties. He arranges a number of thermo-couples in two circuits, connected up in the method employed in the Wheatstone bridge. The alternating current is passed through this double circuit from two points, and the galvanometer connections are taken off at two other points. The arrangement is such that the difference of potential between the two galvanometer terminals due to the alternating current is zero, while the thermal electromotive forces add together to force a current through this circuit. He has used an apparatus of this kind with ten thermo-couples in each side of the bridge. Each row had a resistance of sixty ohms and gave deflections of the galvanometer proportional to the square of the current. Its sensitiveness was such that a current

Digitized by Google

of one milliampere sets up a difference of potential of 7.5 microvolts. With the galvanometer employed he is able to detect a current of 2×10^{-5} ampere.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), July 1.*

A Rateau Exhaust Steam Turbine Plant.

A description is given here of an installation of a Rateau exhaust-steam accumulator and turbine at the Hallside works of the Steel Company of Scotland. This plant deals with the exhaust steam from one high-pressure cogging engine with two cylinders, each forty inches in diameter, and a five-foot stroke, one finishing train engine, with two cylinders, forty-two inches in diameter and a five-foot stroke, and two small mill engines and four steam hammers. The total amount of steam from these engines is about 41,000 pounds per hour. The power to be generated from the exhaust is required for lighting purposes and for the driving of live rolls, saws, sand-blast apparatus, machine tools, etc. It was decided to adopt for driving these machines electric power at 230 volts. The accumulator is of the Rateau water-type, having two compartments. It separates any oil carried over by the steam from the water, and it maintains the water in energetic circulation. The steam passing into this accumulator from the engines is condensed whenever the back pressure is above a certain amount; and, on the other hand, if the back pressure falls, the hot water immediately sets free steam at a low pressure. The accumulator is eleven feet six inches in diameter and thirty-four inches in length. It is capable of handling the load on two turbines for six minutes with the main engine stopped. The turbine is rated at 700 horse-power. The wheels are forty inches in diameter, and there are eleven sets of blades. The machine develops full power at a speed of 1,500 revolutions per minute, and when working on an overload of ten per cent the pressure at the inlet is never more than twelve pounds absolute. The vacuum maintained at the present time is about twenty-eight inches. Since the generator must deliver 2,000 amperes, special care was taken in the design of the commutator. The brushes are of carbon and the commutator bars have special ventilating ducts through the centre. A fan blade is attached to each bar so as to maintain the circulation of air through these ducts. After this unit was installed it was run at full load for two weeks, day and night, without stopping, except on Sunday. During this test the regulation did not vary more than five per cent, nor did the temperature rise above a safe point. Tests of this unit have shown a consumption of 66.4 pounds of steam per kilowatt-hour, with a load of only sixty-nine kilowatts, and with the absolute pressure of the steam on entering the turbine 2.9 pounds per square inch. With a load of 196 kilowatts the consumption was 42.1 pounds of steam per kilowatt-hour, and the absolute pressure of the steam on entering the turbine 5.35 pounds. With a load of 345 kilowatts the consumption was thirty-seven pounds of steam per kilowatt-hour, and the pressure on entering the turbine 8.25 pounds. With a load of 450 kilowatts the consumption was 36.6 pounds of steam and the pressure 11.4 pounds. During these tests the vacuum fell from 28.7 inches for the lightest load to 27.9 inches for the last named.—*Abstracted from Engineering (London), June 29.*

The Creplet System of Hoisting for Mines.

This system, which is described here by M. R. de Valbreuze, is thought to be simpler than the Ilgner system and to have some advantages which the latter does not possess. In the Ilgner system the variations in load are absorbed by means of a motor-generator equipped with a heavy flywheel. In the Creplet system the motor is done away with. The generator is connected in series with the hoisting motor, and on the shaft of the former is placed the absorbing wheel. The object of this is to maintain a constant load on the supply system and to do away with one machine. In the other systems either the motor or generator is idle when the other one is at work. In this system the machine acts at one time as a motor, accelerating its flywheel, and then as a generator, supplying the additional load used in accelerating the winding motor. The system is controlled by regulating the excitation of the balancing generator, but the motor is reversed by reversing the armature connections, which is done without opening the main circuit. An installation has been in use at the mines of Hasard & Fléron. The main power supply to the motors is by means of three-phase current at 2,000 volts, but a motor-generator set has been installed to supply the power for hoisting. The height of the lift is about 950 feet, the speed about thirteen feet a second, and the weight of the cage, loaded, a little over a ton. The generator attached to the flywheel is capable of delivering 150 horse-power. The flywheel weighs three and one-quarter tons. The speed variation is from 600 to 275 revolutions per minute, a variation much greater than that obtainable in the other systems. A test made with this equipment showed that the mean useful horse-power was sixteen and one-half, the mean consumption of power 35.7 kilowatts. The overall efficiency of the installation was thirty-four per cent. This was during a day in which 8,850 tons of coal were extracted. On another day, when 10,800 tons were extracted, the overall efficiency was thirty-three per cent.—*Translated and abstracted from L'Éclairage Électrique (Paris), June 30.*

Apparatus for the Production of Pure Ozone.

The apparatus described in this article by M. Albert Breydel is intended to produce pure ozone economically. Apparatus for producing this substance have been devised previously, but they do not attempt to prevent the formation of other substances when free air is employed as the raw material. Impurities are formed, sometimes ammonia or other compounds of nitrogen, and when metallic electrodes are employed, vapors of these metals will be found in the resulting gas. This particular arrangement is designed to avoid such contamination, as the ozone is sought for medical purposes or other uses in which purity is necessary. It is made by passing pure ozygen through the ozonizer, the oxygen being obtained from the ordinary oxygen cylinders. It is therefore desirable that the apparatus should have a high efficiency as an ozone producer, and, to accomplish this, the oxygen is cooled before passing to the ozonizer. When treated in this way the proportion of ozone produced is increased considerably, particularly if the gas first be thoroughly dried. The method consists in drawing the oxygen from the cylinder, passing it through a drying chamber containing calcium carbide, thence through a worm submerged in a cooling mixture, and thence through the ozonizer proper. To avoid contamination due to the electrodes, the latter consist of very thin films of metal placed between glass plates. A number of such electrodes are arranged in a battery, alternate ones being connected to the opposite poles of the source of potential. This source is preferable to a static influence machine, although any source of high potential may be employed. It is necessary, however, to attach Leyden jars or some other capacity to the two sides of the circuit, and to cause oscillating discharges to take place in the air. When this is done the oscillations set up cause brush discharges to take place within the ozonizer, and bring about the transformation of the oxygen. No figures are given showing the efficiency of the apparatus.—*Translated and abstracted from La Revue Pratique de L'Électricité (Paris), June 20.*

Digitized by Google

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

Herewith we present four samples of printing which have come to hand recently, each of which bears some hallmark of distinction. It is unfortunate that the reproduction is not in the original colors, for, with these samples particularly, the color scheme has much to do with the attractiveness and utility of the printed matter.

The first sample is from the Brooklyn Edison Company and is a simple dodger, five and one-quarter by eight and one-quarter inches, printed a soft brown on white stock. The circular is timely and calls attention to the advantages of the electric light and the electric fan during

Seeking "Coolth"
NOT so long ago we were all huddling up close to the fire seeking warmth. Times have changed. We are now wiping the perspiration from our brows and seeking "coolth."
Right here is where Edison service helps you out and proves a boon, either in home or store. Electric light is a cool light and does not heat up your premises. That's negative coolth. Also, with the same current that gives you the light, you can operate an electric fan, and keep cool effectively without any effort on your part. That's positive coolth.
In fact summer is a season when Edison service spells health and comfort to the many who cannot seek mountain or seashore, but are obliged to stay at home. And this beneficent service is now in Brooklyn, *cheap*, every man not positively poverty stricken can well afford to enjoy its matchless comforts and conveniences.
If your home or store is not yet equipped for electricity, it's time, it's time! Maybe we can help you toward this desirable consummation. Write us about it and we will call and talk the matter over with you. Take pen in hand now—it won't take you but a moment. Address
Edison Electric Illuminating Company
Of Brooklyn
360 Pearl Street Brooklyn, N. Y.

the heated period. The play upon the coined word "coolth" is clever and holds the attention until its whole meaning is grasped, giving time for the suggestion to leave a permanent impression upon one's mind.

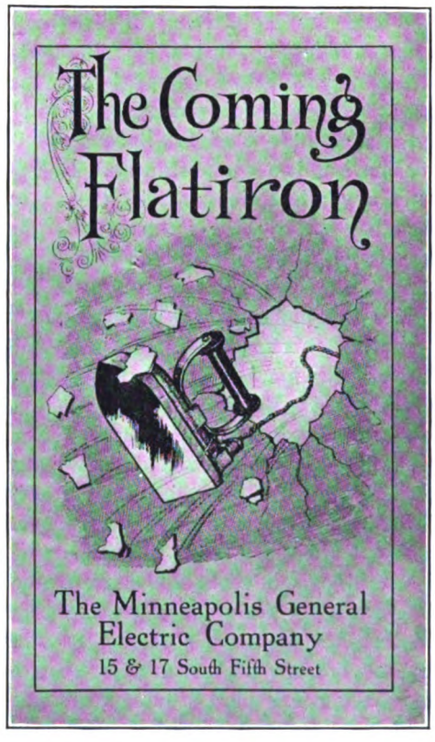
The second and third samples are from the Denver Gas and Electric Company. The first of the two is printed in red and black on a cream stock, three and one-half by five and one-half inches. The statement "if your name is flashed forth like this none can fail to see it," is to the point. The other sample is an example of attractive printing rather than a striking argument for the use of electric signs. The light pink stock is the

PLYMOUTH
If your name is flashed forth like this none can fail to see it. That's the way of
ELECTRIC SIGNS
Letters in lights talk for business steadily. Why not set one to talking for you ?
THE DENVER GAS AND ELECTRIC COMPANY

ALMOST
ANYTHING IN LIGHTS
MAKES
A GOOD ELECTRIC SIGN
When it's distinctive of your business it's an individual ad—one that talks for the business
THE DENVER GAS AND ELECTRIC COMPANY

same size as the card just mentioned, and the color scheme is black and red. The over-printing, black on red, at the top of the card is very catchy, the definition being lost, however, in the photo-engraved reproduction.

The fourth sample is a cover page of a very neat brochure published by the Minneapolis General Electric Company. The frontispiece inside is a photographic reproduction illustrating the electric flatiron in practical service. The brochure explains the operation of the electric iron, the cost of operation, and offers the iron for less than cost on a thirty days' trial, and guarantees them for one year. This offer is not made to the general public, but is made exclusively to consumers of electricity on the company's circuits. This policy is a decided departure from that recently described by S. M. Kennedy, of Los Angeles, where, after several other expedients had been tried, the company invested in several thousand irons, turned them over to consumers on a loaning agreement and built up in short time a profitable load. The competitive conditions of two cities, however, may be so different that while this scheme would be splendidly successful in one place it would entail positive losses in another.



Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

"American" Portable Voltmeters and Ammeters.

The accompanying illustration shows an instrument of a new line of portable direct-current voltmeters and ammeters which has been brought out by the American Instrument Company, Newark, N. J. They are of the moving-coil type, the fixed part being a permanent magnet. Especial attention is directed to the pivots of the new instruments, which are of steel and are cylindrical and journaled into

NEW TYPE PORTABLE VOLTMETER.

watch jewels. This construction, it is claimed, reduces the danger to the jewels from shocks and jars encountered in ordinary usage, and also minimizes friction. The permanent magnets are made of the best magnet steel, carefully hardened and aged. The moving systems are light and stiff, so that with the type of pivot employed there is no danger of their striking against the pole pieces.

Special attention has been paid to the winding of the moving coils, so as to obtain a somewhat larger torque than that usually employed. This enables stronger controlling springs to be used and minimizes any zero errors due to friction. The resistance of the portable voltmeters is wound non-inductively and is designed to have a negligible temperature coefficient.

A feature of this line of instruments is the interchangeability of voltmeter multipliers and ammeter shunts. All voltmeters are adjusted to a uniform resistance of 100 ohms per volt, so that any multiplier may be used with any voltmeter. The portable voltmeters are self-contained up to and including 750 volts, but ranges beyond this are provided for by the use of external multipliers.

The ammeters are self-contained up to and including 200 amperes, but when it is desired to use one ammeter through several ranges a millivoltmeter and separate interchangeable shunts are employed. The millivoltmeter, with its leads, has a resistance of one ohm, and can give a full scale deflection with a potential difference of fifty millivolts. The ammeter shunts are adjusted for a potential drop of fifty millivolts at full current, consequently, any millivoltmeter may be used with any shunt and read correctly.

The portable instruments are made in two types, designated as No. 4 and No. 5. The No. 4 instruments are provided with special iron shields inside of the wood cases, so that they can be used close to large generators. The No. 5 instruments are not provided with this shield and are consequently lighter and somewhat smaller.

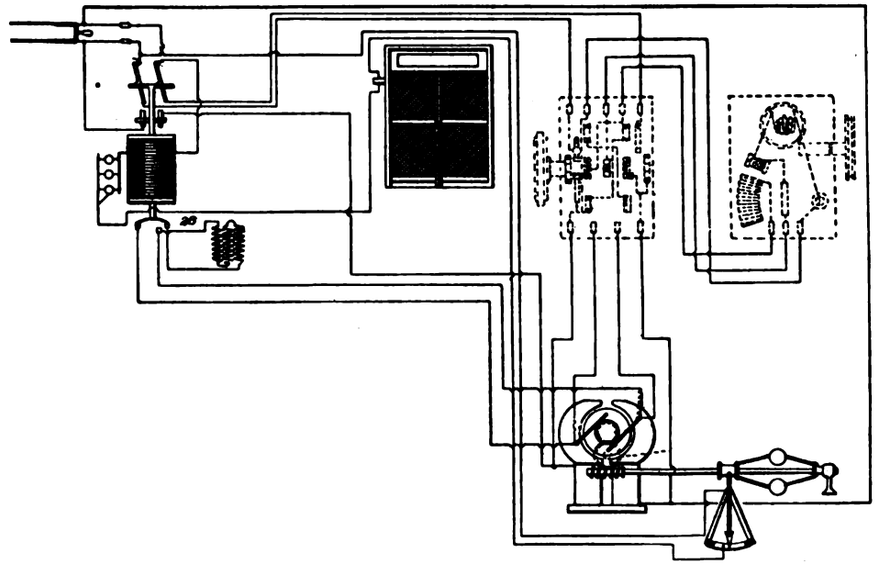
These voltmeters and ammeters are guaranteed correct within one-half of one per cent. The company will also test them and recalibrate them any time within twelve months free of charge, if they are returned to the factory with the seals unbroken.

The general sales office of the American Instrument Company is at 1114 Chestnut street, Philadelphia, Pa.

Safety System for Elevators.

A safety system for elevators operated by any power has been invented by Mr. John A. Miller, and is being put upon the market by the Safety Device Company, Bond Building, Washington, D. C. The object of this device is to prevent the man in charge from starting the elevator until the door has been closed. This is accomplished by means of a set of switches, one located at each door, and all being connected in series. These switches are closed by the act of shutting the door, and the safety circuit is only completed when all doors are closed.

The system, as applied to electric elevators, makes use of this safety circuit to close the switch which supplies power to the motor, which is done by means of a solenoid which operates a switch placed at any convenient point. Whenever a door is opened this controlling switch is thrown, and at once cuts off the power of the car. This motion is also made use of to shunt the motor armature through a resistance, and thus act as a brake to stop the car and prevent accidents. When applied to an electrically operated car it is not only impossible to start the car except when all doors are closed, but the mere opening of any one door will at once bring the car to a standstill. The device thus not only prevents accidents which might happen to the passengers while entering the car,

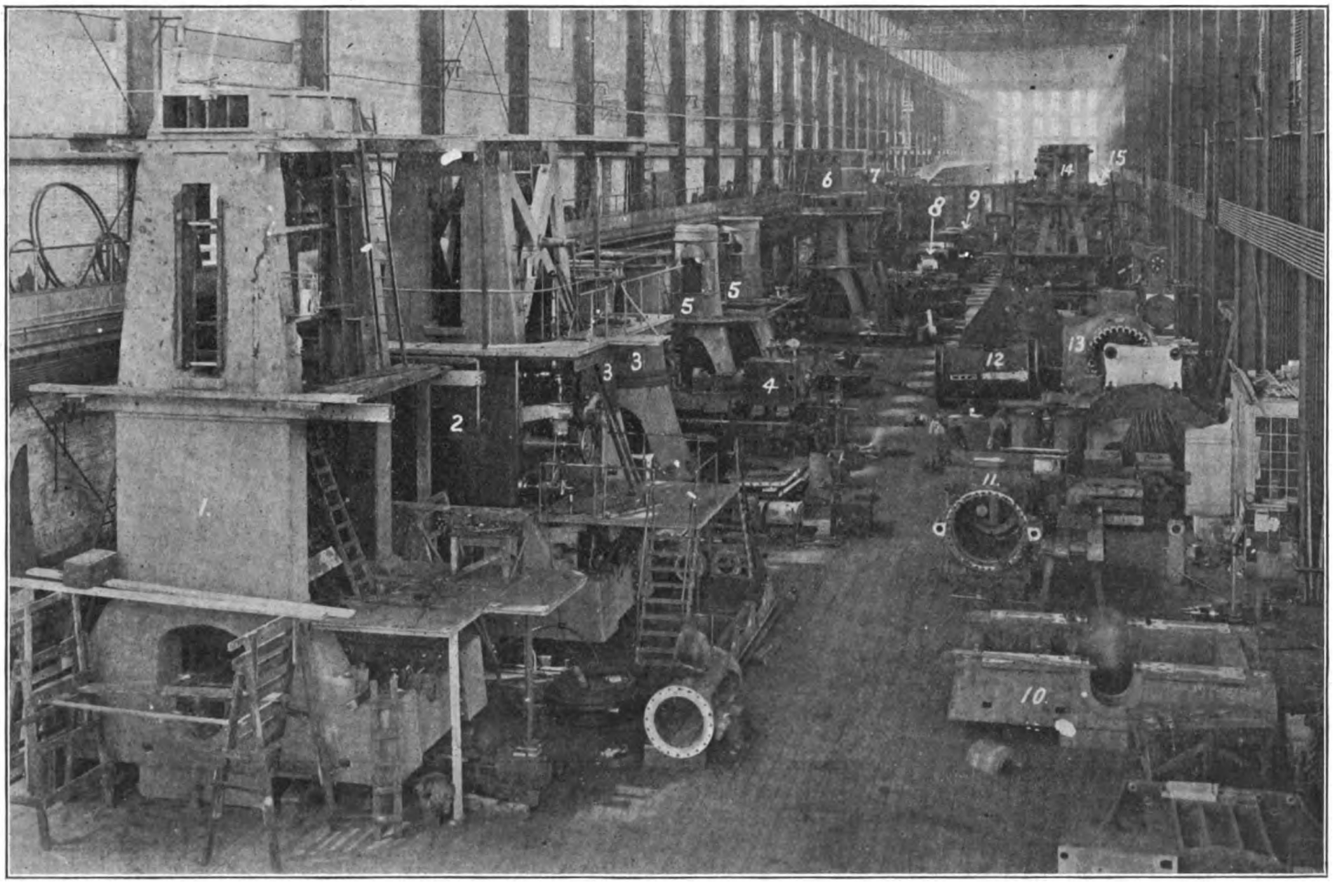


SAFETY SYSTEM FOR ELEVATORS.

Digitized by Google

but does away with accidents which would happen through the opening of any other door. It may also be employed to prevent racing of the car by the addition of a simple speed-limiting controller.

Applied to the hydraulically operated elevator, the device takes the form of a lock operated by means of a magnet, which prevents the controlling valve from being open except when all doors are closed. In this case the set of switches, as before, is arranged at each door and thus connected in the circuit of the electro-magnet. When any door is opened, the magnet releases its armature and allows the lock to fall, which engages in a slot in a disc placed upon the valve rod. This lock is released by the withdrawing of the armature whenever the current is completed by the shutting of all the doors.



ERECTING SHOP OF THE ALLIS-CHALMERS COMPANY, WEST ALLIS, MILWAUKEE.

A Busy Erecting Shop.

The view of the erecting shop of the West Allis, Milwaukee, works of the Allis-Chalmers Company, reproduced herewith, shows, it is believed, a greater number of large steam-driven units in process of erection than has ever before been assembled under a single roof. It is taken from the south end of the building in such a way that the new extension, 589 feet in length to the present shop, may be seen beyond the temporary partition which marks the north boundary of the older structure.

The entire building is 1,155 feet long, 113 feet wide and 72.5 feet high to the roof trusses. The figures shown in the view, and which correspond with the following list, will furnish some idea of the magnitude of most of the engines which are being erected there. They are:

No. 1 and No. 2. Two vertical long crosshead-type blowing engines for the Republic Iron and Steel Company, fifty-two-inch and ninety-six-inch cylinders by ninety-six-inch stroke, with a capacity of 45,000 cubic feet of free air per minute.

No. 3. A vertical steeple cross-compound blowing engine, ordered by the Jones & Laughlin Steel Company.

No. 4. Steam ends of two horizontal cross-compound, vertical shaft centrifugal pumps for the Lawrence avenue station of the city of Chicago.

No. 5. A Reynolds vertical cross-compound engine, thirty-four-inch by seventy-two-inch by sixty-inch stroke for direct-connection to a 2,000-kilowatt generator, being built for the Memphis Street Railway Company, Memphis, Tenn.

No. 6 and No. 7. Two vertical cross-compound Reynolds-Corliss engines, aggregating 2,700 indicated horse-power, for the Hecker-Jones-Jewell Milling Company, whose new plant equipped with Allis-Chalmers milling machinery will be among the largest in the world.

No. 8. One of four horizontal, non-condensing air compressors, for the Buffalo-Susquehanna Coal and Coke Company, each having steam cylinders twenty-six inches by forty-four inches in diameter and air cylinders forty-two inches and twenty-six inches by forty-eight-inch strokes; capacity, 5,000 cubic feet.

No. 9. A double-drum duplex, direct-acting Corliss hoisting engine for the Shattuck-Arizona Mining Company and designed to carry continuously an unbalanced load of 15,000 pounds at a speed of 2,000 feet per minute.

No. 10. A blowing engine bed for one of several heavy furnace-blowing engines recently ordered by the Carnegie Steel Company.

No. 11. The high-pressure cylinder for one of seven pairs of vertical long cross-head-type, furnace-blowing engines, or-

Digitized by Google

dered by the Edgar Thompson Steel Works; steam cylinder forty-four-inch by sixty-inch stroke and air cylinder eighty-four-inch by sixty-inch stroke.

No. 12. Vertical slide for heavy-blowing engine, being built for the Carnegie Steel Company, Carrie furnaces.

No. 13. The famous 105-ton single casting, the largest ever poured by the Allis-Chalmers Company, for the frame and slide of a rolling mill engine to be installed at the Sharon, Pa., plant of the Carnegie Steel Company.

No. 14. Two of the Gillespie pumping engines, with a capacity of 30,000,000 gallons per twenty-four hours, for the city of Pittsburg filtration plant.

In addition to the heavy units visible in the picture, there are a number of others which are hidden from view, including a triple-expansion vertical pumping engine for the Newport Water Works.

The addition to the erecting shop will be in readiness for use within a few weeks' time, as will also the added machine-shop units No. 4, No. 5 and No. 6, which open into the extended portion of the building.

Watertight Telephone System for Battleships.

The following description and illustrations relate to the special telephone system designed and built by the Holtzer-Cabot Electric Company, Boston, Mass., for the naval department of the United States Government. Five similar systems were purchased by the government and installed upon the following battleships: California, South Dakota, Milwaukee, Indiana and Connecticut. To meet the specially severe conditions which obtain on shipboard there were incorporated a number of novel and original features.

FIG. 1.—WATERTIGHT STATION.

It was especially desired that the instruments be unaffected by the action of the air, the movement of the vessel, or the concussion of the heavy guns, and the switchboard and exposed stations were to be absolutely watertight.

Fig. 1 represents one of the watertight stations. The operating parts are mounted on a frame plate which can be readily removed from the case without the use of tools and without disturbing any of the connections. One of the distinctive and original features of this station is the double receiver, the two receivers operating independently of each other, so that either or both may be used. The act of raising one of them to the ear brings the transmitter into the proper position for talking and signals the switchboard. When released all parts return to their normal condition, making it impossible for any user to leave the telephone connected to the line. The receivers are of the watchcase type, double pole, with metal cases, the coils being specially treated to make them waterproof. The transmitters are of the solid back type, the chamber being hermetically sealed, there being used nothing that will be affected by the moisture. The arms will support a weight of 200 pounds. The case which encloses the station is of composition, polished and oxidized and provided with a channel into which is fitted a molded gasket of pure rubber.

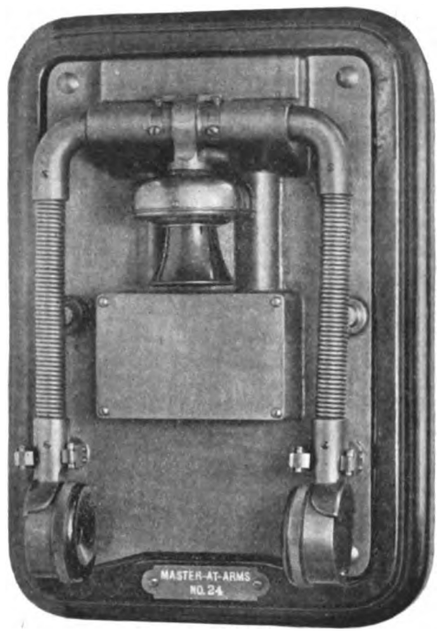


FIG. 2.—NON-WATERTIGHT STATION.

The non-watertight stations (Fig. 2) are interchangeable with the watertight telephones, the operative parts being mounted upon a mahogany base instead of in a metallic case.

With each station there is furnished a separate watertight vibrating call-bell. The design of the mechanism of this bell is distinctly special the blow being delivered to the gong through a phosphor bronze diaphragm, which is reenforced so that there is no danger of its being worn through by use. The parts of the bell are made of non-oxidizable metal with the exception of the iron and steel parts which are copper-plated and lacquered to prevent corrosion.

The operative parts of the switchboard are mounted in a heavy brass case, shown in Fig. 3. This is gasketed so that when the cover is closed it is absolutely watertight. The case is divided into two compartments, the upper containing the terminals and the lower the switchboard proper. The upper part of the case is drilled for two-inch conduits. The terminals are of heavy copper lugs and are insulated with mica. A distinguishing feature of the board is that the connections are made without cords, there being used specially designed keys instead. The front of the switchboard is subdivided into vertical strips, each holding four keys. By taking out two screws any one of these strips may be removed, exposing for examination every contact and connection on the strip. The whole front, which supports the case and signals, is hinged at the bottom so that it may be readily let down, allowing the cables to be examined. A supervisory signal is provided with each connecting circuit, the purpose of which is to indicate when the conversation has been finished.

Provision is made for connection with shore exchanges, the signaling current being obtained from a hand-power generator which is held in the box shown at the right of the cut. The system will work in connection with either a common battery or magneto exchange.

FIG. 3.—SWITCHBOARD ARRANGEMENTS.

Current for the transmitters is taken from a Holtzer-Cabot motor-generator of the noiseless type. These circuits draw their current directly from the motor-generator, there being no storage batteries. The ringing current is obtained from the ship's ringing dynamotor or, in case of disability, from an emergency set of dry batteries. The system

Digitized by Google

operates on a three-wire circuit, and five conversations can take place at the same time, or any number of stations can be connected and an order transmitted simultaneously to them from any other station.

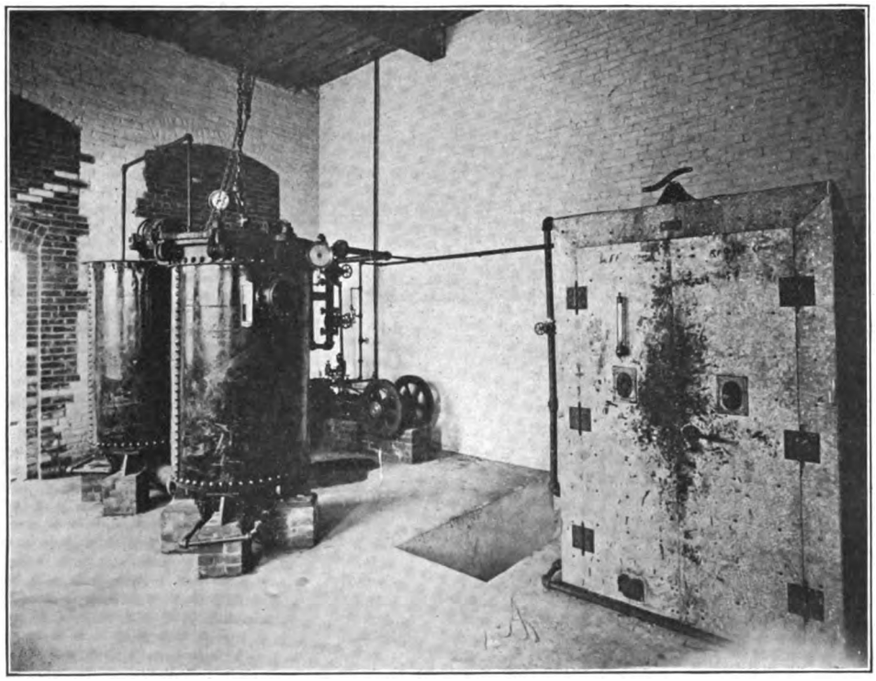
The system as a whole has been built with a special view to ruggedness, so that nothing short of actual violence can cause injury.

Applying the Vacuum Impregnating Method with "Voltax."

One of the most interesting developments during the past year in the electrical world has been the recognition of the value of the vacuum impregnating process for field and armature windings. The Electric Cable Company, of New York, after carefully investigating the claims made for this method, has adopted the Passburg system, using its well-known "voltax" as the impregnating compound. The outfit now installed in the company's works at Bridgeport, Ct., was furnished by the J. P. Devine Company, of Buffalo, N. Y., which controls the Passburg patents in this country. The apparatus consists of two wrought-iron airtight tanks, one of these being for the vacuum chamber compound. The coils to be impregnated are placed in the vacuum tank, after which a combined vacuum and air pump exhausts the air from the vacuum tank as well as any moisture present in the material composing the coils. This moisture passes through a condensing apparatus and is drained off as water. As soon as the best possible vacuum has been secured the pump is reversed to force air under pressure into the tank full of "voltax." This air naturally displaces the compound, which is forced into the vacuum chamber, where it impregnates the coils placed therein. The measuring devices used in this connection comprise an observation glass in the vacuum chamber to see the amount of "voltax" present, a thermometer for showing the temperature of the compound and a gauge to indicate both the vacuum and air pressures.

The coils are kept under vacuum condition for two hours or more, according to the windings, and under air pressure for about half as long. After this the original air pressure is greatly reduced, the connecting valve between the tanks opened and the compound forced back to the liquid tank. The valve is then closed and the coils are left to drip in the vacuum tank for half an hour or so.

It will be seen from the foregoing description that the proper carrying out of this vacuum process results in much longer life for the coils than the old dipping and baking methods. Since the coils are impregnated practically solid, wire slipping is obviated, and the elimination of entrained air and moisture gives the best condition for uniform heat radiation and the prevention of short-circuits. The fact that the impregnating compound enters the vacuum chamber without breaking the vacuum eliminates all possibility of the dried coils absorbing moisture.



VACUUM IMPREGNATING AND DRYING APPARATUS.

Steam Turbine Installations.

The Delaware, Lackawanna & Western Railroad Company has contracted with the Westinghouse Machine Company for two Westinghouse-Parsons steam turbines to be installed in its passenger terminal at Hoboken, N. J. The turbines will operate under a steam pressure of 140 pounds, twenty-eight-inch vacuum, and moderate superheat, driving 500-kilowatt, three-phase, sixty-cycle Westinghouse generators of the rotating-field enclosed turbo type. These machines will supply current to the station and yards. Internal superheaters will be used, while the condensing system will be Worthington barometric. Babcock & Wilcox boilers will supply steam, using small anthracite coal.

The Navy Department in its recent power extensions to the New York navy yard has, through its Bureau of Yards and Docks, adopted Westinghouse-Parsons steam turbines, which will be installed in building No. 41.

The present installation will comprise two 500-kilowatt units operating under 150 pounds steam pressure, twenty-eight-inch vacuum and on superheated steam at 100 degrees Fahrenheit. The power plant supplies three-phase alternating current at 2,300 volts, and sixty-cycle frequency, to machine shops, dry docks, and other general purposes about the New York yards, including lighting of buildings. The contract for these turbines was secured on rigid government specifications and under strong competition. Boilers will be of the Stirling water-tube type, with Foster internal superheaters. Worthington surface condensers will be used. This will make the second turbine plant that the Westinghouse Machine Company has installed for the Navy Department, the first one being at the Boston navy yard, where the turbines have been giving very good service.

The Burlington municipal lighting plant at Burlington, Vt., has recently contracted with the Westinghouse Machine Company for a Westinghouse-Parsons turbo-generator unit. The turbine will be direct-connected to a three-phase, 2,300-volt, sixty-cycle turbo-alternator, running at 3,600 revolutions per minute, and will operate on 150 pounds of steam with twenty-eight-inch vacuum.

Stockholders of the Allis-Chalmers Company at a special meeting, held at Jersey City, N. J., July 16, voted to authorize an issue of bonds to the amount of $15,000,000.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

POWER COMPANY SOLD TO SYNDICATE—Announcement is made of the purchase of the Bar Harbor & Union River Power Company by a syndicate of New York and Philadelphia capitalists, of which John R. Graham, of Bangor, Me., is the head. The men interested are the owners and principal stockholders of the Bangor Railway and Electric Company, the Lewiston, Brunswick & Bath Railway and other enterprises in the state. The amount of capital involved in the transfer is said to be about $700,000.

MEMPHIS TELEPHONE COMPANY TO INCREASE CAPITAL STOCK—The Memphis Telephone Company purposes increasing its capital stock from $1,000,000 to $3,000,000, and to this end has filed a $3,000,000 mortgage. The proceeds of the bond issue will be devoted to the improvement and expansion of the system. The first work will be done in the present home of the company and will include the installation of new machinery. Later the company plans to establish another exchange in the eastern part of the city.

NORTHERN OHIO TRACTION AND LIGHT—The plan under which the Northern Ohio Traction and Light Company will acquire the properties of the Tucker Anthony syndicate in northeastern Ohio has been perfected. It will become operative in about sixty days, or as soon as the legal requirements are complied with. The capital of the Northern Ohio company will be increased from $7,500,000 to $10,000,000, while the preferred stock of the Canton-Akron line will be transferred for six per cent divisional lien mortgage bonds, and the common stock for Northern Ohio stock at par. For the other lines an exchange of stock has also been arranged. This merger will result in a system operating 202 miles.

NEW RAILWAY AND LIGHTING COMPANY—The American Cities' Railway and Light Company has been incorporated at Trenton, N. J., with a nominal capital of $15,000, which will be increased to $27,500,000, divided into $12,500,000 cumulative preferred and $15,000,000 common stock. The new corporation is to take over the Birmingham Railway, Light and Power Company, the Memphis Street Railway, the Nashville Railway and Light Company, the Little Rock Railway and Electric Company, the Knoxville Railway and Light Company and the Houston Lighting and Power Company. In exchange for the stock of these six companies the American Cities' Railway and Light Company will issue its entire common stock and $10,000,000 of its preferred stock, reserving $2,500,000 of the latter for future uses.

ELY SYNDICATE PURCHASES OHIO TROLLEY LINES—The transfer of the Steubenville Traction and Light Company, of Steubenville, Ohio, to the Ely syndicate, of Buffalo, N. Y., by the Ohio Valley Finance Company, an underlying company of the American Gas Company, of Philadelphia, has been perfected. The syndicate is concluding the purchase of lines at East Liverpool, Toronto and other Ohio river points, and proposes to build a line down the Ohio river from Pittsburg, Pa., ultimately to Cincinnati. Van Horn W. Ely was made president of the Steubenville company, succeeding J. Charles Ross. The Steubenville Traction and Light Company was organized in 1901 to merge the Steubenville Traction Company and the Steubenville Gas and Electric Company. It also owns the Steubenville & Pleasant Heights road and controls the Steubenville & Toronto Traction Company. The company has an authorized capital stock of $1,000,000, all of which is outstanding. The funded debt consists of $1,000,000 first mortgage five per cent bonds, of which $790,000 are outstanding, the rest being reserved for extensions and improvements.

LARGE ELECTRIC MERGER—The merger projected by the Clark, Pratt and Seligman interests has been consummated in the organization of the Portland Railway, Light and Power Company, which has taken over the Portland Railway Company, Portland General Electric Company, Oregon Water Power and Railway Company, Citizens' Light and Traction Company, of Salem; Vancouver Electric Light Company and the Union Light and Power Company, operating plants at Woodburn, Silverton and Mount Angel. The company is capitalized at $15,000,000, of which $5,000,000 is preferred stock and $10,000,000 common. Its principal place of business will be at Portland, Ore. Officers have been elected as follows: H. W. Goode, president of the Portland General Electric Company, president; F. I. Fuller, president and general manager of the Portland Railway Company, vice-president; H. L. Clark, of the banking house of E. W. Clark & Company, of Philadelphia, vice-president; S. G. Reed, treasurer Portland Railway Company, treasurer; C. N. Huggins, secretary Portland Railway Company, secretary. The board of directors includes C. M. Clark and H. L. Clark, of Philadelphia; Frederick Strauss, of Seligman & Company, New York; A. C. Bedford, of Charles M. Pratt & Company, New York; H. W. Goode, F. I. Fuller, O. F. Paxton, S. G. Reed and F. G. Sykes, of Portland. The executive committee is made up of C. M. Clark, Frederick Strauss, A. C. Bedford and H. W. Goode. The company plans to expend $2,500,000 in improving and extending its system.

EDUCATIONAL.

POLYTECHNIC INSTITUTE OF BROOKLYN—The fifty-seventh annual catalogue of the Polytechnic Institute of Brooklyn (N. Y.) has been issued. It contains descriptions of the various courses offered at that institution.

UNIVERSITY OF WISCONSIN—The graduating class in electrical engineering of the University of Wisconsin consisted of forty-four men, who, it is announced, have all obtained good positions; in fact, all of them had been retained by some company before receiving their degrees.

UNIVERSITY OF UTAH—The University of Utah has issued its annual catalogue for the School of Arts and Sciences, the State School of Mines and the State Normal School. This gives a description of the work of the different schools and of the courses of instruction offered there.

NEW PUBLICATIONS.

VERIFICATION OF STANDARDS OF MASS—The Bureau of Standards, of the Department of Commerce and Labor, Washington, D. C., gives, in circular No. 3, a description of the work which can be done there at the present time in verifying the standards of mass. This circular describes the present standards, the secondary standards and the classification used in verifying weights. Instructions are given for submitting weights for test.

CANADIAN SELECT COMMITTEE ON TELEPHONE SYSTEMS—Vol. i of the proceedings of the select committee on telephone systems appointed by the Canadian government to investigate the various public telephone systems in operation in Canada and elsewhere has been received. This contains the minutes of the committee's proceedings, minutes of evidence taken, the engineering reports and a synopsis of the exhibits and indices to the different sections of the report.

RAILWAY SIGNAL ASSOCIATION—The Railway Signal Association has issued a digest of the proceedings of the association, formerly known as the Railway Signaling Club, which covers the meetings held during the ten years, 1895 to 1905. This book, which is designated as vol. i of the revised edition, relates the formation of the Railway Signaling Club and describes its growth until the association was formed. The volume includes a large number of interesting papers on railway subjects and the discussions which followed their presentation. It contains 544 pages.

Digitized by Google

NEW INCORPORATIONS.

JACKSON, MICH.—Rives Telephone Company. $1,000.

LANSING, MICH.—Fenwick Telephone Company, Palo. $8,000.

LINCOLN, ILL.—Elkhart Independent Telephone Company. $1,250.

SCRANTON, PA.—Wagner Telephone Company, Dyberry township. $3,000.

LINCOLN, NEB.—City Mutual Telephone Company. Capital increased to $25,000.

DOVER, DEL.—Clayton, Smyrna & Bayshore Traction Company, Philadelphia. $6,000.

LANSING, MICH.—Arenac, Ogemaw & Iosco County Telephone Company, England's Corners. $1,000.

SPRINGFIELD, ILL.—Citizens' Telephone and Telegraph Company, Carlyle, Clinton county. $15,000.

CLEVELAND, OHIO—United States Telephone Company, Cleveland. Increase of capital from $2,500,000 to $4,500,000.

AUSTIN, TEX.—Delta Telephone Company, Cooper, Delta county. $15,000. Incorporators: C. H. Reid, R. M. Connell and R. M. Walker.

JEFFERSON CITY, MO.—Sarcoxie Telephone Company. $5,000. Incorporators: H. B. Boyd, Harry Bean, B. W. Alley and B. Pile.

ST. JOHN, NEW BRUNSWICK—Maritime Light and Power Company. $100,000. Incorporators: James Russell Starr and James H. Spence.

LANSING, MICH.—The Northern Light and Power Company. To develop the water power of the Flint river, in Montrose township. $625,000.

LINCOLN, NEB.—The Chadron Telephone Company, of Chadron. $25,000. Directors: Joseph T. May, Adolph W. Riekman and Louis E. May.

SPRINGFIELD, ILL.—Kavanaugh Telephone Company, Effingham. $30,000. Incorporators: H. H. Kavanaugh, P. N. H. Munson, M. P. Turner.

IDAHO FALLS, IDA.—The Cedar Point Power and Light Company, Limited. To build a power-house at a point on the Snake river. $25,000.

SPRINGFIELD, ILL.—Strasburg Mutual Telephone Company, Strasburg. $10,000. Incorporators: J. F. Kull, Martin Hamm and L. J. Kirchner.

MINNEAPOLIS, MINN.—Town and Country Telephone Company, Dawson. $50,000. Incorporators: Albert Ewing, Peter Bergh, Andrew Grande, Dawson.

SPRINGFIELD, ILL.—Heyworth Telephone Company, Heyworth. $10,000. Incorporators: Henry E. Hitchhorn, H. Dale Cline and Charles Hitchhorn.

COLUMBUS, OHIO—Farmers' Telephone Company, Cadiz. $1,000. Incorporators: A. M. McCombs, James Love, J. M. Megaw, S. E. Adams and Lewis M. Peck.

HOLT, MO.—Clay county Telephone Company, Holt. $50,000. Incorporators: William H. Smith, John A. Eby, George W. Sexton, E. T. Hockaday and others.

ST. PAUL, MINN.—National District Telegraph Company. $50,000. Incorporators: Albert D. Bradley, James Swan, of Minneapolis, and John McRobie, of Chicago.

INDIANAPOLIS, IND.—Advance Telephone Company, Vanderburg county. $650. Directors: Henry Denzer, Henry Hartig, Charles Bocke, Fred Werkman and C. Siefert.

COLUMBUS, OHIO—The Poland, Boardman & Canfield Railway Company, of Youngstown. To construct an electric line connecting the cities named in the title. $10,000.

GUTHRIE, OKLA.—The Day County Telephone Company, Grand. $5,000. Incorporators: J. P. Johnson, E. S. Sharp, E. L. Mitchell, W. H. Hauser, S. Crim, Jr., and T. C. Moore.

COLUMBUS, OHIO—The Old Fort Mutual Telephone Company, Seneca county. $10,000. Incorporators: R. G. Shannon, H. S. Fry, C. J. Fry, N. S. Beck and G. E. Zimmerman.

COLUMBUS, OHIO—Mile Run Mutual Telephone Company, Marietta, Ohio. $2,500. Incorporators: William F. Watkins, Leonard F. Winn, Jessie Thomas, Roger Fish and John S. Wynn.

TOLEDO, OHIO—Toledo, Defiance & Fort Wayne Railroad Company, Toledo. $10,000. Incorporators: E. B. Paxton, James H. Horan, G. L. Shanks, Frank G. Crane and D. L. Stine.

YOUNGSTOWN, OHIO—Cleveland, Youngstown & Eastern Railway. $10,000. Incorporators: Alonzo M. Snyder, H. Park Ford, A. A. McCaslin, H. Melvin Roberts and Elmer G. Derr.

COLUMBUS, OHIO—The Home Telephone Company, Ironton. $50,000. Incorporators: Robert A. Knapp, E. W. Bixby, S. P. Humphrey, B. F. Forgey, J. C. Snyder and A. J. Lathouse.

DENVER, COL.—The Cherryvale Electric Light and Power Company. $25,000. Incorporators: Hugh E. West, W. R. Murrow, Seth H. Piper, Charles T. Fertig, E. A. Sunderlin, Colorado Springs.

SPRINGFIELD, ILL.—Peoria, Streator & Ottawa Railway Company. To run from Ottawa and Streator through Eureka and Washington and connect with the Peoria & Bloomington line at Morton. $100,000.

LINCOLN, NEB.—The Martel Farmers' Independent Telephone Company. $500. Officers: Albert Egger, president; John A. Sittler, vice-president; William H. H. Moore, secretary; Edward Bohmont, treasurer.

BELLEVILLE, ILL.—Risdon Telephone Company, of Lenzburg. Incorporators: Dan Waeltz, Adam Kirchhoefer, Henry Kirchhoefer, Fred W. Wasem, Henry Gruenewald, Herman Kirchhoefer and George Waeltz, Jr.

GUTHRIE, OKLA.—The Farmers' Mutual Telephone Company, of Rossville, Lincoln county. $2,000. Directors: C. A. Taft and D. Keer, of Meeker; W. G. Hall and T. A. Ward, of Rossville, and L. J. Harden, of Middlothian.

LOIS, VA.—Lois Mutual Telephone Company. $5,000. Incorporators: J. M. Price, president; J. E. Stively, vice-president, both of Bealeton, Va.; George E. Bain, secretary and treasurer; R. W. Kemper and L. M. Anns, all of Lois.

MILWAUKEE, WIS.—The Tri-State Telephone and Telegraph Company, Augusta, Me.; western headquarters at Minneapolis. $2,000,000, of which $10,000 is represented by property and business in Wisconsin. E. H. Moulton, president, and F. C. Nelson, secretary.

NASHVILLE, TENN.—Jackson Railway and Light Company, Madison county. To construct an electric railway in the city of Jackson and also in the county of Madison. $600,000. Incorporators: S. S. Bush, Attilla Cox, Alan McDonald, John Wisdom and Charles D. Lehmkuhl.

INDIANAPOLIS, IND.—Citizens' Automatic Telephone Company. To operate automatic telephone systems in the counties of Miami, Howard, Wabash, Fulton, Cass, Carroll, Clinton, Tipton, Madison, Delaware, Blackford, Wells, Huntington, Whitley, Kosciusko and Marshall. $300,000.

CINCINNATI, OHIO—The Jesse T. Sheets Telephone Company. To operate a telephone exchange in Cincinnati, Covington and Newport and in Kenton, Campbell and Pendleton counties, Ky. $10,000. Incorporators: Jessie T. Sheets, Katie Sheets, Horace and Theodore Horstman and Adelaide Ament.

RICHMOND, VA.—Caroline County Telephone Company, of Bowling Green, Va. $10,000. Officers: C. T. Smith, president, Croxtons, Va.; W. E. Innes, vice-president, N. T. McManaway, secretary; L. E. Martin, treasurer, Bowling Green; directors, S. E. Pitts, Sparta, Va.; C. M. Harris, Whites, Va.; G. P. Lyons, Woodfords, Va.

SPRINGFIELD, ILL.—Lee County Railway Company. To be constructed from Nachusa, Lee county, Ill., westerly to connect with the Chicago & Northwestern Railway, thirteen miles. $10,000. Incorporators and first board of directors: Marvin Hughitt, J. M. Whitman and J. B. Redfield, Chicago; W. A. Gardner, Evanston; H. R. McCullough, Lake Forest.

SPRINGFIELD, ILL.—Hammond Belt Railway Company. To be constructed from Hammond, Ind., northwesterly and northerly to a point near intersection of railroads in Calumet Park, Cook county, Ill. $75,000. Incorporators and first board of directors: Worth E. Caylor, Frank P. Schmitt, William G. Wise, Wallace A. Walker, Chicago; Hezekiah L. Jackson, Hammond, Ill.

Digitized by Google

PERSONAL MENTION.

MR. PAUL J. KRUESI, of Chattanooga, Tenn., and Miss Myra Kennedy Smart will be married on Thursday, July 26. Mr. and Mrs. Kruesi will be at home after the first of October at Riverview, Chattanooga, Tenn.

MR. ALTON D. ADAMS, electrical engineer, Worcester, Mass., is appraising the value of the property of the two electric lighting companies at Watertown, N. Y., preparatory to making a report to the city authorities, who contemplate buying the plants.

MR. GEORGE CAMPBELL, president of the Germania Electric Lamp Company, Harrison, N. J., returned recently on the Lucania from Liverpool, where he has been for thirty days in connection with the company's export business, of which Mr. Campbell reports a material development.

MR. WILLIAM M. MARINAN, for twelve years in the employ of the Elmira (N. Y.) Water, Light and Railroad Company, has been appointed general superintendent of the Dunkirk, Fredonia & Brockton Electric Light, Gas and Street Railway Company, with headquarters at Fredonia, N. Y.

MR. ALPHA H. KLING has withdrawn from the Peru Electric Manufacturing Company, Peru, Ind., with which he has been sales manager for some time. Mr. Kling will act as manufacturers' sales agent, and will represent in the central states a number of leading manufacturers, with headquarters at Peru. He will carry a very complete line of electrical supplies.

MR. W. C. WOODWARD, electrical engineer of the Narragansett Electric Light Company, was a New York visitor last week, and while here was the guest of honor at a luncheon at the Hardware Club. A number of electrical men, prominent in various branches of the industry, welcomed Mr. Woodward to the city and congratulated him over the great success of his company.

MR. CLARENCE H. MACKAY, president of the Postal Telegraph-Cable Company, and his mother, Mrs. John W. Mackay, have donated $100,000 to the University of California for the establishment of a professorship of electrical engineering. This bountiful gift is in honor of the memory of Mr. Mackay's deceased brother, Mr. John W. Mackay, Jr. Professor C. L. Cory will be at the head of the department of electrical engineering.

MR. HENRY L. DOHERTY, president of the Denver Gas and Electric Company, has opened a "school of practice," in which twenty young men who have just graduated from the engineering departments of various colleges and universities of the country will receive practical instruction in all branches of the gas and electric business. The course, as outlined by Mr. Doherty, will cover two years, and will carry the students through all departments of the Denver Gas and Electric Company.

MR. H. W. TURNER has associated himself with Mr. H. M. Hobart, consulting engineer, London, England. He will be engaged in advising with regard to manufacturing methods, machinery and shop organization, and other work connected with the manufacture of dynamoelectric machinery. Mr. Turner has had an experience of over twenty years with British, Continental and American companies, having been with the British Thomson-Houston and the British Westinghouse companies three and one-half years, with the Union Elektricitäts Gesellschaft, Berlin and Vienna, for eleven years, and with the Thomson-Houston Company, Lynn, Mass., for nine years. In taking up his new work he leaves the British Westinghouse Company, where he has just completed a two-year engagement.

LEGAL NOTE.

DIVIDED-POLE FIELD-WINDING CASE—In the case of the Emerson Electric Manufacturing Company *versus* the Century Electric Company, both of St. Louis, Mo., heard before Judge Finkelnburg in the United States Circuit Court for the Eastern Division of the Eastern Judicial District of Missouri, a decree was entered on July 9 in favor of the complainant with reference to a master of the court for an accounting. This case was a suit for infringement of patent No. 583,933, dated June 8, 1897, and especially of claim five of this patent, covering the "pyramidal" or divided form of field winding.

ELECTRICAL SECURITIES.

The market last week was dull and irregular, with prices sagging in the main. Dealings were almost wholly professional, and while there was some public liquidation, this was probably offset by an equal amount of outside buying. The crop reports continue to be reassuring, and the only apprehension in this direction is the possibility of monetary stringency during the crop-moving period to come later. The copper situation still shows an unexplained weakness, and in some quarters there is discouraging comment concerning the iron and steel industry, although it is quite likely that the United States steel report for the quarter ending in June will show record figures.

ELECTRICAL SECURITIES FOR WEEK ENDING JULY 14.

New York:	*Closing.*
Allis-Chalmers common	16¾
Allis-Chalmers preferred	46¾
Brooklyn Rapid Transit	72½
Consolidated Gas	136½
General Electric	161
Interborough-Metropolitan common	36
Interborough-Metropolitan preferred	74
Kings County Electric	165
Mackay Companies (Postal Telegraph and Cables) common	71
Mackay Companies (Postal Telegraph and Cables) preferred	71¾
Manhattan Elevated	147
Metropolitan Street Railway	102¾
New York & New Jersey Telephone	125
Western Union	91
Westinghouse Manufacturing Company	152

The pamphlet report of the Brooklyn Rapid Transit Company for the fiscal year to June 30 is in course of preparation, but will not appear until about the middle of August, or later. The company usually publishes its report about six weeks after the close of the fiscal year.

Boston:	*Closing.*
American Telephone and Telegraph	129
Edison Electric Illuminating	240
Massachusetts Electric	68
New England Telephone	130
Western Telephone and Telegraph preferred	90

Philadelphia:	*Closing.*
Electric Company of America	11½
Electric Storage Battery common	67
Electric Storage Battery preferred	67
Philadelphia Electric	7⅞
Philadelphia Rapid Transit	29¼
United Gas Improvement	82

The directors of the Electric Company of America have declared the regular semi-annual dividend of 3½ per cent to stock of record July 20.

Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	135
Metropolitan Elevated preferred	66
National Carbon common	81¾
National Carbon preferred	117
Union Traction common	4
Union Traction preferred	14

The regular quarterly dividend of 2 per cent on Chicago Edison is payable August 1. Books close July 21 and reopen August 2.

For the half year ended June 30 the Chicago elevated roads carried 65,830,000 passengers, the increase being 7.12 per cent, rather above the normal gain.

OBITUARY NOTICE.

F. T. FOXENBERGER, who had been with the Bossert Electric Construction Company, of Utica, N. Y., died on the afternoon of Thursday, July 12, as the result of an operation. Mr. Foxenberger was widely and pleasantly known throughout the electrical industry, especially among the contractors and manufacturing branches, and his death at such an early age (he was under thirty) will cause much regret. Some two months ago he underwent an operation which was not successful, and this later one, from which he died, was deemed necessary, although the surgeons realized the small probability of saving his life.

Digitized by Google

ELECTRIC RAILWAYS.

MARYSVILLE, CAL.—Grading has been commenced on the extension of the Northern Electric road to Sacramento.

ELLOREE, S. C.—There is a plan on foot to build an electric line from Elloree *via* Parlers to Pinckney's Landing, a distance of seven miles.

MORGANTOWN, W. VA.—The South Morgantown Traction Company has let the contract for grading its right of way. The company expects to have cars running by September 1.

DELPHI, IND.—The construction of the Lafayette & Logansport Traction line has been begun near Delphi. The builders hope to have the line completed and cars running by the first of next year.

BROCKPORT, N. Y.—The Brockport village board of trustees has granted a franchise to the Buffalo, Lockport & Rochester Electric Railroad Company to extend its lines through Brockport streets.

MUNCIE, IND.—The Muncie & Union City Traction Company has been incorporated at Indianapolis with a capital of $500,000 to build a line between Selma, Parker City, Farmland, Winchester and Muncie. The road will parallel the "Big Four."

CHICAGO, ILL.—The sale of the Calumet Electric Street Railroad Company, to a syndicate headed by Cobe & McKinnon, has been confirmed. This was one of the assets of the National Bank, of Illinois, the receivership of which will shortly be terminated.

COLUMBUS, GA.—The work of constructing the Atlanta, Birmingham & Atlantic Railway from Warm Springs to Atlanta, a distance of seventy miles, begins soon, the contract having been let to the Callahan Construction Company, of Knoxville, Tenn.

COLUMBUS, GA.—The movement to build an electric railroad from Columbus to Dothan, Ala., and thence to St. Andrews Bay, Fla., is taking shape, a large number of the business men of Columbus having signed an agreement to heartily support the project.

AUSTIN, TEX.—E. M. House, of Austin, is arranging with Stone & Webster, Boston, Mass., for the building of an interurban electric railway between Houston and Galveston. It is stated that the negotiations for building the line have been closed. It will be fifty-one miles long.

ASHLAND, OHIO—Officials of the Cleveland, Ashland & Mansfield Railway Company have arranged for building the Ashland & Mansfield end, and to give service between these points by January 1. The line will then be extended north to North Fairfield, connecting with the Lake Shore Electric.

CLEVELAND, OHIO—The Columbus, Delaware & Marion Traction Company is now engaged on the construction of an extension from Marion, the present northern terminus, to Bucyrus, where connection will be made with the Ohio Central. It is understood that this line will be completed by the fall.

TORONTO, OHIO—The ordinance granting a franchise to the Steubenville Traction and Light Company, for the construction of a second track through the city of Toronto, and the extension of the present franchise for a term of twenty-five years, has been passed unanimously by the city council.

WILMINGTON, DEL.—An ordinance has been passed by the town council of Newark, giving permission to the Delaware Interurban Railway Company to lay tracks on Main and Elkton streets in that town. The granting of the franchise was made conditional upon the depositing of $2,000 by the company within thirty days.

SHARON, PA.—The Shenango-Midland Street Railway Company has accepted the franchise ordinance passed by the Sharon council. The company has five months to begin work on the line in Sharon, at which time it must pay the city $2,500 and ten months after another $2,500. This is part of the line which will extend to New Castle.

ALBUQUERQUE, N. M.—Frank G. Caldwell, American representative of a foreign corporation, interested in building an electric line from Hillsboro mining camp, thirty-six miles to Osceola, on the Santa Fe railroad, states that the road will be built, construction to commence shortly after his return to New York to make final report on the project. The proposed electric road will facilitate mining operations in that district greatly.

WINSTED, CT.—The New York, New Haven & Hartford Railroad has acquired three-quarters of the Torrington & Winchester Street Railway, running from Winsted to Torrington, ten miles, and will, it is reported, extend the line to Thomaston, to which place the trolley is to be extended from Waterbury. It is generally believed that the New York & New Haven road will eventually build a trolley line connecting Winsted and Canaan, to which place it is to extend its Berkshire trolley line from Great Barrington, Mass.

SPOKANE, WASH.—The British Columbia Electric Railway Company has decided to construct an electric line from New Westminster to Port Moody and from Port Moody to Vancouver, which will make an alternate route to that now in operation between Vancouver and New Westminster direct. The direct road is only twelve miles long, but the new line, about eighteen miles, will take in the small places along Burrard inlet as far as Port Moody and then turn west toward New Westminster, taking in the new town of Millside.

CINCINNATI, OHIO—The Hillsboro, Belfast & Peebles Traction Company has been organized by a number of citizens of those towns, for the purpose of building an electric road from Hillsboro, through Belfast to Peebles, with a proposed extension to the Ohio river at Aberdeen. The officers elected are: P. M. Hughes, of Lovett, Ohio, president; J. W. Letherman, of Belfast, vice-president; W. B. Cochran, of Hillsboro, secretary. The proposed road will connect at Hillsboro with the Cincinnati & Columbus traction line, which operates from Cincinnati to Hillsboro.

ATLANTA, GA.—At a meeting of the incorporators of the new interurban electric line between Macon and Atlanta it was authorized that work on the line be begun at once. The stock subscribed was $100,000, but this will be increased from time to time. The executive committee is composed of W. J. Kincaid, of Griffin, chairman; W. J. Massee, of Macon; Colonel Clifford L. Anderson and Edwin P. Ansley, of Atlanta, and W. A. Wimbish, of Atlanta, secretary and treasurer. The line will be eighty-eight miles long, and will connect Atlanta, Forrest, Griffin, Forsyth, Macon and the intervening towns.

NEW HAVEN, CT.—The Consolidated Railway Company has authorized the survey of a line between Mount Carmel and Cheshire, a distance of about seven miles, the new line running as a double track to the Northampton steam road between the two points. This is preliminary to the electrification of that part of the Waterbury and Meriden branch which runs eight miles between Cheshire and Waterbury. When the electrification of the two roads is completed there will be a local service between New Haven and Mount Carmel, and between the latter point and Waterbury an express electric service on a line with low grades and few stops.

BOSTON, MASS.—Stone & Webster have purchased the Key West Electric Company, which does the entire electric railway and lighting business of Key West, Fla. The company will retire all the outstanding securities, and the new capitalization will be as follows: $1,000,000 first mortgage, fifty-year, five per cent bonds; $230,000 preferred, six per cent non-cumulative stock; $500,000 common stock. New money will be provided to reequip the power station, to purchase cars and equipment, to extend the lighting system, to develop the gas business under the franchise owned by the company, and to put the entire property in the best operating condition. The present street railway mileage is five miles.

MOUNT STERLING, KY.—Under the articles of incorporation of the Paris, Mount Sterling & North Middletown interurban railway, the stockholders met at Paris and elected a board of directors, as follows: John T. Collins and W. A. Thomason, of North Middletown; Judge H. Clay McKee and J. M. Bigstaff, of Mount Sterling; R. J. Neely, Robert C. Talbott and Henry A. Power, of Paris. After the election of the board of directors, the following officers were elected: Robert C. Talbott, president; John T. Collins, vice-president; Henry A. Power, treasurer, and H. Clay McKee, secretary.

Digitized by Google

TELEPHONE AND TELEGRAPH.

TUSCALOOSA, ALA.—The Postal Telegraph Company is rebuilding its line through Alabama.

MOUNT MORRIS, N. Y.—The Bell Telephone Company has installed a common battery system in Mount Morris.

PLAINFIELD, N. J.—Work has been commenced on a three-story building for the New York & New Jersey Telephone Company.

RISING SUN, MD.—Telephone lines are being erected from Blake to Lombard and from Rising Sun to Rock Springs.

ANNISTON, ALA.—The Anniston line of the Southern Bell Telephone Company has been rebuilt and put in excellent condition, and is now open for business.

GOSHEN, IND.—The Bell Telephone Company will shortly begin the work of overhauling its system in Goshen. A new board with a capacity of 1,000 lines will be installed, and 36,000 feet of cable will be strung.

FORT WAYNE, IND.—The Home Telephone Company has closed a contract with the Stromberg-Carlson Telephone Manufacturing Company for a complete new toll board. One section will be fitted up for farmers' lines.

GREENVILLE, S. C.—At a meeting of the board of trade a resolution was adopted looking toward a contract with the Southern Bell Telephone Company for installing a larger and entirely new plant in Greenville.

BUTTE, MONT.—The Rocky Mountain Bell Telephone Company is now erecting new buildings at Bozeman and Livingston, and a new wire is being constructed from Logan in order to give an additional circuit for Butte and Helena.

TROY, ALA.—The Orion Telephone Company has been organized. It will build a telephone line from Troy to Orion, Pine Level and China Grove. W. C. Starke, of Troy, was chosen president, and W. G. Chancy, of Orion, secretary and treasurer.

WILMINGTON, DEL.—The Delaware & Atlantic Telegraph and Telephone Company is arranging to put a large force of men to work to complete its conduit system in Wilmington. It is likely that the system will be completed before the end of the year.

SCHENECTADY, N. Y.—At the annual meeting of the directors of the Home Telephone Company plans were made for the extension of the system of the company in the city and the laying of all cables underground. The directors reelected the old officers, as follows: president, Charles F. Veeder; vice-president, Irving H. Griswold; secretary, F. M. Strong; treasurer, E. S. Kellogg.

GREEN ISLAND, N. Y.—At the meeting of the village trustees a franchise was granted to the Hudson River Telephone Company, allowing it to construct and maintain a system of underground wires in all of the streets, alleys and public places. According to the terms of the franchise the company will be obliged to comply with all the laws of New York state and special ordinances relating to villages.

DETROIT, MICH.—The directors of the Michigan State Telephone Company have approved the extension plans recently decided upon by the executive committee. These extensions include the erection of a large addition to the company's headquarters in Detroit, an extension of conduits that will permit the installing of something like 10,000 more telephones in Detroit and extensions of long-distance lines throughout the state.

FREDONIA, N. Y.—The Fredonia Telephone Company has its new line to Cassadaga, which will join at that place the long-distance line of the Jamestown company, nearly completed. The company will install a new exchange at Cassadaga and operate a branch system covering Lily Dale and Stockton. A large number of new telephones will be installed in the thickly settled farming community between Fredonia and Stockton.

JOPLIN, MO.—A franchise granting to the Missouri & Kansas (Bell) Telephone Company the right to construct a conduit underground system from First to Tenth street, on Main, has been passed by the Joplin city council. The franchise grants permission to construct an underground conduit for telephone wires, with suitable manholes, in exchange for which the company agrees to remove its present poles from Main street, to supply, through such conduit, free fire-alarm and police call service as may be installed by the city, to furnish the city rent free ten telephones, and to supply other additional city telephones at one-half regular service rates. The work of building the conduit is to begin at once.

ELECTRIC LIGHTING.

KENNETT, MO.—It has been voted to install an electric light plant at Kennett.

OTTAWA, KAN.—The city of Ottawa has taken over the water and electric light plants, and will begin at once to spend $80,000 in improvements.

BELLAIRE, MICH.—Bellaire has voted to borrow $2,200 to raise the dam of the municipal lighting plant and install a municipal system of waterworks.

NELSON, BRITISH COLUMBIA—A new company has been formed with a capitalization of $1,500,000 for the purpose of generating power for the supplying of light and motive power to the towns surrounding Moyie and Cranbrook, where many mines are situated.

BUFFALO, N. Y.—At a meeting of the Cataract Power and Conduit Company the following directors were elected: Edward D. Adams, John Jacob Astor, D. O. Mills, Francis Lynde Stetson, Edward A. Wickes, Charles R. Huntley, Daniel O'Day, George Urban, Jr., and DeLancey Rankine.

COLORADO SPRINGS, COL.—Plans for the erection of an electric power station, west of Green Mountain Falls, to furnish light and power to Ute Pass points, have been completed by Theophilus Harrison and F. E. Dow, who own a large water system above Green Mountain Falls, on the north slope of Pike's Peak.

ONTARIO, ORE.—The Ontario city council has granted a ten-year franchise to the Idaho Light and Power Company for an electric light system. The company will secure its power from the Payette river in Idaho, and will also supply the towns of Weiser, Payette and New Plymouth in Idaho with light. The franchise calls for the completion of the system within one year.

CLINTON, MASS.—The Boston Heat, Light and Power Company, which owns the electric and gas lighting plants in Clinton and Leominster as well as in twenty-five or thirty other towns and cities in the state of Massachusetts, it is announced, is to build a power plant for the generation of electricity at Still River Depot, in the town of Harvard. Surveys of the property to be acquired are now being made.

SWEETWATER, NEV.—Work has been begun by the New Bodie Mining Company upon the construction of a large electric generating station on the East Walker river, which is intended to supply power for the mines of Aurora, Masonic, Bodie and southern Nevada. Sufficient water has been taken up to operate a 10,000-horse-power plant. The electric station alone will cost over $150,000, according to the plans outlined.

WILMINGTON, DEL.—The Delmarvia Construction Company has been organized for building an entirely new power plant and distribution system for serving residents of Wilmington. This undertaking, it is understood, is being financed by Baltimore interests. A new plant is now under construction and is designed entirely for steam turbines. Two 750-horse-power Westinghouse-Parsons steam turbines, with a number of motors and generators, will be installed at the present time.

LOCKPORT, N. Y.—The rates for electric power for consumers in the milling district of Lockport have been announced by the Lockport Gas and Electric Company. All consumers of from fifty to 100 horse-power will pay $22 per horse-power per year; 100 to 500 horse-power, $20; 500 to 1,000 horse-power, $19, and all over 1,000 horse-power, $18. These prices are based on the condition that the city of Lockport grants the company the privileges of stringing a high-voltage transmission line along the outskirts of the city to the proposed transmission station in the milling district.

RED BLUFF, CAL.—The Northern California Power Company is doing a large amount of construction work in the vicinity of its power plant at Volta, in the northwestern part of Tehama county, with a view to doubling the capacity of the plant. It has over 100 men at work, and this force will be kept busy until September to complete the work mapped out. When the improvements are finished the plant will be capable of generating 48,000 horse-power. The company is now furnishing power to operate the Chico & Oroville electric road, and has a contract to supply motive power for the San Francisco street car system as soon as it can complete the additions to its plant.

Digitized by Google

INDUSTRIAL ITEMS.

THE DEAN ELECTRIC COMPANY, Elyria, Ohio, is distributing bulletin No. 103 descriptive and illustrative of portable desk telephones. This will be sent, on request, to any one interested.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is distributing the July issue of "The Emerson Monthly." This contains timely descriptions of Emerson apparatus and other interesting matter, and also an index to the company's bulletins and price book No. 7.

THE CHARLES J. BOGUE ELECTRIC COMPANY has been incorporated to take over the business formerly conducted by Charles J. Bogue. The officers of the company are: president, Charles J. Bogue; treasurer, L. Robertson; secretary, F. Plante. Headquarters have been established at 213-215 Centre street, New York city.

THE NATIONAL METAL MOULDING COMPANY, Economy, Pa., carries a complete stock of all sizes of mild steel heavy wall conduits in its factory at Economy, and also at its New York warehouse. This conduit is covered inside and outside with enamel, which is claimed to be unaffected by acids or alkalies.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., has issued its first catalogue descriptive of magneto telephones. This catalogue contains sixty-three pages, and gives complete descriptive matter and illustrations bearing on the subject. It is in loose-leaf form, which style has been adopted by the company for future bulletins.

THE NILES-BEMENT-POND COMPANY, 111 Broadway, New York city, has issued list No. 12 of second-hand metal-working machinery. This includes railroad machinery, screw-cutting lathes, speed lathes, chucking machines, planers, shapers, drills, milling and boring machines, grinding and polishing machines, and miscellaneous apparatus.

THE SPRAGUE ELECTRIC COMPANY, New York city, announces that it has reopened its office in San Francisco, Cal. The former office was destroyed by the earthquake, after which temporary quarters were opened in Oakland. The company is now permanently located in the Atlas Building on Mission street, San Francisco, where all orders from that territory will receive prompt attention.

THE UNIVERSAL MANUFACTURING COMPANY, 206-208 Illinois street, Chicago, Ill., has issued a descriptive bulletin of its "Universal" flat-rate controller, which it claims is cheaper than meter service, and which will absolutely control the supply of current to patrons by switching off and on at intervals of thirty seconds whenever the contact load is exceeded by as much as one eight-candle-power lamp.

THE NIAGARA TACHOMETER AND INSTRUMENT COMPANY, Niagara Falls, N. Y., has designed and is now manufacturing a tachometer which is claimed to be of absolute and permanent accuracy, though it has reached the maximum simplicity of construction. The company also manufactures a hand-tachometer. These instruments are manufactured in speed ranges from thirty to 4,000 revolutions per minute.

W. S. BARSTOW & COMPANY, 56 Pine street, New York city, have been engaged as engineers for remodeling the plant of the Jamestown Worsted Mills, Jamestown, N. Y. Plans will be drawn covering an extensive addition to the power plant, and the plant will be changed over to electric-motor drive throughout. Barstow & Company recently completed a similar installation for the Hartford Carpet Corporation, Thompsonville, Ct.

THE WESCO SUPPLY COMPANY, St Louis, Mo., announces that its new general electrical catalogue No. 100 is now completed and is being distributed to the trade. This catalogue is very complete, containing full descriptions of the various appliances. The company will be pleased to send it upon request. The Wesco company is also distributing a net price list in booklet form, covering its line of magneto and central energy telephones, and giving prices on linemen's tools, construction material, exchange equipment and supplies.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is distributing a series of bulletins dealing with its motor starters and controllers. Bulletin No. 10 illustrates and gives the sizes of multiple switch-starting rheostats; No. 19, of motor-starting rheostats, and No. 17, of motor-starting rheostats of the double-lever type. Bulletin No. 32 gives dimensions for drilling for field rheostats. Bulletin No. 59 deals with radial-arm reversible controllers, describing and giving the dimensions of types A and B. Bulletin No. 70 describes the company's self-starters used for motor-driven pumps, elevators and similar services, and No. 92 lists "Simplicity" type interlocking dimmers.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., reports having closed contracts for the following apparatus: National Tube Company, McKeesport, Pa., twenty-one direct-current motors, ranging from six to seventy-five horse-power. Pensacola Electrical Terminal Railroad Company, Pensacola, Fla., one 500-kilowatt, direct-current generator. American Multigraph Company, Cleveland, Ohio, one 100-kilowatt, alternating-current, engine-type generator, three-phase, sixty cycles, 240 volts, and one six and one-half-horse-power exciter, 125 volts, to be installed at the company's new factory at Cleveland. New Jersey Zinc Company, Franklin Junction, N. J., one seventy-five-horse-power, 115-volt, direct-current motor.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., has issued bulletin No. 608 and circulars No. 778 and No. 785. The bulletin is devoted to the new "G. I." flush pocket wall receptacle, which is adapted for use with standard Edison attaching plugs and has a round door, eliminating the objectionable sharp corners of the old style of receptacle. Circular No. 778 is entitled "Circuit-Breakers *versus* Switches and Fuses," and gives lists and prices of the Stanley-G. I. "C-7" circuit-breakers. Circular No. 785 describes and illustrates "K-9" arc lamp for multiple alternating-current circuits, which is suitable for operation on standard induction-motor voltages, *viz.:* 220, 440 and 550. Any of this literature will be furnished on request.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a new series of advertising literature, which is now being distributed. Bulletin N. 4441 describes and illustrates type H subway transformers, and supersedes bulletin No. 4400; bulletin No. 4442, the GE-87 railway motor; bulletin No. 4444, direct-current, motor-driven air compressors, geared type; bulletin No. 4445, direct-current Curtis steam turbine-generators, horizontal type, and bulletin No. 4448, small polyphase motors. There are also price lists, No. 5151 and No. 5152, applying, respectively, to National Electrical Code Standard and old code enclosed fuses and cutouts, and to "Gem" regular incandescent units and "Gem" meridian units. Supply catalogue No. 7598 lists parts for plain type carbon feed enclosed arc lamps, and flyers No. 2185 and No. 2190 illustrate and describe, respectively, the "G. E." moulding rosette, and cast-grid field rheostats, type F, form S, for sixty and 125-volt circuits. A four-page folder is devoted to the subject of Edison reflector lamps, and there is a change notice to accompany catalogue No. 1052 on lightning arresters.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., has received an order from the Philadelphia Rapid Transit Company for a complete equipment of Roney mechanical stokers for its large subway power plant now building in Philadelphia. This plant was constructed for turbine machinery, and Westinghouse-Parsons turbines of 6,000-kilowatt capacity will be installed. With the equipment of mechanical stokers and other labor-saving devices the plant will represent one of the most up-to-date modern power stations. The order covers stokers for the entire boiler plant of 32,700 horse-power. The boilers are of the Parker water-tube type. The New York, New Haven & Hartford Railroad Company recently adopted mechanical stokers for its power plant at Cos Cob, Ct., now building to serve the electrified section of the company's New York city terminal. The initial order comprised twelve stokers. These stokers will serve twelve 520-horse-power Babcock & Wilcox water-tube boilers. A large order for mechanical stokers has also been received from the American Steel and Wire Company, Pittsburg, Pa., covering equipments for nineteen boilers.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 4. NEW YORK, SATURDAY, JULY 28, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. L. W. MARSHALL, Manager
BOSTON OFFICE: Delta Bldg., 10 Post Office Square, M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad St., London, E. C., HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.
Copyright, 1906, by Electrical Review Publishing Co.
Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

CONTENTS.

EDITORIAL:
An Interesting Experiment in Recharging Dry Cells . . . 121
The Influence of Electrical Engineering . . . 121
Directed Wireless Telegraphy . . . 122
Engineering Experiment Stations . . . 122
The Use of Colloids in Technical Processes . . . 123
The Present Condition of Wireless Telegraphy . . . 123
Electric Railway Development at Niagara Falls . . . 123
The Sixth Annual Convention of the National Electrical Contractors' Association . . . 124
The Twelfth Annual Convention of the Ohio Electric Light Association . . . 125
Alcohol Engine Investigations . . . 125
Change of Name of the National-Interstate Telephone Association . . . 125
Chicago, Lake Shore & South Bend Railway . . . 126
Increase in Power Plant of the Pittsburg Railways Company . . . 126
The New St. Denis Electric Plant at Paris, by C. L. Durand . . . 127
Glasgow Telephones . . . 135
Electrical Mining Notes, by Sydney F. Walker . . . 135
The Power Plant of the Electrical Development Company of Ontario, by F. O. Blackwell . . . 138
Power Supply to Tramway Systems, by S. J. Watson . . . 140
ELECTRICAL PATENTS . . . 143
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 144
METHODS OF GETTING NEW BUSINESS . . . 146
INDUSTRIAL SECTION:
Horizontal-Type Direct-Current Curtis Steam-Turbine Generators . . . 147
The Electrical Equipment of the Indiana Steel Company, Gary, Ind. 148
A New Form of Flashing Sign . . . 148
The "Hylo" Flasher . . . 148
Allis-Chalmers Company and the Manufacture of Christensen Air-Brakes . . . 149
American-Ball Engines and Generators . . . 149
The Electric Locomotives for the New York Central Lines . . . 150
Gas-Blowing Engine Plant for the Indiana Steel Company . . . 150
CURRENT ELECTRICAL NEWS . . . 151

AN INTERESTING EXPERIMENT IN RECHARGING DRY CELLS.

Every now and then some enthusiastic thinker or untiring experimenter hits upon or tries the interesting experiment of recharging dry cells. If dry cells were made in small quantities and sold at a high price, such a proceeding might be called sensible, but generally it is worse than a waste of time and energy.

In a recent issue of a popular journal an experiment of this kind is described, the experimenter being pleased to find that after a few minutes' charge his cells would give "a fairly strong current." Naturally, if a short charge accomplished some wonderful results, a longer charge produced still better ones, so he proceeded to continue the work of charging, and was somewhat chagrined, after several hours, to find that his cells had gone all to pieces. He was not, however, one who was easily discouraged, for he immediately procured a new lot of batteries and started over again to see why the trouble had happened. This time the charge was stopped before the batteries had gone to pieces, and after removing the belt from the small generator used in charging, a surprising thing happened: the generator ran as a motor in the same direction, instead of turning in the opposite way. The explanation of this peculiar behavior is that "the current from the batteries reversed the field of the generator, and also the armature, thus making two reverses, which is the same as none at all." What about the reversal of functions which takes place when changing a dynamo to a motor?

THE INFLUENCE OF ELECTRICAL ENGINEERING.

An interesting editorial in the *Engineering Magazine* for July dwells upon the necessity for the engineer to obtain a business training. He should appreciate the influence exerted by his work upon business methods, and he should therefore have a particular appreciation of his relation to the work of the world, so as to cause him to realize his position as an economist. To illustrate this relation the influence of electrical methods in various branches of work is cited: "It is a trite saying that railways have transformed commerce, but it is not so fully realized that with the improvement of communication in a thousand ways, by the telegraph, the telephone, the pneumatic tube and even the mail chute, business has been facilitated, effort concentrated and human energy conserved and directed."

The effect in manufacturing arts has been equally noteworthy: "In like manner, with the control and direction of human energy, the engineer is combining and controlling mechanical energy and directing natural forces. Already the development of the 'white coal' of Italy, Switzerland and France is diverting industries from centres originally created and still maintained by the diminishing supplies of fossil carbon. With the recognition of the fact that the true function of electricity is that of a transmitter of mechanical energy there has come an industrial development which is necessarily causing economic methods to be profoundly modified. The possession of local power facilities or of water transport no longer controls absolutely the situation of industrial establishments any more than the position of tools in the shop is determined by the position of the line shaft; the power is brought to the tool, and, in many cases, the tool to the work." It is this recognition of electricity as a means to an end, as the flexible agent for utilizing at one point power more conveniently generated at another, that has brought about such great changes in our industrial methods. Electricity is unquestionably the modernizing agent both in commercial and in manufacturing work.

Digitized by Google

DIRECTED WIRELESS TELEGRAPHY.

Some experiments made during the last year or so by Mr. William Marconi, on a method of directed wireless telegraphy, were described in the issue of the ELECTRICAL REVIEW for May 26. Results were given in this article both of laboratory tests and of tests carried out on a larger scale. The directive action was secured by means of a horizontal antenna stretched a short distance above the ground. Some encouraging figures were obtained, transmission in one direction being considerably better than in another. Polar diagrams, plotted from the laboratory experiments, showed that the curve of equal intensity took a double lobed shape, resembling somewhat two intersecting ellipses. No explanation was offered of the action of the transmitting system at that time.

In a note read a short while ago before the Royal Society, of London, Dr. J. A. Fleming, who has been associated with Mr. Marconi in his work in England for some years past, offers a theoretical explanation of the directive action of a horizontal antenna. Dr. Fleming considers this arrangement equivalent to three Hertzian oscillators placed at right angles to each other. The horizontal wire forms one, the connection between this and the ground and the ground itself the second, and that part of the ground lying below the horizontal wire the third. Dr. Fleming concludes from his analytical examination of this arrangement that its unsymmetrical radiation in the equatorial plane depends not upon the absolute wave-length, but upon the ratio of wave-length to the distance of the receiving point and upon the proportion between the length of the vertical and the horizontal portions of the oscillator; and these deductions seem to be supported by the observed facts. Mr. Marconi, in describing his experiments, said: "I have observed that in order that the effects should be well marked it is necessary that the length of the horizontal conductors should be great in proportion to their height above the ground, and that the wave-lengths employed should be considerable, a condition which makes it difficult to carry out such experiments within the walls of a laboratory." This is in accordance with Dr. Fleming's theory.

Another explanation of this action has been offered which also seems to fit the facts. This considers the horizontal antennæ as forming an electrical connection between two oscillating systems. One of these is the vertical connection between the horizontal wire and the ground, and the other is the oscillator formed by the extremity of the horizontal wire and the ground. These two oscillators, if placed a half wave-length apart, will oscillate with a difference of phase of 180 degrees, and hence the waves set up by one will be added to those starting from the other in the plane containing the two oscillators, and interference to a greater or less degree will take place throughout other angles. If the two oscillators were exactly equal and exactly a half wave-length apart there should be no transmission in the plane at right angles to the plane containing them. In other words, the horizontal conductor, according to this explanation, is merely a poor substitute for two properly tuned vertical antennæ placed the proper distance apart.

The curve showing the intensity of transmission of such a system, plotted on a polar diagram would resemble certain of the curves shown by Mr. Marconi. Moreover, since the length of the wave depends upon the height of the antennæ, the distance apart of the two vertical oscillating systems will depend upon their heights. It is possible that this arrangement will not explain all of the observed facts. The analytical study of these phenomena is exceedingly complex, so that in such a study it is generally necessary to assume rather ideal conditions, and then see how near one can come to them experimentally. These studies are nevertheless of great importance, since they guide the work of the experimenter, enabling him to proceed with a definite object in view, and not in a haphazard manner.

ENGINEERING EXPERIMENT STATIONS.

An interesting development now taking place in the central western states is the utilization of the university equipments for solving industrial and technical problems. Every one is familiar with the excellent work which has been done by the agricultural experiment stations in their particular field, but, until recently, the engineering schools made no attempt to assist the manufacturing industries in a similar way. Many—in fact, most—of these states have magnificent equipments for teaching various branches of engineering—equipments which consist not only of apparatus used in various branches of industrial life, such as boilers, engines, dynamos, machine tools, etc., but include as well accurate instruments for determining the performance of these machines, for carrying out all kinds of measurements and conducting investigations in any kind of work. The civil engineering department has, as a necessity, a complete collection of instruments, which no private engineer can aspire to, and the mechanical department has at its disposal not only many types of boilers and engines, but completely equipped shops. The electrical departments have instruments and supplies enabling them to make tests and conduct investigations in any line of electrical work. These equipments are needed to instruct the students in their use and to teach them the principles of engineering; but they are also available for carrying out such research work as the members of the teaching staff can undertake.

The new development contemplates putting these fine equipments at the service of the state for carrying out the investigation of problems which private companies or individuals can not undertake. In certain branches of industry the manufacturers have established research laboratories, where problems connected with the manufacture of their material, or which may possibly lead to the development of new apparatus and methods, are conducted. This is true notably in the electrical manufacturing business, but such laboratories are very few, and the results of their work are private, and not public, property. The work of the engineering experiment stations, on the other hand, will, in general, be made public, though they may, of course, undertake investigations for private concerns. In the first case the state gains directly, while in the latter it gains indirectly, since the state must benefit due to any improvement in any industry, and, further, since the fees required for conducting such an investigation will help to support the work of the station.

Digitized by Google

THE USE OF COLLOIDS IN TECHNICAL PROCESSES.

A new filament incandescent lamp, the invention of Dr. Hans Kuzel, of Baden, Austria, was described in the ELECTRICAL REVIEW for March 3. At the same time, reference was made to a patent obtained by the inventor covering the method of manufacturing this filament. The interesting feature of this patent—and, indeed, of the lamp itself—is the method of manufacturing, for it is applicable to a large number of materials difficult to work with in the ordinary way. The method, in short, consists in reducing the metal which is to form the filament to the colloidal state by volatilizing it under water by means of the electric arc. While in this finely divided condition it is mixed with a binder, the water evaporated so as to reduce the combination to the consistency of a paste, and in this form it is pressed through dies to form the raw filament. A slight drying of these filaments renders them conducting, so that the completion of the drying and conversion process may be carried out by an electric current passed through the filament itself.

This process is discussed at some length in *Engineering* (London) for July 6, and possibilities of a wider use of materials in the colloidal condition are suggested. In this condition the usual physical characteristics of the metal are held in abeyance. Hardness, brittleness or lack of ductility in no way interferes with the process, and, due to the exceedingly fine division of the metal, a mixture which is, to all practical purposes, perfectly uniform can be secured, so that with the driving off of the binding material a wire of uniform cross-section may be obtained.

As is well known, finely divided materials often exhibit powerful catalytic action. Sometimes violent chemical reaction may be produced if the materials are reduced to a fine powder, whereas, in the ordinary state, they would be inactive. It is thought, therefore, that metals in the colloidal state might be even more energetic and might bring about easily reactions hitherto unobtainable or brought about only with great difficulty. It has already been shown that colloids exert a great influence on fermentation and other organic processes, and it is very possible that certain of these uses may become important, as may also the reduction of materials to the colloidal state in working with them. The study of colloids has been taken up recently with renewed interest because of the electrical phenomena exhibited, and it will be strange indeed if no useful result comes about.

THE PRESENT CONDITION OF WIRELESS TELEGRAPHY.

There is no doubt that, for the present, at least, the most important use of wireless telegraphy is for transmitting messages across water. Whatever may be the future of the art, the need at present is for a reliable, powerful marine system. A good deal of interest therefore attaches to the present condition of wireless telegraphy when used at sea. For these reasons an article contributed to the proceedings of the United States Naval Institute by Commander B. T. Walling will be read with careful attention. Commander Walling has had a great deal of experience with the several systems now being tested by the Navy Department, and in this article he cites from tests made during the past two years.

The results, of course, varied with the apparatus and the power employed, and, no doubt, depended upon atmospheric conditions to a considerable extent. At times long distances were covered, messages being read, under favorable conditions, over distances of from 1,000 to 1,400 miles. During experiments conducted in January of the present year messages were received at Culebra Island, off Porto Rico, from the Atlantic fleet during several days. At times the sending vessel was over 1,100 miles distant. On one occasion the receiving station at Culebra was able to locate the relative positions of the different vessels of the fleet simply by the intensity and characteristics of the messages received. From these tests and others it is concluded that at the present time we have a transmitter sufficiently powerful for marine purposes; but as much can not be said respecting the receiver. Those employed on land are satisfactory, but those which may be used on a vessel can not be depended upon under all conditions.

Commander Walling says that this apparatus should be capable of transmitting messages 1,000 miles without overstrain, and 500 miles surely under favorable conditions—for example, at night. It should be able to send a message at least 300 miles at any time of the night or day.

An interesting phase of this problem comes up when wireless telegraphy is employed by naval vessels during times of war. The use of this method during the recent Russo-Japanese war is significant, and the author concludes that while it is possible for one fleet to confuse and render unintelligible the signals being sent out by the scouts which are watching it, and even to succeed in disabling part of the delicate apparatus on the scouts by keeping up a continual bombardment of intense electric waves, "the mission of the scout is to hang on and still hang on, and send, send, send, pushing his information into the atmosphere for a reasonable time with every watt of energy of which his transmitter is capable, and he will be successful!"

ELECTRIC RAILWAY DEVELOPMENT AT NIAGARA FALLS.

It is interesting to follow the drift of opinion among steam railroad men respecting electrification. A few years ago they did not hesitate to say that the electric motor was incapable of taking up the work of the steam locomotive. A little later they admitted that the motor could do the work, but said that it would be more expensive to operate than the steam locomotive, and would only be used where the steam locomotive is displaced for special reasons. To-day we find a good many railway engineers who are taking a still more favorable attitude.

The point of view taken by some is well shown by the remark made by a widely known engineer who was at Atlantic City. He said that, in his belief, the day was not distant when every locomotive between Syracuse and Cleveland, and in all that territory not more than 100 miles from Niagara falls, would be operated from power generated there. Such a transformation would be of enormous industrial importance, but it is to be hoped that in bringing it about the æsthetic value of Niagara will not be lost sight of.

Digitized by Google

The Sixth Annual Convention of the National Electrical Contractors' Association.

Cleveland, Ohio, July 18, 19, 20.

As published in the ELECTRICAL REVIEW last week, a large and representative body of men gathered for the sixth annual convention of the National Electrical Contractors' Association, held at Cleveland, Ohio, on July 18, 19 and 20. Nearly 600 names were registered on the association books. Delegations came from nearly all the large cities, and New York, Chicago, Boston, Philadelphia and Cincinnati were especially well represented.

The two sessions held on the mornings of Wednesday and Thursday were attended by many of those whose interests brought them in contact with the work of the contractors, though they were not all eligible to membership. The other several meetings were behind closed doors and were devoted to deliberations on the questions of labor unions and the conditions arising with employés, the work of the local and national boards of inspection, the use of special types of fittings and equipments, etc., etc.

In the last issue of the ELECTRICAL REVIEW a report of the first day's proceedings was given. The meeting of the 19th was partially devoted to an address by J. Robert Crouse, who described the purposes and accomplishments up to this time of the Cooperative Electrical Development Association, and especially the bearing of the work of the association on the welfare and progress of the electrical contractors. Mr. Crouse has such a mastery of the subject and has analyzed each situation so carefully that his point of view of the spirit and progress of cooperation as it applies to the progress of the electrical contractors was especially timely and interesting.

During this meeting an address was made by J. H. Montgomery, of the National Electrical Inspectors' Association, and his remarks covered some of the phases of electrical inspection arising from the constantly changing conditions developing in all construction work.

National Treasurer J. R. Galloway, of Washington, D. C., was the last speaker at this meeting.

On the afternoon and evening of the 18th and the afternoon of the 19th, long and animated business sessions of the association were held, which were attended only by accredited association members, and of these meetings the ELECTRICAL REVIEW offers no report, in deference to the wishes of the association.

At seven o'clock on the evening of the 19th a dinner was served in the Hollenden banquet room which was exclusively for members of the National Electrical Contractors' Association. No facilities were granted to press representatives for reporting the speeches and toasts during the affair. John P. Coghlin, of Worcester, Mass., acted as toastmaster, and responses were made by Jas. R. Strong, president of the association; E. M. Lawton, of Cincinnati, state director for Ohio; D. N. Goble, of Dallas, Tex., and John P. Faure, of Ossining, N. Y.

As the result of actions taken at the final business session Thursday afternoon, President Strong was authorized to appoint a committee to cooperate with the Winona trade school at Indianapolis, Ind. This school is doing much for the education of boys in mechanical arts, and the naming of a committee was requested, so that the association might officially acknowledge the good work done by this school.

Another important committee appointed was one to consider the pros and cons as to the use of uniform specifications and contracts for such work as is generally done by electrical contractors, and a report of the conclusions of this committee is to be submitted to the association at the next annual meeting.

An action which will be of wide interest was the adoption by the association of a series of official symbols to be uniformly used in making electrical wiring plans and construction work, and a committee was appointed to place the plan for the use of these symbols before the architects and engineers of the country and to endeavor to accomplish their cooperation toward their adoption.

At this last business session the following officers were elected: James R. Strong, New York, president; W. T. Gray, Minneapolis, first vice-president; Walter C. McIntire, Philadelphia, second vice-president; F. E. Newbery, St. Louis, third vice-president; J. R. Galloway, Washington, treasurer; W. H. Morton, Utica, N. Y., secretary; J. C. Sterns, Buffalo, sergeant-at-arms.

On Friday, the 20th, all the members of the association, with their guests, to the number of 500, went by steamer to Put-in-Bay as the guests of the Ohio State Association. Dinner was served en route, and the boat reached Cleveland on the return trip during the early evening. Many ladies were in the party and the day was the social event of the week. Among the other social features on Tuesday, the 17th, a luncheon was served at the Hollenden Hotel for the officers of the National Association by officers of the Ohio State Association.

A reception for ladies by the ladies' entertainment committee was held on Tuesday and a ladies' luncheon was served at 1 P. M. During the afternoon a trolley ride was given for the ladies.

On the following days numerous entertainments were so arranged that the ladies and guests were furnished with enjoyable amusements.

The next annual meeting of the association will be held in New York city for three days, beginning the third Wednesday in July.

A number of manufacturing companies exhibited and among those present the following may be mentioned:

Buckeye Electric Company, Cleveland—represented by L. P. Sawyer, Milton Hartman, F. W. Bliss and W. Ennis.

Brilliant Electric Company, Cleveland—E. J. Kulas and R. S. Jackson.

A. & W. Electric Sign Company, Cleveland—F. E. Hays, general sales agent.

Reynolds-Dull Flasher Company, Chicago—E. R. Dull, president.

W. J. Barr Electric Manufacturing Company, Cleveland—W. J. Barr and Thomas E. Barr.

Pass & Seymour, Incorporated, Syracuse, N. Y.—J. W. Brooks, F. F. Skeel, A. M. Little and W. Brewster Hall.

Wagner Electric Manufacturing Company, St. Louis, Mo.—Thomas T. Richards.

F. D. Lawrence Electric Company, Cincinnati, Ohio—represented by Charles S. Nolloth.

Vallee Brothers Electrical Company, Philadelphia, Pa.—Dale B. Scarborough, sales manager.

American Circular Loom Company, Chelsea, Mass.—H. B. Kirkland, Alex Henderson, Thomas G. Grier and H. C. Adams, Jr. This company distributed an artistic little memorandum book.

V. C. Gilpin, manufacturers' agent, New York.

I. A. Bennett, manufacturers' agent, Chicago.

Digitized by Google

Francis Raymond, manufacturers' agent, Chicago.

Alpha H. Kling, manufacturers' agent, Peru, Ind.

Barriett Electric Manufacturing Company, Cincinnati—represented by C. H. Haddrell, president.

Mark Manufacturing Company, Chicago—E. L. Markle.

Benjamin Electric Manufacturing Company, Chicago—O. Bennett.

John A. Roebling's Sons Company, Trenton, N. J.—F. W. Harrington and J. B. Bowman.

Union Electric Company, Pittsburg, Pa.—Percy Frost and L. H. Kellar.

American Watchman's Time Detector Company, Cleveland, Ohio—J. E. Kellar.

Steel City Electric Company, Pittsburg, Pa.—J. N. G. Fullman.

Osburn Flexible Conduit Company, New York, N. Y.—C. E. Corrigan.

Economy Manufacturing Company, Economy, Pa.—R. L. J. Fortune and C. E. Corrigan.

Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.—C. O. Baker, Bailey Whipple and others.

Troy Electric Company, Troy, N. Y.—E. G. Bernard.

Doubleday-Hill Electric Company, Pittsburg—Elliott Reynolds, manager Columbus, Ohio, office.

Trumbull Electric Manufacturing Company, Plainville, Ct.—F. Trumbull.

George Worthington Company, Cleveland—David Aikin.

India Rubber and Gutta Percha Insulating Company, New York, N. Y.—J. B. Olson, sales manager.

Dossert & Company, New York, N. Y.—E. A. Dossert.

W. R. Ostrander & Company, New York—H. E. Monk.

Columbia Incandescent Lamp Company, St. Louis, Mo.—Coles King.

Novelty Incandescent Lamp Company, St. Marys, Pa.—M. K. Mickey, president.

Banner Electric Company, Youngstown, Ohio—N. C. Norris.

Standard Electric Manufacturing Company, Niles, Ohio—H. H. Albert and L. J. Crane.

American Conduit Manufacturing Company, Pittsburg—C. A. Flack.

Phelps Company, Detroit, Mich.—W. C. Phelps.

Hart & Hegeman Manufacturing Company, Hartford, Ct.—George S. Searing, manager Chicago office.

Crouse-Hinds Electric Company, Syracuse, N. Y.—C. M. Crofoot.

W. P. Crockett, manufacturers' agent, Chicago.

De Veau Telephone Manufacturing Company, New York, N. Y.—Charles Auth.

J. Lang Electric Company, Chicago—Warren Ripple.

Western Electric Company, New York and Chicago—E. M. Rockafellow, F. Dusenberry, S. Baldwin and others.

Gail-Webb Manufacturing Company, Buffalo, N. Y.—H. M. Gail and Charles W. Webb.

Switchboard Equipment Company, Bethlehem, Pa.—G. L. Crosby.

S. B. Condit Electric Manufacturing Company, Boston, Mass.—S. B. Condit, Jr.

Electric Storage Battery Company, Philadelphia, Pa.—W. W. Winship.

Eastern Carbon Works, Jersey City, N. J.—O. L. Turgeon.

M. B. Austin Company, Chicago—M. B. Austin.

Sarco Company, New York—Ralph A. Schoenberg.

Warren Electric and Specialty Company, Warren, Ohio—Colonel E. E. Nash.

The F. Bissell Company, Toledo, Ohio—W. S. Bissell.

Jandus Electric Company, Cleveland—J. Potter.

D. & W. Fuse Company, Providence, R. I.—represented by the sales department of the Western Electric Company.

Hart Manufacturing Company, Hartford, Ct.—W. P. Crockett, manager Chicago office.

F. D. Killion, of the Western Electric Company, Chicago and New York—representing D. & W. specialties, and "Deltabeston" wire.

The Twelfth Annual Convention of the Ohio Electric Light Association.

The twelfth annual convention of the Ohio Electric Light Association will be held at Hotel Victory, Put-in-Bay Island, Ohio, Tuesday, Wednesday and Thursday, August 21, 22 and 23. The papers already prepared and the arrangements which have been made ensure a very instructive and interesting convention. A few of the subjects upon which papers will be presented are as follows: "Natural Gas Engines in Competition with Electric Motors"; "What Inducement Should Be Given to Increase Business in Villages or Small Cities in Which the Population is Not Increasing?" "Description of Wiring of a Moderate-Priced Residence Scientifically Lighted"; "Progress of High-Efficiency Lighting Units in Ohio by Central Station Men"; "New Business—How to Get It and How to Keep It"; "One Successful Way to Get Business"; "Legislation—Its Uses and Abuses"; "Luminous Arc Lamps with Mercury Arc Rectifiers"; "Notes on High-Efficiency Lighting Units by the Manufacturers, and Wiring for Electrical Appliances Other Than for Lighting."

There will be reports of the committee on cost determination and the committee on publicity, and an illustrated lecture on electric heating and cooking devices.

The entertainment features will be made particularly attractive to ladies. A number of prizes have been provided, and a series of games and contests has been arranged so that every lady will be able to take part. The games consist of a card party, bowling contest, guessing contest, tennis or croquet, and an aquatic contest in the natatorium. In addition there will be bathing, automobile rides and other special features for both the ladies and gentlemen. The Sons of Jove will hold a rejuvenation on Wednesday evening, August 22.

The secretary of the association is D. L. Gaskill, Greenville, Ohio.

Alcohol Engine Investigations.

As a result of the passage of the bill allowing the sale of alcohol without the internal revenue tax, the Department of Agriculture has decided to publish a bulletin on January 1, 1907, when the law goes into effect, giving the public a collection of the best obtainable data on the use of alcohol in small engines. For this purpose Professor Charles E. Lucke has been retained by the department as expert to conduct these investigations at the laboratories of Columbia University, New York city. This bulletin will contain all of the work done on the subject here and abroad, a complete bibliography, together with the results of experiments and conclusions drawn therefrom on American engines.

Professor Lucke is desirous of securing the cooperation of everybody interested in this matter and invites the contribution of any data or suggestions concerning the existence of such data. Any patents relative to this subject on vaporizers, carbureters or complete engines will be investigated and apparatus tested in the laboratory. These tests will be conducted without expense to the public, except the transportation of the apparatus. The reports will be published in the bulletin. Data or shipments should be addressed to Professor Lucke at Columbia University, and they will be returned when the work is completed, due acknowledgment being given for the assistance rendered.

Change of Name of the National-Interstate Telephone Association.

In accordance with the change made in the constitution, the name of the National-Interstate Telephone Association is changed to the International Independent Telephone Association of America. For convenience in general correspondence, the last two words in the title will be omitted.

Digitized by Google

Chicago, Lake Shore & South Bend Railway.

J. G. White & Company have completed estimates and surveys for an important addition to the traction system centering in Chicago, which will be an electric railroad seventy miles long from South Bend, Ind., to the Illinois-Indiana state line in the city of Hammond, to be known as the Chicago, Lake Shore & South Bend Railway. It is reported that the road will be financed by the Transit Finance Company, of New York, and it is expected that the line will be completed by the Illinois Central from Hammond northwest into Kensington, there making connection with the Central tracks for a continuous route into Chicago. The Illinois Central is bound by traffic agreements not to build east of the state line, which accounts for the rather unusual construction conditions.

From Hammond the new road will run eastward into the United States Steel Corporation, city of Gary, crossing the Grand Calumet river just before entering the city. From Gary east to Dunne Park the electric line will practically parallel the tracks of the Lake Shore & Michigan Southern, crossing them as well as the tracks of the Baltimore & Ohio Railroad from the south to north at Miller. From Dunne Park to Michigan City the route of the electric road will lie between the tracks of the Michigan Central and the shore of lake Michigan. The route from Michigan City is almost straight east to South Bend, a distance of about thirty miles. The tracks of the Lake Erie & Western Railroad and of the Pere Marquette will be crossed about a mile east of Michigan City. From New Carlisle into South Bend the electric road will be exactly parallel to the Lake Shore & Michigan Southern for a distance of fourteen miles. It is anticipated that a steamer service from Michigan City to Chicago will be run in connection with the new road, giving the residents in the district from Michigan City to South Bend, inclusive, a particularly quick and convenient route into Chicago. The road will be for both passenger and freight traffic, and that it will be thrown into direct competition with the steam roads in the district is at once apparent. Indeed the situation now obtaining on the south shore of lake Erie between Cleveland and Toledo will be practically duplicated on the completion of the new road. It is not as yet determined whether the line will be single or double track.

The construction will conform to the best interurban standard, and track will be laid with seventy-five-pound rails. The specifications in the case of the single-track line call for a width of eighteen feet on the fills and twenty-one feet in cuts, with side slopes one and one-half to one. All bridge structures, except the bridge over the Calumet river, will be of concrete or steel, and two trolley wires will be included in the overhead equipment. In case the single-track road is decided upon, eight sidings, each 2,700 feet long, will be provided. Specifications for double-track road provide for a width of thirty-one feet on the fills and thirty-four feet in cuts. The conditions of grade and curvature will be very moderate over the entire line. On eighty-five per cent of the road the grade will not exceed two-tenths of one per cent, and the usual maximum for overhead crossings will be two per cent. At two points, however, the grade on these bridges may run to five per cent. As approved, the total curvature for the line amounts to 1,034 degrees, divided between fifty-nine curves, practically all within the city limits of the various towns *en route*.

Increase in Power Plant of the Pittsburg Railways Company.

Almost 30,000 additional horse-power in boilers, engines and electrical machinery will be added to the great Brunot's Island power-house of the Pittsburg Railways Company this year. Contracts were closed this week and involve considerably over $300,000 in investment.

There lately have been tremendous demands for power upon this plant, because of the extension of lines in all directions not only in the two cities, but throughout the suburban districts. The company, when it built the big plant on Brunot's Island, arranged for increasing the plant to 50,000 horse-power. With this additional power the plant will contain practically this limit and there is a likelihood that it will be further increased in the future.

New equipment contracted for consists of three turbine engines of 7,500 horse-power each and one of 5,000 horse-power, making a total of 27,500 horse-power. Besides this, there will be the additional boiler capacity, electric generators, switchboards and wiring.

Initial installation of turbine engines by this company makes it one of the most important orders in the country. Pittsburg is at present the slowest to take hold of the new power method, and this installation is the first of importance in the city. The Westinghouse Electric and Manufacturing Company and the Westinghouse Machine Company have the orders for the entire contract.

The additional power will not only be used for the new traction lines to be ready for operation soon, but for lighting purposes as well. The company has started a regular schedule on its new line from Avalon to Emsworth, that line having recently been completed. Work is now to be started on the next division of the road down the Ohio river toward Beaver, which will run from Emsworth to Dixmont, passing around the rear of Sewickley, and when that line is completed the distance between Pittsburg and Beaver will be nearly closed up with electric roads. These will be supplied with power from the central power station in Pittsburg.

The new suburban line from Pittsburg to Canonsburg and then to Washington, Pa., will be completed this year and will demand more power, while the expansion of the city lines in many directions all call for additional power. In these additions the plan is to transmit the power over high-tension wires from the power-house to distributing points, where it will be reduced in voltage to the requirements of the service. The power will go out of the power station in the form of an alternating current and be transformed to a low voltage direct current for car service.

When the Brunot's Island power-house is fully equipped it will be one of the largest of its kind in the world. There are some larger plants in hydraulic power in this and other countries, but when steam is depended upon the matter is different. The first power-house of the Niagara Falls Power Company, with its great hydraulic turbines, contains only 50,000-horse-power capacity, and when built was the largest unit of horse-power known. Under the old forms of steam power such a unit would have been almost impractical.

Fuel for this plant will come almost exclusively from a coal mine owned by the Pittsburg Railways Company adjacent to Brunot's Island, and which will give the company plenty of coal at practically the cost of mining. The fuel arrangements give the company quick handling of coal, and the ashes from the boiler are being used to fill up the low parts of the island, thus reclaiming them for commercial purposes. The total cost of the plant will be close to $2,000,000.

The exports of copper for the first six months of 1906 were 101,765 tons, against 129,801 tons for the first half of 1905. The imports for the first six months of 1906 were 50,205 tons, against 44,100 tons for the same period in 1905.—*Copper Gossip.*

Digitized by Google

The New St. Denis Electric Plant at Paris.

By C. L. Durand.

THE city of Paris now possesses a number of electric stations which have been laid out on a large scale, but none of these has a greater interest than the new plant which is in erection at St. Denis, and which is now partly completed. When entirely finished, the station will be far the largest which is to be found in the region, and there is probably no other plant which will surpass it in the size of the buildings and the capacity of the units. The St. Denis plant is noteworthy for several reasons: first, on account of the vast size of the plant, the number of buildings and the extent of ground it covers, from the fact that reciprocating engines are entirely dispensed with, and it uses steam turbine and dynamo groups of the largest capacity which have yet been built on the Continent. Another feature which impresses the observer is the modern design of the whole station, especially as regards the use of automatic appliances for carrying out most of the operations such as handling the coal, boiler stoking, switchboard connections, pumping plant and many others, so that one is surprised to see the small amount of labor which is employed to handle such a large station.

Owing to the constantly increasing amount of current which is used in Paris and the suburbs for the lighting mains, the tramways and stationary motors, the new plant will find a ready use for all the current which it is capable of furnishing. The Metropolitan subway comes in for a large share of this current, and its lines are laid out to receive high-tension three-phase current at twenty-five cycles, this being connected in the different substations in the city. But the St. Denis plant will also be called upon to furnish a supply for a number of the city mains, notably for two systems of mains which are under the control of separate companies, each operating its own generating station. The circuits are laid out to run upon two-phase current at forty-two cycles, and in order not to be obliged to increase their stations, they will no doubt use a considerable amount of current from the St. Denis plant. Direct current is also to be furnished by the station for a number of tramway lines, especially those which lie in the neighborhood of the plant, and for this it is necessary to operate generating units at 550 volts. For the use of the station itself, notably for the large number of motors which are used in the premises as well as for the lighting, it was decided to use direct current at 250 volts.

While it would have been preferable to have laid out the station so that the main units should be all alike, it will be seen that under the existing conditions this could not be carried out, and accordingly it was decided to employ different units which should furnish three-phase current at 10,250 volts and twenty-five cycles as well as two-phase current at forty-two cycles, also direct current at 500 and at 250 volts. We shall see in the following description how these different kinds of current are provided for. It is to be remarked that at present the four main turbo-generator groups which have been installed are all designed for twenty-five-cycle current, and it is proposed to erect other sets for the forty-two-cycle current during the year. The steam turbine units and most of the electrical outfit in general has been furnished by the well-known Swiss firm, Brown, Boveri & Company. The writer is indebted to Mr. Durand, one of the chief engineers of the St. Denis station, for most of the information which is here given.

One of the engravings (Fig. 1) gives an idea of the general appearance of the St. Denis plant when viewed from the Seine, but as this is an end view of the buildings the general disposition is better seen in the plan view (Fig. 2). In laying out the station with a view of extending it greatly in the future, it was decided to build it in a certain number of units, each boiler house, coal bins and the corresponding machines in the dynamo room forming one such unit. Referring to the plan view A is the dynamo building which contains the main turbine groups. At B are the three boiler houses and back of each of them are four smokestacks. The three coal bins at C have almost the same size as the boiler rooms. The disposition of the units, which are formed in this way, is observed in the general view, and one such unit is now completed. Before the end of the present year it is expected to have all the part of the plant erected which is shown in the plan view, with the exception of the portions indicated in dotted lines, and the work upon the new portion is now being actively carried on.

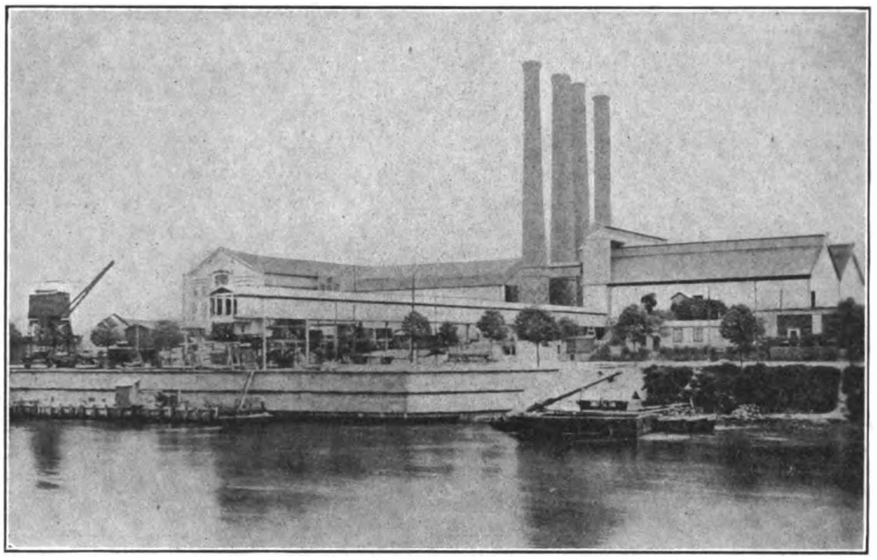


FIG. 1.—VIEW FROM THE SEINE OF THE ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

The interior of the large building, which contains the coal bins, four in number, is shown in Fig. 3. Each of the bins has sufficient capacity for storing over 4,000 tons of coal, making 16,000 tons for the whole building. The latter is a square structure of brick, stone and iron beams, and measures about 140 feet on a side. Coal is brought into the building from the Seine by a well-planned system of motor-driven conveyers. The boiler room has about the same dimensions as the former building, and is designed to contain twenty Babcock & Wilcox boilers, with super-

Digitized by Google

heaters and all the accessory parts, using automatic stokers for the furnaces.

The main building, which contains the machines, is a large brick and iron structure which has sixty-five feet width and a height from the ground level of fifty feet. When completed as far as is shown here, this building will be about 600 feet long. Below the ground there is an elaborate system of foundations, which go down to a first level or basement at sixteen feet depth, then to a second level at fourteen feet below this point. In this building are contained two ranges of main steam turbine units, which have a capacity of 12,000 horse-power each, and are constructed by the Brown-Boveri firm, of Baden, Switzerland. An iron staircase leads down to the basement, and in this part is a chamber containing the motor-driven pumps for the condensers. At present two rotary converters have been installed, and a booster set for the storage battery. There is also a smaller steam turbine unit, which has a capacity of 300 kilowatts and operates a direct-current generator. Of the main turbine groups, four complete units have now been installed, and two of these are now supplying current. Against the dynamo building is an annex of four stories and a basement, which is designed to contain the various circuits of the switchboard. The operating tables of the board are located in the upper story of this building. A general view of the generating room is shown in Fig. 4.

The coal is brought alongside the station on barges, and an electric crane, mounted on the wharf, lifts the coal from the barge and drops it into a hopper, from which it falls in an even distribution upon a horizontal conveyer of the continuous pattern. At the end of its course this conveyer, which has a capacity of eighty tons per hour, pours the coal into a hopper and thence it is taken by a vertical bucket conveyer. Later on it is designed to add a second electric crane and a second conveyer so as to make the system double, and working on either side of the last-mentioned hopper. The vertical conveyer takes the coal up to the buckets of the principal conveyer which passes from the Seine along a covered passageway into the coal building. Another set of buckets receives the coal and raises it to the height of the roof, at which point a horizontal conveyer receives it and runs along under the roof so as to drop the coal into the bins. This latter conveyer is double, and there is one for each half of the building. The coal is weighed and registered by automatic scales along its passages.

No less interesting are the methods which are used for taking the coal from the bins into the boiler room. The conveyer after passing across the roof of the building and pouring out the coal is brought down the side wall of the building, passes into a sheet-iron protecting housing, and then runs along in a gallery which lies underneath the coal bins and parallel with the portion on the roof. As this tunnel is provided with a set of chutes leading from the bins, the coal can be dropped into the conveyer buckets by operating a set of gates. Thence the conveyer mounts up the opposite wall and after passing the coal through a weighing device it is transferred to the horizontal conveyer which runs along over the boiler room. The interior view of the boiler room (Fig. 5) shows the under side of the coal bunkers for the furnaces, and the last-mentioned conveyer is made to discharge into these bunkers as it passes along above them.

After passing over the coal bunkers, the conveyer descends along the opposite end of the boiler room and runs along under the floor in a large tunnel. The buckets which are now empty are utilized to take off the cinders from the furnaces, but the latter are not discharged automatically into the conveyer from the ash-pits, seeing that the heat of the cinders might damage the apparatus, so that the cinders are cooled first by a water spray and then are loaded upon the buckets by hand. The conveyer then passes out and reaches the pits, which are designed to contain the cinders, these being located in the front part of the coal building, and after rising along the wall the conveyer pours out the cinders, which are thus

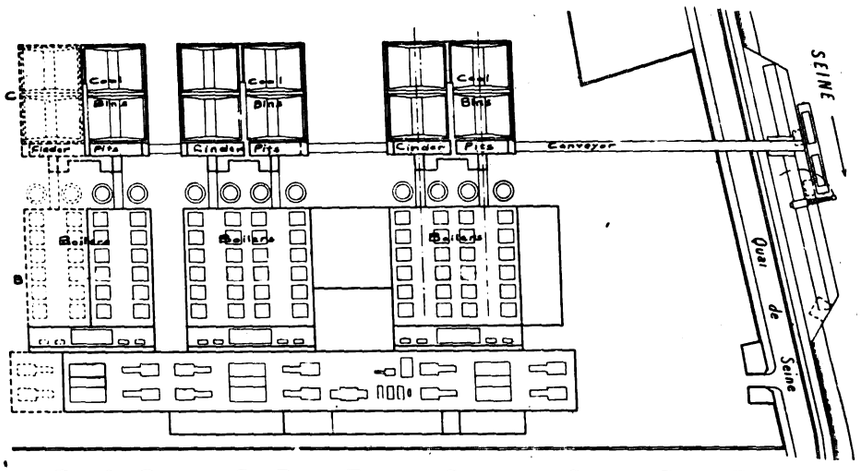


FIG. 2.—PLAN OF ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

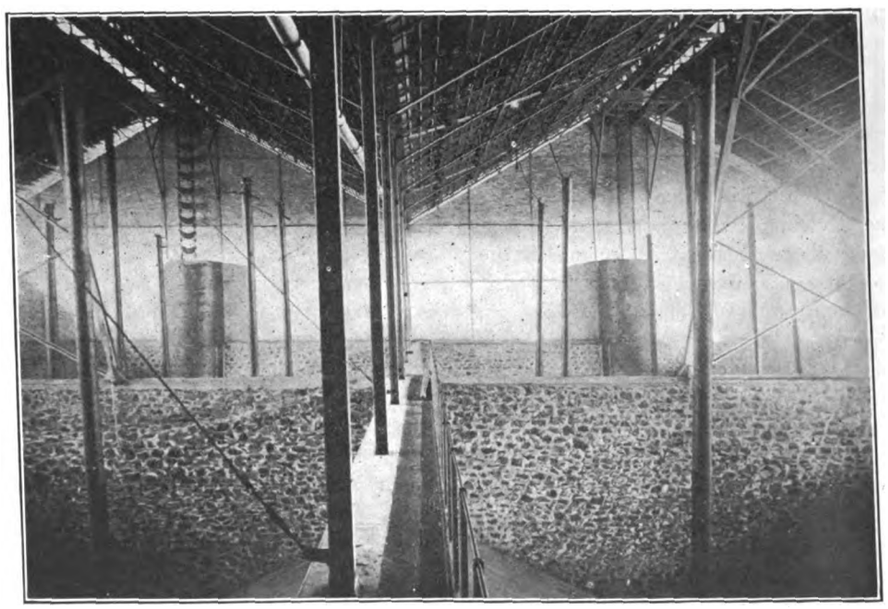


FIG. 3.—COAL STORAGE BINS, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

Digitized by Google

stored up and may be taken out of the building on carts, or when the main conveyer is not in use they can be taken upon it directly to the Seine by reversing its movement, and so can be loaded upon the barges.

There are four ranges of boilers with five units in each row. The furnaces of two ranges face toward each other, leaving a middle space between the boilers, as will be noticed in the interior view (Fig. 5). A complete system of automatic stoking has been adopted in the present case. From the coal bunkers the coal descends through a hopper and falls into a feeding hopper which is placed above the furnace. The grate of the furnace is formed of an endless platform, which is made up of heavy iron links articulated so that the system is passed over two drums at the front and rear of the furnace. Revolving the drums causes the web to move slowly to the inside, and it draws along the coal, which is fed down on it from a narrow slit. A countershaft passing along above the furnaces works a series of vertical shafts, which control the rotation of each drum. The coal feed is varied by a gate which works in the feeding trap. Each group of five boilers corresponds to one of the smokestacks which are between the boiler room and the coal building. In order to secure a good regulation of the draught in the flues which lead from the boiler furnaces to the chimneys, in each of the flues is placed a swinging gate which opens or closes the orifice. These gates are operated electrically from a special switchboard panel located in the adjoining room. On the panel is mounted a gauge whose indications are transmitted electrically from a thermometer which is located in the flue, so that the attendant can see the temperature of the outgoing gases and regulate the draught accordingly.

The steam which leaves the boiler is taken off by four main pipes which pass along the boiler room, and these join on to a main collecting pipe which lies in the middle space. From the latter are branched five separate sets of piping and these pass into the dynamo room to the steam turbines, using four sets of large capacity for the four principal turbines, and one set of smaller piping for the 300-kilowatt group. In the case of the steam piping, which leads to the main turbines, it has been given a uniform section of twelve inches, which was the largest section allowable in the present conditions on account of the distance.

In the space between the boiler room and the dynamo hall are placed the main pumps which are used for the boiler feed. These are located in the basement, while the ground floor is devoted mainly to the different kinds of indicating and controlling instruments and panels. Here are also placed a set of water meters, as well as the storage tanks for the main water supply. Only a small part of the water for the boilers is taken direct from the Seine, seeing that the condensers are made to furnish most of the water. The latter is used directly, while the additional amount of river water is passed through a filtering apparatus. Four main tanks, two in the basement and two in the upper part of the building, are used to contain the main supply of pure water for the boiler feed. Each of these tanks has a capacity of 150 cubic yards.

At present there are three water pumps

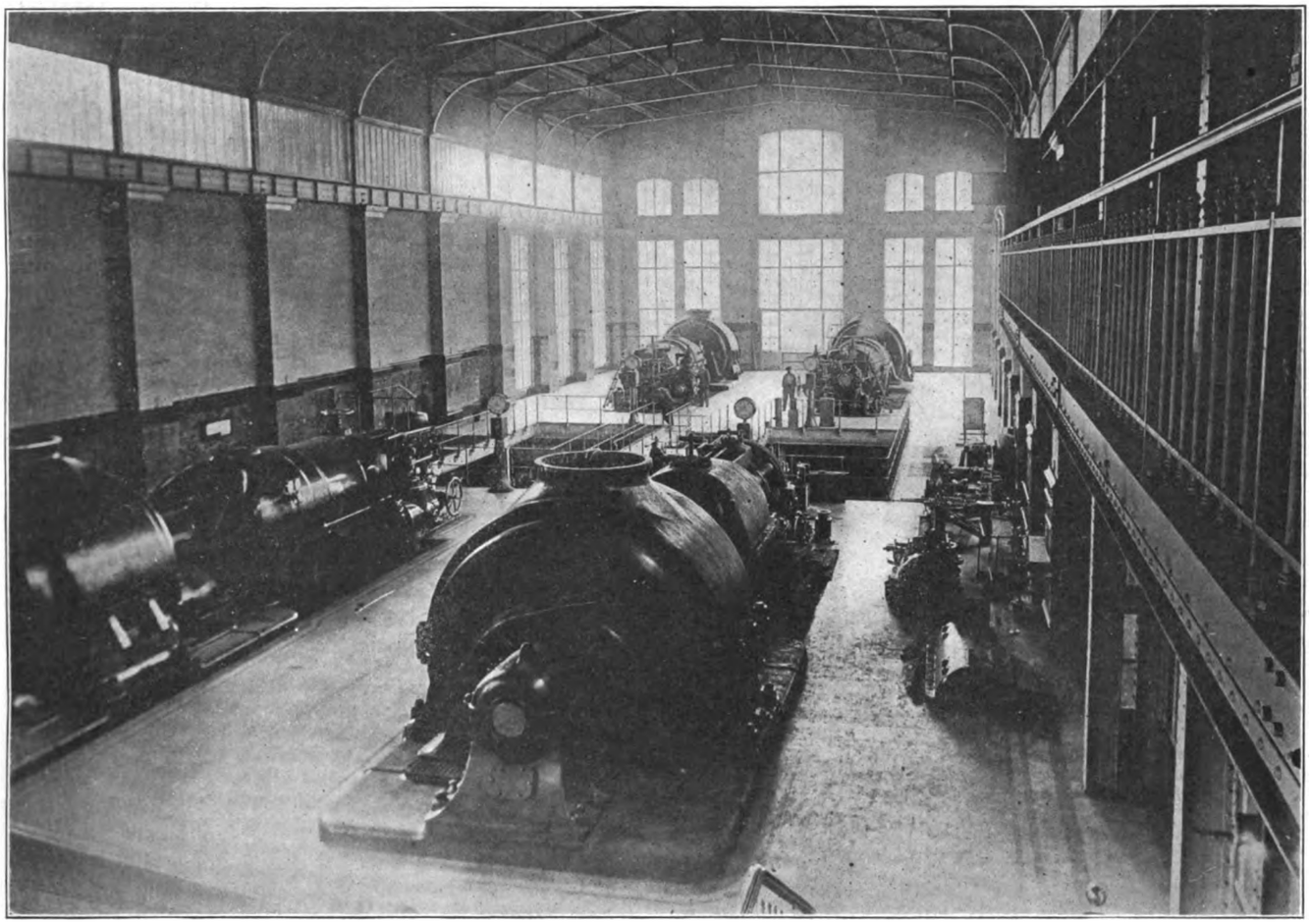


FIG. 4.—GENERATOR ROOM, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

Digitized by Google

in operation for the boiler feed. One of these is a Laval turbine-pump, driven by a direct-current motor of eighty horse-power working at 1,200 revolutions per minute. The second pump is of the triplex pattern with four vertical pistons and is also operated by an electric motor. Another pump of this kind is soon to be installed here. A steam pump of the Weir pattern completes the present outfit.

The building which has been erected to contain the main turbine-dynamo groups of the station, together with the condensers, pumps and other apparatus for handling the water supply of the condensers is shown in section in Fig. 6. The upper story of the building is used to form the main hall and is laid out to contain the principal generating groups and smaller turbine sets, together with the rotary converters, boosters and other apparatus, besides a special converting group which we will mention below, also the minor switchboards for these different machines.

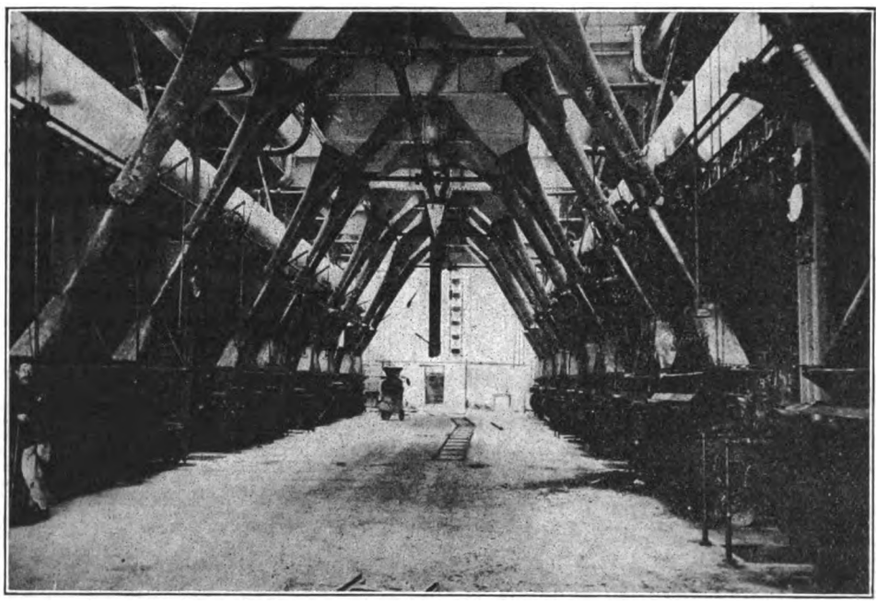


FIG. 5.—BOILER ROOM, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

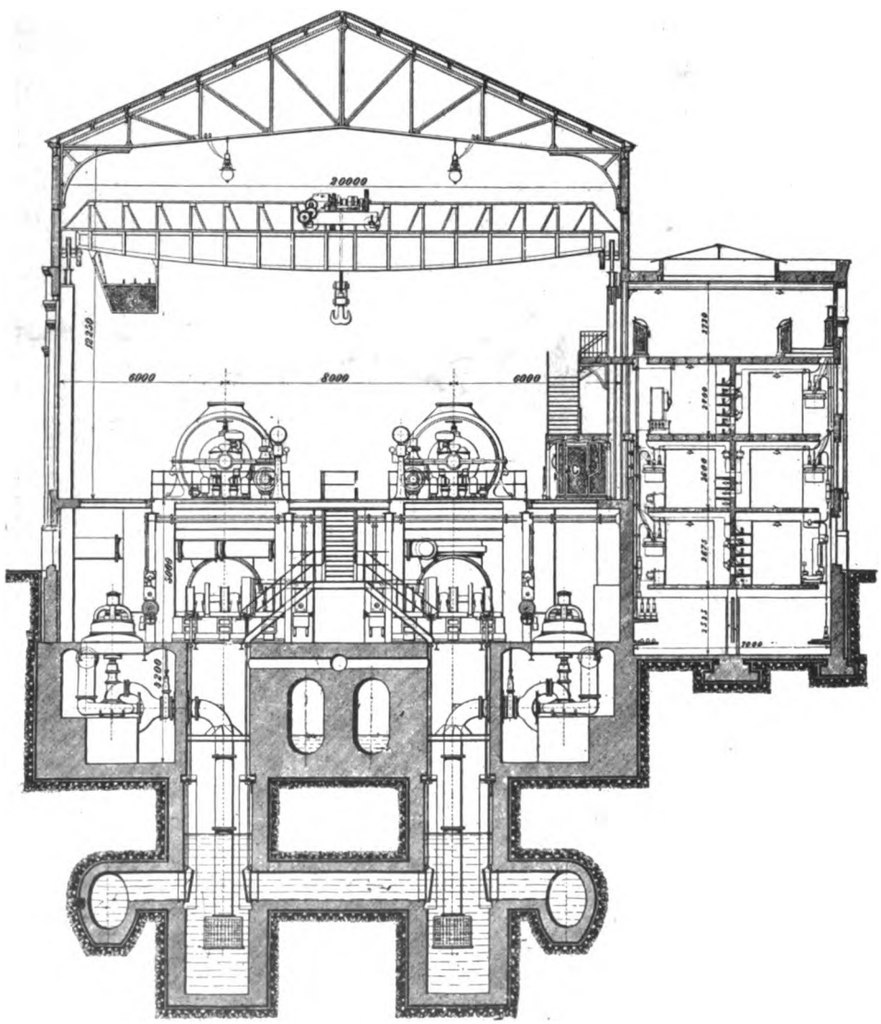


FIG. 6.—SECTIONAL VIEW OF THE ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

Underneath the main floor is a basement in which are placed the motor-driven pumps and various appliances which are needed for the water supply. In order to obtain the water supply, two long water flumes run from a point which is well below the ground level and lead to the Seine; at the mouth the flumes are provided with a special inlet arrangement, and the water is sent into a series of deep wells, connected across by a gallery. The water inlets and also the latter gallery are controlled by a set of gates which are operated by a rod transmission running to the main basement floor. Four wells are grouped together at one point. By connecting the wells in pairs, one pair can be used at a time, and is supplied from one of the main water flumes, should it be necessary to make repairs upon the other flume.

On the level of the basement floor is mounted a turbine pump which takes the water up from the well by means of the piping and sends it to the condensers. Each of the wells has one independent motor-driven pumping set of this kind. The motor is mounted on the top of the pump upon the vertical shaft. This motor is of the eight-pole, 130-horse-power Brown-Boveri type, and runs on 220 volts, direct current, using a maximum of 470 amperes, and running at 310 revolutions per minute. Each of the four motors is provided with a small marble panel containing a 500-ampere ammeter and a carbon-break switch. An oil rheostat for the motor is placed on the floor. Flush with the cement floor of the basement are the circular iron traps which cover the mouths of the wells. The pumps send the water into the condensers, and thence it descends into the evacuation conduits which lie close together under the middle of the basement. These conduits are

Digitized by Google

placed at a higher level than the inlet flumes, and run from the station to the Seine, where the water is discharged.

Symmetrically disposed to the four turbine pumps are four motor-driven pumps which serve as air-pumps for the condensers. These latter groups work with horizontal shaft and the latter operates three pump cylinders of large capacity. Between two of the cylinders is mounted a Brown-Boveri ten-pole direct-current motor of fifty horse-power, which operates on 220 volts, 195 amperes and 225 revolutions per minute. The air is sent through piping to the condensers, which are placed in galleries in the rear of the pumps.

One of the main points of interest in the station is, of course, the steam turbines, which are among the largest of the kind to be built. No less than 12,000 horse-power is given by each of the four turbines, and taken together they have a total capacity of nearly 50,000 horse-power. Allowing for the twelve turbine groups which it is expected to erect, a final capacity of about 150,000 horse-power will be available. Fig. 7 is a near view of one of the 12,000 horse-power units. On the front end is mounted the governor. The main operating hand-wheel for the inlet is placed in front of the turbine. A heavy foundation plate is used to support both turbine and alternator, and it rests upon a concrete foundation which goes down to a considerable depth. As is the usual practice for steam turbines, the foundation plate rests upon the concrete mass without the use of bolts. Since the two groups which are now running in the station have been in operation, no trouble has been experienced, and everything seems to have gone on smoothly from the start. The alternator which is mounted on the end of the turbine shaft is entirely enclosed in a casing, part of which is formed by the field casting of the machine and the remainder by two end-plates which have no openings in them, so that the whole group of turbine and alternator is entirely ironclad. A cap-plate can be unbolted from the top of the alternator to allow of inspecting the inside. The alternator is a three-phase machine which is built to deliver 5,000 kilowatts when on normal running, but has sufficient capacity to be run as high as 6,000 kilowatts without undue overheating. The speed of operating is 750 revolutions per minute. A standard voltage of 10,250 volts has been adopted as the best for working the alternator at this speed, with a frequency of twenty-five cycles. That the present groups have a very reasonable size for their capacity will be observed from their general dimensions, which are: length, forty-seven feet; width, fourteen feet; height, eleven feet. When running on no load, the turbines consume about fifteen pounds of steam per kilowatt-hour and on half load this rises to eighteen pounds, using superheated steam at 300 degrees centigrade and a pressure of twelve atmospheres.

Besides the principal turbine groups of the station, a smaller steam-turbine set has been erected, which has a capacity of 300 kilowatts. In this case there is a direct-current generator coupled on the shaft. The general appearance of this group is about the same as that of the large groups. The direct-current machine operates at 2,700 revolutions per minute, and it delivers 230 volts and 1,360 amperes. Means had to be provided for ex-

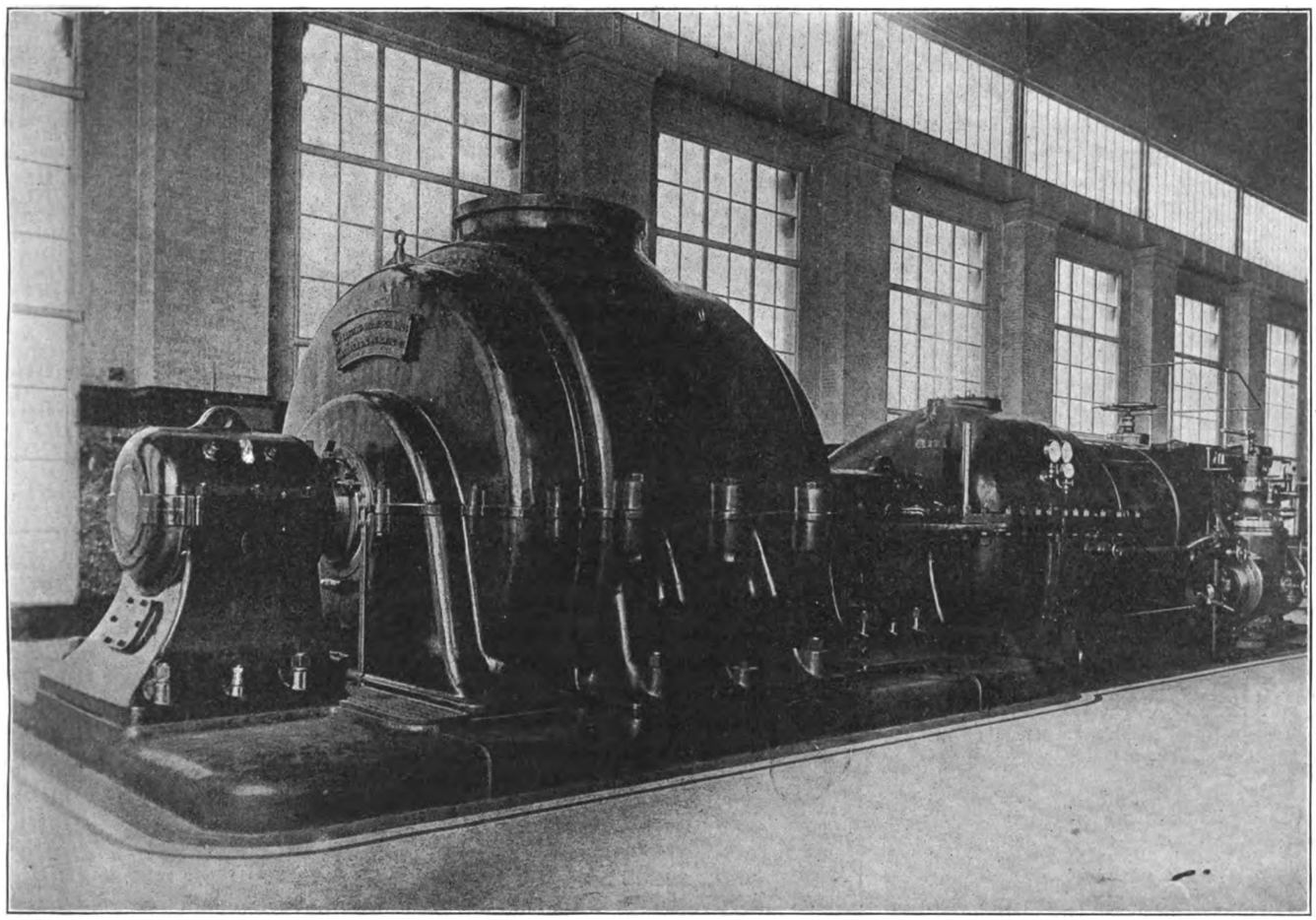


FIG. 7.—NEAR VIEW OF 12,000-HORSE-POWER TURBO-ALTERNATOR, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

Digitized by Google

citing the fields of the main alternators while the turbines were being started up. The present group accomplishes this and furnishes the needed current, then when the alternators are running at full speed the three-phase current is used to operate the rotary-converter groups of the station, and the latter supply the exciting current for the alternators when the small turbine group is stopped. A small exciter is mounted on the outside of the main direct-current machine of this group, seeing that its field is separately excited. On the side of the foundation plate is fixed a rheostat with hand-wheel which controls the exciter, so that the group is quite independent. Owing to the high speed at which the turbine is run, the commutator of the dynamo is braced in the middle by a heavy steel ring, which is shrunk on to it in order to prevent bursting.

Not far from the last-mentioned group are the sets of rotary converters. These machines consist of a Brown-Boveri direct-current generator mounted on the same bed-plate with a three-phase motor. Working at the standard speed of 375 revolutions per minute, the three-phase machine acts as a motor and runs on the main-station current of 10,250 volts and twenty-five cycles, using some twenty-five amperes at full load. It thus operates the direct-current generator so as to furnish all the continuous current which is needed for the general use of the plant, such as for exciting the alternator fields, lighting of the premises and furnishing current to the different motors, of which the boiler pump and condenser motors take the largest amount of power, besides the coal-conveyer. The direct-current machines of these groups are of the eight-pole type, working at 1,700 amperes and 225 volts, which latter is the standard direct-current voltage of the station. Besides the two main rotary groups is a small booster set, which consists of two six-pole, direct-current machines of similar build, mounted on the same shaft. The booster is intended to be used with the large storage battery of the station. The latter will have 126 cells, giving a total capacity of 1,300 ampere-hours on a one-hour discharge rate.

In the rear of these rotary sets and under the iron staircase which leads to the floors of the annex building is a switchboard which is used for operating the converter sets. This board has sets of panels for the high-voltage three-phase current coming to the motors and other panels for handling the 225-volt direct-current circuits of the generators. At present there are ten panels of gray marble erected, having the voltmeters, ammeters and switches mounted at the upper part, while in the lower part of each panel is placed a rheostat wheel.

Each of the main turbine groups is provided with an instrument column which is placed near it so that the attendant can see at a glance how the alternator is running and also at a considerable distance. At the top of the column, which is some eight feet high, is mounted a large dial which faces both ways alike, so that it can be read from either side. The dial contains a voltmeter scale reading up to 12,000 volts which shows the main voltage of the machine, and beside it is an ammeter scale reading to 400 amperes. Below is a scale showing kilowatts and going up to 7,500 kilowatts. The instruments are all mounted inside the case between the two dials, and thus show the readings both on the front and back. Under the main dial is mounted an Aron meter which indicates kilowatt-hours on a set of dials. On the main cast-iron pillar supporting these instruments is a projecting switch handle for cutting off the current.

An interesting mechanical feature is the assembly of four different machines of large size, mounted on the same shaft. The new group is known as a "polymorphic" set, that is, it is capable of furnishing two-phase or three-phase current at the two different frequencies which were adopted as the standard for the plant, as well as supplying direct current for various circuits. All of these different currents are not supplied at the same time, however. Either the three-phase or the direct-current machines can be used as motors, from the bars of the station, thus driving the others as generators. This group, which is shown in Fig. 8, has been designed and built by one of the well-known French electrical companies, the Societé Parisienne Electrique, whose works are located at Jeumont, in the north of France, and was assembled by M. Pierre Flamant.

Upon the main shaft of the group, which has an unusual length and is supported in six bearings, are mounted the two alternators and the two direct-current generators, placed as follows: first comes a generator (in the foreground) which is designed to operate on 500 volts. After the second bearing is placed a three-phase machine working on twenty-five cycles and 10,500 volts. Lying next to it is an alternator having a somewhat similar appearance in general, but designed as a two-phase machine working on forty-two cycles and 6,000 volts. Between the two alternators is mounted a magnetic clutch which is used to separate the halves of the group, formed each of one generator and one alternator. After the forty-two-cycle machine is placed a generator, which is the last of the series and is of the same type as the first generator. The twenty-five-cycle machine may receive three-phase current at 10,000 volts from the station bars, and drive either or both of the generators so as to furnish 500 volts direct current. The three-phase motor can also be used to operate the forty-two-cycle machine lying next it, and the latter will thus give two-phase current at 6,000 volts.

In general, the twenty-five cycle machine is used as a motor from the station bars. The group is started up by running either of the 500-volt generators as a motor on the 250-volt circuit of the station. The generator thus brings the three-phase, twenty-five-cycle machine up to speed, and when at the right point this machine is thrown on to the three-phase circuit of the station, and is thus made to run as a motor, in which case the direct current is cut off from the generator. The three-phase motor is now prepared to run the forty-two-cycle machine, either alone or in combination with one or both the direct-current generators. Usually this is the method on which the above group is operated.

The polymorphic group is operated at a normal speed of 500 revolutions per minute, and it is able to furnish a total capacity of 2,500 horse-power with the maximum grouping of the machines. It is to be remarked that the twenty-five-cycle machine is operated as a synchronous motor. The twenty-five-cycle, three-phase alternator has a total capacity of 1,500 kilowatts or 1,675 kilovolt-amperes when operating at the normal speed. It is designed to run on 10,500 volts with $\cos \phi = 0.895$, and in this case it will furnish a current of ninety-two amperes. With $\cos \phi = 1$ it will give 82.5 amperes. The exciting current for the field is fifty-seven amperes and 225 volts. The second alternator, which gives forty-two cycles, when running at the above speed develops 1,850 kilovolt-amperes with $\cos \phi = 0.81$, which is the usual condition of working, and in this case it has a capacity of 147 amperes. The working voltage is 6,300. To excite the fields of the machine seventy-five amperes and 200 to 225 volts are required, which latter current is taken from the station bars. This alternator is constructed on the general lines of an exterior slotted armature ring and an internal field with projecting poles. The field is formed of a steel drum keyed to

Digitized by Google

the shaft and carrying eight poles around the periphery. About the usual method is used in mounting the field coils and current is brought into them by a double steel ring collector mounted on the shaft. On the inner face of the laminated ring which forms the stator of the machine we find the usual system of lathe-wound coils placed in slots. In the view the end cover has been removed and the projecting ends of the coils can be seen. Extra heavy copper bars make up the coils, and there are nine slots corresponding to each pole. A section of about one inch wide and one and one-half inches deep is given to the slot. The main diameter of the machine is about nine feet and its width five feet. The diameter of the revolving field is about six feet.

The general design of the forty-two-cycle alternator is about the same as the foregoing, except that the dimensions and the form of the windings are somewhat different. There are ten poles on the revolving field, which has an outer diameter of five feet. Around the field is a laminated ring containing six slots per pole, with a slot section about the same as before.

Both the direct-current machines are of the same construction. They are eight-pole machines of the drum-armature type, but the method of designing the fields shows some original points, as here there is a set of auxiliary poles which are placed so as to present sparking of the commutator. The eight principal poles of the generator have a compound winding, and the series winding consists of several turns of a one and one-half-inch copper strip which is wound on a separate spool lying between the main winding and the field iron. Between the main poles are placed the extra poles which are thus also eight in number and occupy the middle spaces. These poles are of a smaller diameter than the others, and contain a winding of eight turns per layer, of copper strip about one and one-half inches wide. A copper ring runs around the machine near the field coils to connect all the auxiliary poles, and a similar ring is used with the series winding of the main poles.

On the middle of the commutator is a steel ring of large section which is separated from the bars by a thick layer of mica. Like steel rings are used at each end of the commutator. The high speed of running made these precautions necessary. A large steel ring frame passes around the middle of the commutator, so as to hold the brush-holders, which are eight in number on either side. When running at the standard speed of 500 revolutions per minute the generators are wound for 500 volts and have a capacity of 1,400 amperes. The maximum output of these machines is about 750 kilowatts.

The arrangements for handling the different circuits of the St. Denis station are carried out in the most complete manner and all the apparatus has been carefully designed with a view of handling the large amount of power which is furnished by the plant with simplicity as well as safety. A large annex wing has been added in front of the main building, and it is entirely devoted to the circuits and switching apparatus, along with a room containing the storage batteries. As this part of the plant has only been finished recently the present account of the switchboard apparatus and the views which we show here are first to be published about this part of the station. The annex has four stories, including the basement, and the four lower stories are di-

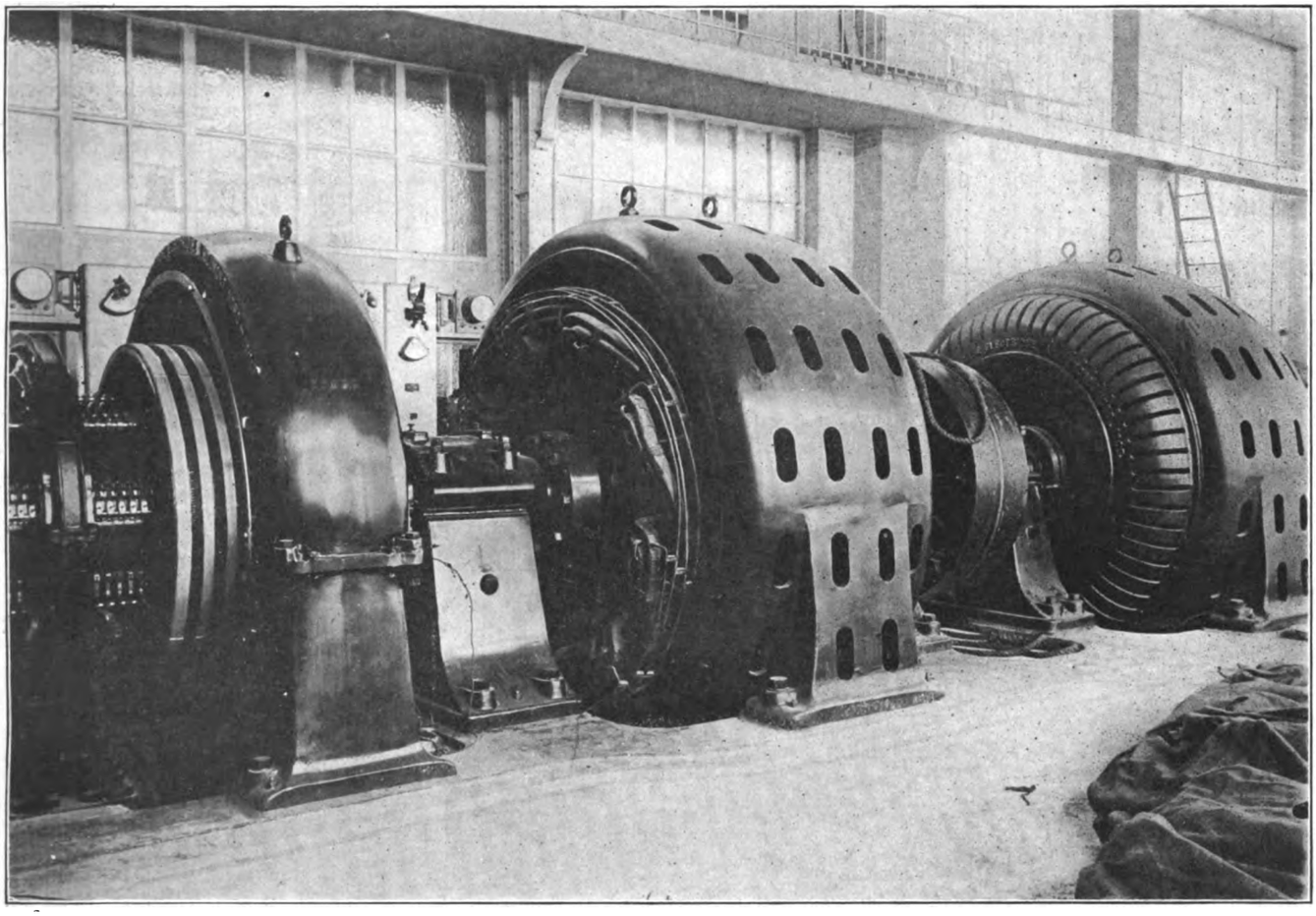


FIG. 8.—POLYMORPHIC SET, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

Digitized by Google

vided by a partition in the middle, thus making eight separate rooms for the current bars and other circuits of the plant, along with the switching apparatus, rheostats, lightning arresters and other apparatus belonging to the switchboard. The top floor, which lies three stories above the main dynamo hall, is laid out in a single large floor, and here have been installed the series of panels which contain the operating levers and instruments for handling the apparatus below. From this point the attendant has a good outlook over the dynamo room, and can observe all the machines, exchanging signals, if need be, with the engineers.

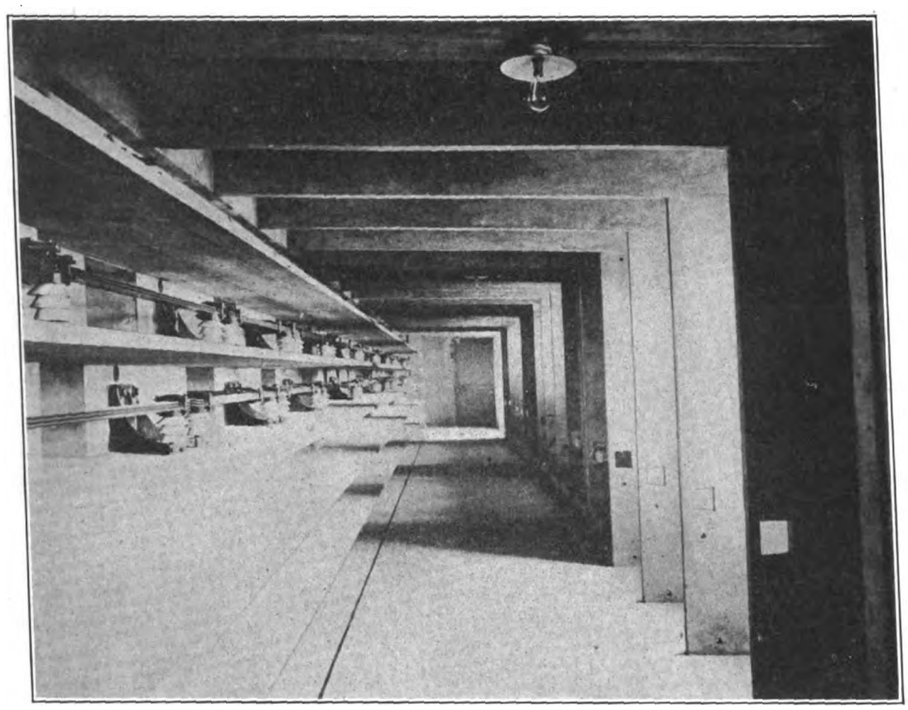


FIG. 9.—MAIN BUS-BARS, SWITCHBOARD ROOM, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

The switching apparatus contains many novel and interesting features, and may be taken as representing the most recent progress which has been made on the Continent in this direction. In general, the main alternator groups of the plant are run upon two different sets of bus-bars which form the principal bars of the station. One of these sets consists of the main bars and the second set forms the auxiliary bars. Current is switched from one to the other set, as is desired for operating. The six main rooms of the annex are fitted up to contain the bars, special care being given to mount them in the proper manner so as to have a good insulation for the 10,000-volt circuits and keep them well separated. Fig. 9 shows the arrangement of a switchboard chamber. The bars are held at the proper intervals by triple-porcelain insulators mounted on a cast-iron bracket. The bars are sectioned at intervals, and proper arrangements are provided for connecting the sections together. These rooms are well aired and are lighted either by large windows or by lamps.

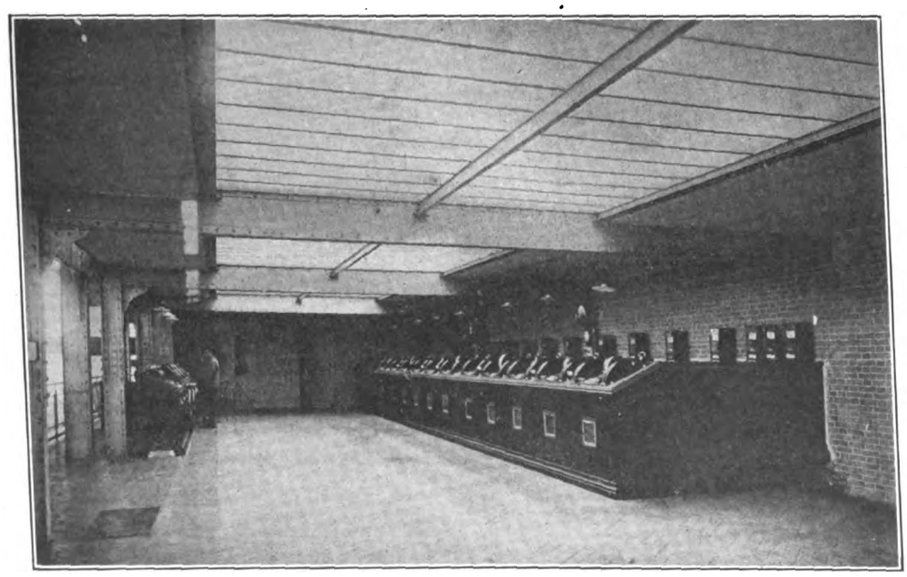


FIG. 10.—CONTROL SWITCHBOARD, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

The switchboard control apparatus, which has been designed by the Brown-Boveri firm, is mounted upon a form of desk panel, having a slanting top (Fig. 10), this forming a continuous bench. The panels are of black marble and are mounted in metal fittings of black enamel finish. With the handles of the instruments and the various metal parts nickel-plated, the whole presents a very handsome appearance. On the top of the panel are mounted most of the handles and the indicating instruments. Electrical and mechanical control is used for operating the various devices of the switchboard from these benches. Along the rear wall of the room runs the bench which is used for handling the feeder circuits, while in front and next the dynamo hall is placed a shorter bench, consisting of five panels for operating the machines. Each panel of the bench forms a separate unit, both for the machine and the feeder benches. A certain number of units, such as are needed for the present capacity of the station, have already been assembled, but a large space is left in the hall so that a great number of panels can be added on to the ends of the rows from time to time, as the extension of the stations may require.

Where two or more of the alternator groups are operated in parallel, it is not necessary to use all the panels which belong to these machines, seeing that in this case a special panel has been provided. After starting up the machines and bringing them into synchronism they are thrown in parallel, and then can be operated from the special panel. On the vertical front is mounted a large rheostat wheel which uses a transmission device so as to allow all the rheostats of the machines to be operated from this point. The top or desk part of this panel contains simply three ammeters of the sector pattern,

Digitized by Google

reading up to 3,000 amperes. Below the rheostats of the machine panel is a specially designed instrument which is intended to act as a circuit-breaking device for breaking the current in the fields of the alternators in the case of a short circuit, but it does not act for an overload. A set of disks working in a revolving field is used for this purpose, and the device acts as a relay to operate a solenoid switch placed in the lower stay. A glass panel in front allows of inspecting the instrument.

As regards the feeder panels, the same general design prevails. Each panel of the bench contains the apparatus for using either the main set of bus-bars or the auxiliary set.

At present there are ten feeder panels mounted in the station for use with the feeders which the plant is now supplying, with two others left in reserve. An additional panel is used to supply that part of the city system which is operated by the Continental Edison Company.

Separating the feeder panels from the rear wall is a space of four or five feet, and the flooring is elevated about a foot so as to allow for the different connections from the bench to the wall and thence down to the lower floors. Against the wall is a continuous shelf containing a set of meters, one for each feeder panel. These meters are of the Aron type, with automatic electric rewinding system, working on a maximum of 53 by 165 amperes and 10,250 volts. Behind the Edison feeder is mounted a very elaborate system of registering wattmeters. One of these is a three-phase wattmeter which registers up to 2,000 kilowatts. Below it is mounted a large instrument, some three feet square, built by the C. Olivetti firm of Milan and using a pen recorder to register to 2,000 kilowatts with a maximum of 150 amperes.

Glasgow Telephones.

The purchase by the British post office of the Glasgow Corporation's telephone enterprise has at last been effected after a protracted series of negotiations. Full particulars concerning the deal appear in another column, but it is significant to note that the amount at which the concern has been sold is nearly £20,000 less than the sum offered by the National Telephone Company. The latter company proposed to pay the book value of the asset, which stood at over £320,000. It is estimated that the loss which will fall upon the shoulders of the ratepayers as a result of the present deal will amount to about £15,000. It appears from the agreement arrived at between the post office and the Glasgow corporation that the former undertakes to maintain the existing rates to subscribers for two years. There are now four municipal systems in existence—Brighton, Portsmouth, Swansea and Hull—and it remains to be seen what effect the Glasgow purchase may have upon the negotiations which are going on for their acquisition by the government.

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

THE MEETING OF THE MINING INSTITUTE.

At the recent annual meeting of the Institute of Mining Engineers in London, electricity was again very much to the fore. There were no less than four papers out of thirteen devoted specially to electrical apparatus, and in some of the other papers electricity came in occasionally. Mr. Mountain had another paper upon the question he has been thrashing out, as to the commercial possibility of electrical winding, in which he returned to the charge, as against his German critics, with some fresh tables. The discussion on this paper brought out the fact that winding by electricity is being seriously considered by mining men in the United Kingdom, and that in a number of instances it is actually in use with economy. The manager of some shale mines in Scotland mentioned the fact that in one of their mines they were winding by steam, and in the other by electricity, transmitted from a generating station, three-quarters of a mile away, and they found that the electrical winding was cheaper. The depth in this case was very small, only 140 yards, and the quantities of mineral wound were small in comparison with the quantities wound in the large collieries at the present day, but it is just in these smaller cases where probably electrical winding will first establish itself, and where the experience will be made that will finally enable it to be used generally. In Germany, where it has taken such a great hold, the criticism is made that the mines do not turn out much. Professor Redmayne also mentioned that he had gone very fully into the question of winding, and working a new colliery generally by electricity, for two shafts, 500 yards deep, that are about to be sunk in South Wales, from each of which 1,200 tons per day will be drawn, and he stated that he had come to the conclusion, absolutely, that electricity would be cheaper for all the work of the colliery, and they were going to adopt it everywhere, except for ventilation. It was pointed out in the discussion that the running of the ventilating fan by an electric motor from a three-phase service is the weak point of the electrical working of collieries. The economy of the question turns upon whether there is steam in the immediate neighborhood of the fan or not. If there is, the most economical arrangement is to use the steam directly to drive the fan engine, as there is no steam economy that can be adopted to generate electricity that can not be adapted directly to the fan engine. With three-phase motors also there is the objection that they do not readily lend themselves to the variation of speed that is sometimes required with the fan. It is usual in most collieries to lower the speed of the fan engine at week ends for two reasons: to economize in coal, a smaller quantity of air being sufficient when there are no men in the pit, or only a few repairers, and also because English mining practice prefers to have as small an air-pressure as possible on the coal faces. The view of experienced English mining engineers is that it is better for any gas that is likely to exude from the coal to come away and be carried harmlessly up the upcast shaft, than for it to be imprisoned in the coal, possibly acquiring pressure and being given out in large quantities in case of any disturbance of the ventilation at any particular point. In addition to lowering the speed of the fan at week ends, it is the practice to vary the speed occasionally with varying barometric pressures. The variation is small, and it could be accomplished by putting a resistance in the rotor circuit of the motor, as is done with some electrical haulage plants, but this would be so obviously wasteful considering the time the fan is running, that it does not meet with favor. It appears to me that the solution of the problem would be to convert the three-phase current by a rotary converter or motor generator, and to drive the fan by a continuous-current motor, regulating the speed by adjusting the resistance of the field-shunt coils in the usual way. There are other apparatus about a colliery that would be more conveniently driven by continuous-current motors for the same reason. It may perhaps be noted that the fan load is almost the ideal. It is an even better load than that of the ocean steamer, inasmuch as it is practically constant for days together, and is continuous day and night for every day throughout the year.

The next paper dealt with electrically driven air-compressors, the air being used for working coal-cutting machines. This arrangement, which was adopted in Germany a good many years ago, practically solves the problem for the present of the difficulty of using electrically driven apparatus at the face of the coal in fiery mines, and the enormous losses incurred in the transmission of compressed-air under ordinary conditions. The net efficiency of compressed-air when the air is compressed on the surface and transmit-

Digitized by Google

ted by pipes to the face of the coal is rarely over twenty-five per cent, and may be as low as seventeen per cent. It is possible to obtain higher efficiencies if the air can be reheated at, or near the face, but in fiery mines this is of course impracticable. The great source of loss in transmitting compressed-air is the leakage from the pipes. As I have before pointed out in these notes the roadways of a mine are constantly "working," with the result that considerable strains are brought upon the joints of the pipes. In addition, the pipes themselves are often buried by the débris, coal dust, etc., on the main roads, and any air leakage, which would be difficult to see under any circumstances, is completely hidden. By placing the compressor near the face, and transmitting the power by electricity, this heavy source of waste is eliminated. The combined efficiency between the steam engine driving the electrical generator on the surface and the indicative horse-power in the air-compressor underground being given at from sixty-two to sixty-four per cent. As was pointed out in the discussion, there is an alternative to the method. Flexible metallic tube might be employed to transmit the air from the surface to the coal-cutting or other machines to be driven by it. It is probable that the leakage would be almost eliminated if flexible metallic tube was employed. On the other hand, the flexible tube is very expensive, and it is really a question for the usual balance sheet, placing on the one hand the first cost and upkeep of the flexible tube, on the other hand the cost of the generator or the proportion of the generator employed, the cables, the motor, the switch gear, etc. The method of compression near the face of the coal has the disadvantage that it is not possible to work the air isothermally, or in any way approaching to it. That is to say, it is not possible to make any attempt to extract the heat from the air, as it is generated during compression, and this must materially reduce the efficiency of the air-compression system, as the expansion of the air causes a smaller quantity of free air to be taken into the compressor at each suction stroke. In connection with the use of compressed air, an old suggestion of my own was brought up in another paper, that by Sam Mavor—the air might be heated by electricity transmitted from the surface. I have not had time to examine the economy of question in the light of later knowledge, but the following figures will enable anyone that is interested in the subject to do so. One British thermal unit will raise the temperature of fifty-five cubic feet of air at about sixty degrees Fahrenheit, one degree Fahrenheit. A kilowatt contains approximately fifty-seven heat units. Air at sixty degrees Fahrenheit expands by $\frac{1}{461}$ of its volume for every degree of increase of temperature.

Another paper devoted nominally to electricity was by a colliery manager, who has made a rather exhaustive study of electricity, on the adaptation of a Rateau three-phase turbo-generator, supplied with steam from the exhaust of the winding engines. Professor A. Rateau, of the École Superieude des Mine, of Paris, has worked out a system for the use of the exhaust steam from winding and other engines, in low-pressure steam turbines. The essence of the invention is really in the thermal storage apparatus which he has worked out. The exhaust from a winding engine is intermittent. On the other hand the demand for current from the generator driven by the steam turbine, varies, and the thermal storage or accumulator, as Professor Rateau calls it, acts virtually as the receiver of an air compression system does, or as the accumulator in the modern generating station, with Highfield booster. The accumulator consists of an old boiler, or any convenient cylinder of a similar kind, partially filled with a mass of scrap iron, old pit rails, etc. There is water in the cylinder, occupying a portion of the space not filled up by the scrap iron. The exhaust from the winding engine is delivered to the accumulator, and the turbine receives its steam also from the accumulator. The exhaust steam causes the water in the accumulator to generate steam, and the heat which it brings is taken up very largely by the scrap iron. When the winding engine stops for a certain time, the scrap iron gives up its heat to the water surrounding it, maintaining the steam pressure in the accumulator, until the exhaust steam is delivered to it again. For driving the turbine at any time when the winding engine is stopped for a long period, a connection is made to the boiler service, through a reducing valve, and when the pressure in the accumulator falls to a certain figure, the connection to the boiler service is opened, and the turbine is worked directly from the boiler at the reduced pressure. At the Hucknall colliery in Nottinghamshire, where the apparatus is at work, it is stated that there is no appreciable variation in the speed of the turbine, whether it is fed with live steam from the boiler, the exhaust steam from the winding engine, or the regenerated steam, as it is called, produced by the delivery of heat to the water in the accumulator from the scrap iron. One point that is of interest in this matter, seeing that the question of winding by electricity is so much to the fore at present, is, that it is considered unsafe by colliery managers to allow a condenser to be connected to the winding engine when men are being raised or lowered. In the mines in the United Kingdom, the home office makes very stringent regulations as to the winding of men. When coal only is being pulled up, or empty mine wagons lowered, the arrangements may be very much looser than when men are being wound. At the Hucknall colliery, where the Rateau apparatus is in use, the cost per unit is stated to be 1.3 pence when working 250 days per annum, and after allowing ten per cent for depreciation. It is stated that if the turbine ran at full load for the 250 days per annum, the cost per unit would be reduced to 0.55 penny. The quantity of electricity generated is not large, 230 board of trade units per day, of which twenty-seven units are consumed by the underground service. The cost of generation in this case strikes me as high. There are a great many mines in the United Kingdom that are generating current at a very much lower figure than either of those named.

The fourth paper was by the writer, on "Capacity Current and its Effect on Leakage Indications on Three-Phase Services." In the correspondence in discussion of the paper I read at the Mining Institute meeting in Manchester last September on "Earth in Collieries," the question was raised as to whether it was possible to distinguish between capacity currents discharging through the indicating apparatus, and leakage currents proper, in the case of a three-phase service. One gentleman who has an electrical plant under his charge stated that he had an apparent leakage of thirty-three milliamperes from each of his three cables, but that an expert who had been called in stated that they were really capacity discharge currents. I was requested to explain the whole matter, and to say how the difficulty was to be met. In my paper I pointed out that as the algebraical sum of the currents of a three-phase system at any instant is zero, the capacity currents should also be zero, providing that the capacity of the three cables is alike, and that therefore, if any cable is injured, its capacity is altered, and it really makes very little difference whether you consider that you are measuring an actual leakage current, or a difference in the capacity current, providing that you

Digitized by Google

understood that the difference is caused by damage to the insulating envelope of the cable. With any one of the leakage indicators on the market, there would be no indication as long as the indicator was connected, either to the neutral point, or to a neutral point formed by connecting three resistances to the three cables, unless the capacity of one cable is altered, and it is then a simple matter to test the three cables. There is, however, a case where this is not correct, viz., where the characteristic of the service is not a true sine curve. As I understand, the tendency of modern generators, and modern alternating systems generally, is toward pure sine curves. In some of the earlier apparatus, this was not so. It is possible to resolve every curve, however irregular it may be, into a number of sine curves, of which the first curve, or first harmonic, represents the principal portion of the energy of the service. The second and fourth harmonics go out by cancellation, and the third and fifth harmonics are the only ones likely to give trouble, and then only if the separate curves of each harmonic of the three phases are in phase with each other. When that happens you may have a comparatively large discharge current, and I have been informed of cases where there is such a discharge current. The only remedy appears to be to ascertain the curve of the system with an oscillograph, and if it is worth the expense, to have the generator and transformers altered, so that an approach to the sine curve may be obtained. In the great majority of cases it appears to me that the third and fifth harmonics of the three phases of the service would probably not be in phase with each other, so that the algebraical sum of their capacity current, or the resultant curve, would be very small indeed, and not worth troubling about. In the discussion, the question was raised about the case where the neutral of a three-phase system is earthed. The board of trade in the United Kingdom and the home office in its control of electricity in mines, do not demand exactly the same arrangements. The home office allows the neutral to be connected to earth, if the mine management so chooses. The board of trade says that the neutral of a power service must be earthed. It was suggested by the engineer of the Lancashire Power Company, that a very low-resistance ammeter might be inserted in the wire, connecting the neutral with earth, the ammeter being fitted with several shunts of varying values, so that leakage indications of greater and greater quantity might be obtained by successively switching on the different shunts. It is merely an adaptation of the form of ammeter, now commonly employed to this service, with the provision of a number of shunts of varying multiplying power, and should answer very well.

THE COLLIERY EXHIBITION.

This exhibition is getting to be an institution held biennially in London, at the time of the annual meeting of the Institute of Mining Engineers. Electricity is very much to the fore at the exhibition. The principal firms who cultivate mining work, the Westinghouse Electric and Manufacturing Company, Lahmeyer & Company, Messrs. Ernest Scott & Mountain, The Brush Company, Mavor & Coulson, and others, had large stalls. Coal-cutting machines are undergoing an important modification. The chain long-wall machine, which was introduced over here some years ago by the Morgan-Gardner Company, has caught on. The Morgan-Gardner machine has apparently failed to satisfy the requirements of mining work, and I understand has been almost entirely withdrawn. On the other hand, the Austin Hopkinson machine, which is almost identical with the Morgan-Gardner, is doing good work. Mr. Hopkinson told me that he had sold twenty machines within a very short time, and that he had not had a single armature burned out. As shown at the exhibition, his machine looks very strong and suitable for the rough and tumble of colliery work. I gathered that he only uses series-wound continuous-current motors, and that he constructs them with specially long armatures, of small diameter, so that if they do race (one of the complaints that is made against the series-wound motor) it is not a serious matter. The three-phase driven coal cutter he makes with a very large rotor slip, and I understand that he finds it able to cut its way into the coal, and to deal with anything in the way of hard stuff, or pyrites, with a squirrel cage motor. For starting, he has an auto transformer. The switch is enclosed, and is operated by a substantial rod with a hook at the end, by which it is pulled either into contact for regular working, for starting, or for stopping. The Diamond Company have also introduced a chain machine, run on the same lines as the Hopkinson and Morgan-Gardner, but while those firms only have one motor, the jib or frame carrying the chain being at one end of the machine, the Diamond Company have two forms, one with two motors, the frame carrying the chain being at right angles to the body of the machine, and another form in which only one motor is employed, the arrangement being similar to that of the Morgan-Gardner and Hopkinson. The Brush Company had an electrical coal-cutting machine on view. It is a disc machine, and a modification of the Diamond machine with two motors, the disc being held in the centre of the machine between the motors. The Brush Company claims certain improvements in details, one of which is the employment of ball bearings on the main driving shaft, and a special arrangement of feed for the haulage gear. Another noticeable development in connection with all the coal-cutting machines now on the market is the adoption of "skids" in place of rails. One of the difficulties in connection with the working of coal-cutting machines has always been the laying of the rails for the machine to run on. Messrs. Mavor & Coulson have always insisted that 100 yards of face should be prepared in front of the machine, and that the rails should be laid well ahead. Other makers employ only three pairs of rails, one pair on which the machine is standing, a second pair laid immediately in front, to which the machine will move as it leaves its present pair, and a third behind, which, as it moves, the man behind picks up and passes over the machine to the man in front. There is considerable trouble in laying the rails, so that the wheels of the machine will take them, and if it does not take them properly, there is trouble with both the haulage gear and the cut. If the rails are laid properly, the friction is of course considerably less than with "skids." On the other hand, "skids" will adapt themselves to the inequalities of the floor, and the increased power demanded by the haulage gear, which pulls the machine along, is not of any consequence compared with the greater convenience of cutting. A paper that was read by Mr. Mavor, of Mavor & Coulson, on practical problems of machine mining, was a plea throughout almost its entire length, and it was a very long paper, for greater care in preparing roads for coal-cutting machines, greater number of gate roads; the roads, usually made up of loosely packed rubbish, by which the coal face is approached, and a greater number of cross-gate roads joining these. He also pleaded for cutting in the coal in place of cutting in the fire clay that usually underlies the coal. The relative advantages are, by cutting in the fire clay the whole of the coal in the seam should be obtained in the form of round coal, with very little small. On the other hand, cutting in the fire clay requires more power than cutting in the coal, and the coal dust does not create friction in the working parts of the machine; so that the machine is therefore

Digitized by Google

able to continue running for longer periods than where it is subject to the fine dust formed when cutting in the fire clay. At the exhibition, the Lahmeyer Company exhibited a form of controller, for three-phase main and tail haulage, worked by a lever at the end of a pair of H girders, the lever being arranged to occupy the usual position at the engineman's hand. The lever moves longitudinally between the girders, and in so doing revolves the controller, this being enclosed in a substantial iron cylinder, fixed at right angles to the girders. The lever also moves transversely to the girders, and in so doing operates the reversing switch contained in a box attached to the girders, fixed between the lever and the controller. The switch and controller works in oil. The engine man has all the motions under his control by different motions of one lever. The controller is arranged to throw different resistances into the rotor circuit, and the motor it controls is wound for only two phases, while the stator is wound for three phases. They claim to be able to reduce to half-speed, by any convenient steps that are required. The efficiency at full speed is stated to be ninety-one per cent at half speed seventy-two per cent. The Westinghouse Electric and Manufacturing Company showed an earth detector for three-phase services of 3,000 volts and upwards, which appeared to me to be on the right lines. The conductor of each cable is connected to a small condenser, and the outer conductors of each condenser all connected to electro-static apparatus, whose needles indicate a difference of pressure between each phase, and earth. The electrostatic apparatus consisted of light aluminum vanes, carrying pointers which moved over scales graduated up to 3,000 volts in either direction, the vanes being suspended between two copper enclosing pieces. The vanes are connected to earth, and the two enclosing pieces to two of the phases. Two instruments are fixed side by side, two phases being connected to each instrument, so that full indication is obtained of any phase to earth.

Professor A. J. Pollock and S. H. Barraclough, of the University of Sydney, in a paper before the Royal Society, of New South Wales, described a hollow lightning conductor crushed apparently by the electrodynamic action of the current. The tube was 1.8 centimetres in diameter, 0.1 centimetre thick. Assuming the material was plastic at the time of crushing, the current is calculated to have been about 20,000 amperes; if not, the current would be about 100,000 amperes.—*Nature.*

THE POWER PLANT OF THE ELECTRICAL DEVELOPMENT COMPANY, OF ONTARIO.[1]

BY F. O. BLACKWELL.

The power plant of the Electrical Development Company was designed to utilize 11,200 cubic feet per second of water under a head of 135.5 feet. The water is diverted from the Niagara river at Tempest Point, midway between the headworks of the Ontario Power Company and the Canadian Niagara Falls Power Company.

The general plan of development adopted called for the construction of a wing wall to gather the water from the rapids, the excavation of a forebay of sufficient capacity with the river at its lowest future stage, a wheel pit, and a tailrace tunnel discharging under the centre of the Horseshoe falls, where the flow of water over the falls is greatest.

The forebay in the rapids and the tunnel outlet under the falls were both bold and original conceptions, which were thought at the time to be practically impossible of execution.

In order to uncover the forebay it was necessary to construct a coffer dam 2,200 feet long in the rapids, where for a portion of the way the cribs had to be sunk in water twenty-six feet deep and running at a velocity of twenty-two feet a second. This work was started in April, 1903, and proved to be an extremely difficult undertaking, but was successfully completed in about twelve months.

The tailrace tunnel was started in May, 1903, by the sinking of a construction shaft on the bank of the river 150 feet deep and fifteen by seven feet inside the timbering. From this shaft a drift fourteen feet wide and seven feet high was run 670 feet to the portal of the tailrace tunnel, work upon which was only actually started in December of the same year. The final opening under the falls proved very difficult on account of the large amount of water encountered near the face and the mass of detritus that had to be cleared away by men exposed to the full force of the wind and spray from the falls.

The wing dam is 785 feet long, and its maximum height is twenty-seven feet. The elevation of the crest is 527 feet, and there will be from three to eight feet of water flowing over it, depending upon the condition of the river. Near the power-house the dam is cut away for a length of thirty feet to an elevation of 524 feet so that there will be three feet additional depth of water to carry away ice from the submerged arches in front of the power-house. This question of guarding against ice is one of the most important problems which had to be met. In addition to the first line of submerged arches just referred to, a second wall has been constructed outside of the racks. The spaces between the outer and inner walls, and between the latter and the racks, are arranged each with a spillway at one end, so that such ice as passes through will float out at the north end of the building.

The wheel pit is 416 feet long and twenty-two feet in width inside of the brick lining, which is two feet thick, and is spanned by masonry arches at three levels to carry the machinery. The ends of the pit are also closed by arched wall linings. The arches were not allowed to be put in until the pit had closed in as much as it would and come to rest. There has been no movement whatever at the union of the arches and the walls that the most accurate observations could detect, which is interesting on account of the theory once advanced that there was a periodic change in the distance apart of the sides of the pit.

For the power to be developed the length of the wheel pit is much less than in previous developments of this character. This is due to the penstocks alternately being on the right and left-hand sides of the water-wheels, permitting one hoistway to serve two wheels.

The water after passing through the racks enters a cast-iron bell-mouth, which in turn joins on to a riveted steel penstock ten feet six inches in diameter.

There are eleven penstocks, and at the head of each there is an electrically operated gate to control the water. The penstocks are connected at the bottom to water-wheels of 13,000 horse-power capacity, running at a speed of 250 revolutions per minute. The wheels and penstocks rest on a heavy concrete foundation, which covers the bottom of the wheel pit.

The hydraulic apparatus is being furnished by the I. P. Morris Company, of Philadelphia.

Each wheel unit consists of two Francis internal discharge turbines five feet four inches in diameter. The discharge of water is to be governed by cylinder gates, and the weight of the moving parts will be partially taken by a water piston in the wheel. There is a single cast-iron draft tube nine feet in diameter for each wheel, and the units alternately discharge water underneath the east and west tailrace tunnels. The object of the under discharge is to seal the draft tubes and prevent loss of vacuum, no matter what

[1] Paper read before the Canadian Electrical Association, Niagara Falls, Ontario, June 20.

Digitized by Google

the elevation of the water in the tunnels may be, and without the necessity for a tailrace weir. By using two tunnels it is possible to shut off the water entirely from one-half of the wheels without interfering with the other half. By closing down the wheels, discharging water into either tunnel, that tunnel will drain itself, and there is no necessity for closing off the mouth of the tunnel. A gate is provided at the mouth of both tunnels, however, in case of extreme back-water, which has been known to be fifty feet above normal in the lower river.

As the wheel pit is not connected to the tailrace, the hydraulic apparatus can never be flooded out.

The tunnels on each side of the wheel pit are twenty-five feet deep, and vary in width from sixty-six to thirty feet, with a velocity of from fifteen to twenty-one feet a second. At a point about 150 feet north of the wheel pit the tunnels come together. At the junction the tunnel is thirty-five feet wide and twenty-five feet six inches high and tapers to a width of twenty-three feet five inches and a height of twenty-seven feet one inch, which section is carried to the edge of the falls, a distance of 1,935 feet. The slope of the main tunnel is .005, making the total loss about ten feet, and the velocity is twenty-six feet a second. The tunnels have a lining two feet thick throughout of concrete faced with brick, except for 300 feet at the north end, where the lining consists of concrete rings in six-foot sections, which are expected to break off as the falls gradually wear away. This is necessary, as the crest in the centre has been receding at an average rate of two and one-half feet a year.

The power of the water-wheels is delivered to the electric generators through vertical shafts 150 feet long, consisting of riveted steel tubes thirty inches in diameter between bearings and solid shafts fourteen and one-half inches in diameter at bearings. This shaft is held at three points in the wheel pit by steady bearings resting on concrete arches. At the upper end there is an oil thrust-bearing thirty-seven and one-half inches in diameter fed by oil under a pressure of 350 pounds, which is sufficient to carry the weight of the entire revolving parts should the water thrust fail from any cause.

There will be ultimately eleven 8,000-kilowatt generator units, four of which are now being installed by the Canadian General Electric Company. These are of the revolving field type and run at a speed of 250 revolutions per minute. They deliver three-phase alternating current at a periodicity of twenty-five cycles and a potential of 12,000 volts. There are at first to be two 500-kilowatt water-wheel driven exciters in a room underground, and two motor-generator sets of the same capacity on the generator floor. Eventually three sets of each type will be installed, any two of which will excite all the alternators.

The controlling switchboard for the entire plant, including transformers and transmission lines, is located in the centre of the power-house, where the operator can see the generators. It consists of an enclosed compartment with a bench-board in front and doors at the ends. The instruments which are ordinarily employed in the operation of the station face toward the generator room. On the back are the recording instruments and switches, which are only occasionally used or referred to. Dummy bus-bars and signal lamps on the bench-board clearly indicate to the operator the connections in the station, and the instruments are so located that they are over the switch which controls them. The generator instruments, for instance, are over the generator control switch. The board is so compact that an operator standing in front of it can see all the instruments from one position, and can conveniently reach all the controlling switches. The power-house bus-bars, generator oil switches, instrument and switch transformers are located immediately below the power-house floor in brick compartments. The wiring arrangement is such that a generator can either be connected to the bus-bar or to a separate outgoing cable. In ordinary operation the current from each generator will leave the building by the shortest possible route, and there will be practically no cables running the length of the power-house.

The power-house will be a handsome building in the style of the Italian Renaissance, about 500 feet long and seventy feet wide. The height will be forty feet, except at the centre and end bays. The centre bay will stand out from the face of the building, and, besides being the main entrance, will give room for the offices of the power company. On the inside it will afford space for the switchboard and auxiliary apparatus. The power and transformer houses are 1,817 feet apart, and will eventually be connected by four underground conduits. One conduit will be in reserve, and the plant will not be crippled unless two conduits should simultaneously fail.

At present two conduits only are constructed, each with sixteen four and one-quarter-inch ducts placed two wide and eight deep. The manholes are common to the two conduits, but are divided into two parts by a central partition, so that one duct system would not be damaged by a burnout on the other.

The cables required for the portion of the power plant first installed are six 500,000 circular mils triplex for 12,000-volt power, two 00 B. & S. for the switch motor bus-bars, two with forty-five No. 8 B. & S. wires for oil-switch control, two each of thirteen No. 12 and fourteen No. 7 wires for instrument connections. The cables are in duplicate, and either half of the ducts might be disabled without shutting down the power system.

The transformer house is on top of the bluff outside of the park limits, and is designed to accommodate fifteen 2,670-kilowatt transformers furnished by the Canadian General Electric Company, twelve of which are now being installed. These transformers are of the oil-immersed, water-cooled type, and are wound for 10,000, 11,000 and 12,000 volts primary and 60,000, 50,000 and 40,000 volts secondary. They will be connected in delta on both primary and secondary sides.

Each transformer is placed in a separate closed fireproof room, so as to minimize the fire risk and prevent the possibility of trouble in one transformer being communicated to others. The transformers are mounted on rails and arranged to slide out of the compartments into a gangway, where they can be readily handled by an overhead traveling crane.

The piping for oil and water is placed in the basement under the back of the building and on the wall of the transformer compartments.

The cables from the power-house are carried in ducts to a gallery above the transformers, where the 12,000-volt switches, instrument transformers and bus-bars are located.

The high-potential bus-bars, wiring instrument transformers and air switches for the 60,000-volt circuits are located in the room back of the transformers, and connected through the gallery floor to the high-potential oil switches on the floor above.

The outgoing transmission lines leave the building through porcelain bushings at the back, and are protected by lightning arresters on the wall below.

The wiring throughout is completely enclosed in brick compartments, the only openings being through asbestos doors placed at points convenient for inspection.

The transmission line to Toronto, con-

Digitized by Google

structed by the Toronto & Niagara Power Company, is built on a private right of way eighty feet wide, which can later be used for a double-track railway. With this idea in view, the line was located so that the maximum grade at no point need exceed one per cent, and the minimum radius of track curvature can be made as low as a quarter of a mile.

Two complete steel tower transmission lines will eventually be constructed, one only being erected at present. Each tower carries two circuits of 190,000 circular mils copper conductor. The standard distance between poles is 400 feet, although much longer spans are used in crossing rivers and ravines. For curves and long spans special extra heavy towers are employed, with double and triple insulators. The height of the standard tower is sufficient to support the lower cable at a height of forty feet from the ground. Fifty and sixty-foot towers are made by bolting extensions to the bottom of the standard towers, and are used wherever there are depressions along the right of way. In two places towers 150 feet and 175 feet high are required in order to cross navigable channels at the Welland canal and at Burlington Beach.

The copper cable consists of six strands with a hemp centre, and has a tensile strength of 60,000 pounds, and an elastic limit of 40,000 pounds per square inch. It was made by the Dominion Wire and Cable Company, of Montreal.

A large portion of the power is delivered to synchronous apparatus, the Toronto street railway employing rotary converters, and the lighting company synchronous motor-generator sets. The loss of power, when transmitting 10,000 horse-power to Toronto over each circuit, will be less than sixteen per cent, and either line can transmit 20,000 horse-power with less than twenty per cent loss should the other become disabled.

The insulators are fourteen inches in diameter and fourteen inches high, and are tested for a potential of 120,000 volts complete, or 60,000 volts on each of the three parts of which it is composed.

The transmission towers are heavily galvanized after all machine work upon the parts has been completed. They were made by the Canada Foundry Company, of Toronto, and the Riter-Conley Manufacturing Company, of Pittsburg, Pa. At points exposed to severe lightning the line will be protected by twelve-foot extensions carrying galvanized steel cable above the power conductors.

There will be three division houses along the line, dividing it into four sections, any one of which can be cut out for inspection or repair. The length of the line is about ninety miles, and the division houses will therefore be twenty-two and one-half miles apart. A lineman will control each section daily after the transmission is in operation.

The substation in Toronto is designed for fifteen 2,670-kilowatt transformers, and is similar to the transformer house at Niagara falls, except that there will be double low-tension bus-bars and a much larger number of feeder cables for distributing power throughout the city of Toronto.

The switchboard is located at one end for controlling the transmission lines, transformers and 12,000-volt circuits. This is equipped with dummy bus-bars with all necessary instruments.

In the plans of the Electrical Development Company every effort has been made to avoid any interruptions to the power service. No single accident or any probable combination of accidents is ever likely to shut down the entire plant. The double ice protection, twin tailrace tunnels, the extra 8,000-kilowatt water-wheel, generator and transformer unit, and the duplication of the transmission lines and of all auxiliary apparatus is with this end in view.

The engineering design of the plant is in charge of Dr. F. S. Pearson as consulting engineer. The water power development was planned by H. L. Cooper, chief hydraulic engineer, and the writer laid out the electric plant. The construction of the hydraulic work and power-house was originally under Beverly R. Value, and is now in charge of L. J. Hirt as resident engineer, and Walter Pearson as electrical engineer.

The transformer houses and transmission line were built by Robt. C. Brown, chief electrical engineer of the Toronto & Niagara Power Company.

The officers of the company are: president, H. M. Pellatt; first vice-president, Frederic Nicholls; second vice-president, William Mackenzie; manager, H. H. Macrae; secretary, H. G. Nicholls; treasurer, D. H. McDougall.

Among the developments for supplying electricity in Japan is the 40,000-horse-power hydroelectric plant of the Uji River Electric Power Company. The plant will be in the neighborhood of Kobe and will supply current for lighting and power to Kyota and the surrounding district. A water-power plant is also contemplated by the Hanshin Electric Railway Company.

POWER SUPPLY TO TRAMWAY SYSTEMS.[1]

BY S. J. WATSON.

The number of street tramways constructed or reconstructed for electrical working during the last few years has necessitated a large increase in the capacity of existing generating stations, or the provision of separate stations to supply the power. In papers read before this and kindred associations the pros and cons of separate *versus* combined stations have received attention. The principal argument advanced in favor of a separate station has been that provided the power required was above a certain amount, the cost of constructing a separate station would be as low and the costs of production much lower than with a lighting station, consequently no possible advantage could accrue to a tramway department by amalgamation with the lighting department for generating purposes.

With the rapid growth in the demands for light, power and tramways, and in the sizes of our generating stations and outputs, the costs of production have been considerably reduced, and an advocate for a separate station is rarely met with nowadays. It is still difficult to say what is the limit in the size of a station so far as low-production costs are concerned; the issue appears to depend entirely on the size of the units installed.

The writer does not intend to bring within the scope of this paper the question of supply to very large tramway undertakings; the following remarks are, therefore, intended to apply to small and medium-sized districts operating from six to thirty cars.

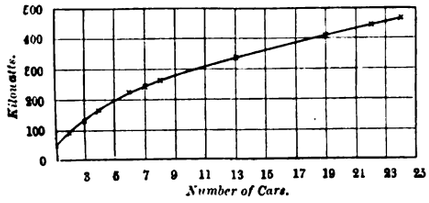
Capacity of Plant—When the construction of a tramway system is decided on, one of the first points to be settled is that of the provision of sufficient generating plant to maintain the service of cars under the varying conditions that a tramway system is called upon to fulfil if it is to satisfactorily deal with the demands of the traveling public. The principal requirements consist of an early morning workman's service between five and seven o'clock, a ten to twenty minutes' service between eight and noon, and a more frequent service from noon to eleven or half-past eleven at night; also, and this is of considerable importance from a power-supply point of view, a much-increased service for special local events. For a fairly hilly district the following curve may be used to obtain the

[1] Paper read at the eleventh convention of the Incorporated Municipal Electrical Association, London June 22.

Digitized by Google

approximate maximum loads required from a plant supplying one to twenty-five cars in service on a regular time-table.

For a flat district the maximum would, of course, be considerably less than that shown, possibly by twenty-five or thirty per cent.



RELATION OF LOAD TO NUMBER OF CARS.

To take as an example a system with twenty-four cars in use. From the curve above the maximum load will be 465 kilowatts, and where heavy special traffic has occasionally to be handled this should be increased by thirty-three and one-third per cent—say 155 kilowatts, making a total of 620 kilowatts. A separate power station to meet such demands would require as a minimum 750 kilowatts of plant, divided into three sets each of 250 kilowatts normal capacity. Allowing for twenty per cent overload for one hour, two sets would give a maximum of 600 kilowatts, the other set standing by as spare. The cost of such a plant, including site and buildings, would be £19,750, equal to £32.9 per useful kilowatt installed. To put down a direct-current plant capable of dealing with the same load in an existing station supplying alternating current, some reduction could be made in capital outlay. An extension of the buildings could be carried out for considerably less than the cost of an entirely new building. A full complement of boilers would not be necessary, as the new boilers would work in conjunction with those already installed. Altogether, a reduction in the cost of £3,500 should be made. The additional outlay to install the plant in an existing alternating station would be £16,250, equal to £27 per useful kilowatt installed. A further saving in capital outlay will be possible if such a plant is put down in a direct-current station already supplying light and power at 440 to 480 volts, as one of the existing steam sets could be altered at little expense to serve as the stand-by for both lighting and tramways, in which case there would be a saving on generating plant of about £2,250. The additional outlay for the installation of tramway plant in an existing direct-current station supplying at 440 to 480 volts would be £14,000, equal to £23.3 per useful kilowatt installed.

Type of Plant—From the supply point of view, a small tramway system provides one of the most severe loads that has to be dealt with, owing to the large and frequent fluctuations in the demand. With a system of the size mentioned, a variation from 50 to 465 kilowatts in a few seconds is not uncommon. It is therefore necessary to run a plant largely in excess of the mean load requirements, which seriously affects the economical efficiency of the works.

It has been the usual practice to provide generators to compound up from 500 volts no load to 550 volts full load, to compensate for feeder resistance. Such design is approximately correct for lighting and power distribution, but for small tramway systems it has little practical advantage, as the maximum load on one feeder may and frequently does occur at the same time as the minimum load on another. A constant pressure of 525 volts at the generating station will give the least variation at the cars, taking the system as a whole.

If there is one class of supply more than another where storage batteries can be used to advantage it is in connection with small tramway systems, but to enable the battery to be commercially successful in operation some regulating device is necessary to compensate for the difference in battery terminal pressure between the limits of full charge and full discharge. A considerable amount of attention has been given to the design of apparatus to obtain automatic battery regulation, and the cheapest and best method now in use is the reversible booster. With such a machine the full regulation mentioned above can easily be obtained, the line pressure can be kept nearly constant, and the generating plant run at practically constant load.

To supply a tramway of the size under consideration, a battery having a capacity of 250 kilowatts at the one-hour rate controlled by a reversible booster will be found an economical addition to the plant. It will then be possible to deal with the normal maximum loads of 465 kilowatts with the battery and one 250-kilowatt generating set running practically at constant two-thirds full load, instead of two 250-kilowatt sets each with a varying load averaging only one-third full load.

In a paper entitled "Economic Considerations in the Employment of Storage Batteries," read last session before the Manchester Section of the Institution of Electrical Engineers, J. R. Salter stated that there was no commercial advantage in using batteries in conjunction with steam plant when supplying power to a tramway undertaking using twenty-eight cars, and in support of his contention put forward the steam-consumption results obtained on steam plant when working with and without a battery. The conclusions arrived at by Mr. Salter did not appear such as could be generally applicable to other undertakings on account of the particular arrangement and cost of the plant tested. To obtain further information on the matter, the writer has carried out a number of tests on the plant under his charge, which is somewhat similar in size. The tests have been made to ascertain: (1) the cost per unit sold when running one 250-kilowatt set with a battery; (2) the cost per unit sold when running two 250-kilowatt sets without a battery; (3) the cost of running one 250-kilowatt set excited, but without load, including auxiliaries, such as condensers, pumps, etc. The object of the last test was to find the cost of running steam plant with little or no load in the early hours to supply workmen's cars and later at night for taking cars to the shed, which running is avoided if a battery is used.

The extra steam consumption when running two sets and auxiliaries without the battery compared with one set and auxiliaries with the battery was 4.75 pounds per unit sold. With an evaporation of 7.5 pounds water per pound of slack and an output of 1,106,267 units this represents 234 tons of slack per annum, which, at a price of 7*s.* 3*d.* per ton, will be worth, say, £85. The steam consumption when running one set excited without load, together with auxiliaries, was 1,420 pounds per hour. With a battery installed, it should be possible to reduce the running hours of the plant at least one and one-half hours a day, or 547.5 hours per annum. The saving will then be 780,000 pounds steam per annum. Allowing for the same evaporation, this gives forty-six tons of slack per annum, worth £17. The total gain in fuel is therefore 280 tons per annum of a value of £102. It may be noted in passing that the value would be double that amount if the price of coal was 14*s.* 6*d.* instead of 7*s.* 3*d.* If one set of plant is run instead of two there will be a further saving in oil and stores, repairs and wages of attendant, as the cost under these headings does not depend on output so much as on the actual running hours. These may be taken as follows: oil and stores, £35 a year; re-

Digitized by Google

pairs, £40, and attendance, £25; a total of £100 a year. The payments under a maintenance agreement for a period of years on a battery capable of giving 250 kilowatts at the one-hour rate would be about £150 per annum. The savings shown above in running one set of plant instead of two, total up to £202, so that there is a clear gain in favor of the battery of £52 per annum.

Charges for Supply—The addition of a tramway load to a small existing lighting and power station undoubtedly has a beneficial effect on the costs of the producing department. This is not necessarily due to the tramway load in itself or to an increase in the load-factor of the station, if such occurs, but is the result of the relatively large increase in the output when the tramway is started. The reduction in cost would probably be quite as much if the increased output was for light and power. Without wishing to depreciate the influence that high load-factor has on the question of economical generation, the writer is inclined to think that sufficient importance is not attached to the effect of a large increase in the output. Published records only show the result of tacking on a tramway load to an existing light and power station; it would be interesting to see the result of adding a large power and lighting load to an existing tramway station. Although the combined load-factor conditions would probably be worse, there is no doubt the cost sheet would show useful reductions.

From time to time the writer has had to go carefully into the charges for tramway supply. In order that the matter may be discussed the following particulars relating to an undertaking, together with the method employed of allocating the costs, are given herewith.

The total capacity of the plant installed is 1,760 kilowatts, and the generators are suitable for a direct-current working pressure of 440 to 525 volts. The capital expenditure to the end of March, 1906, was as follows:

Site and buildings	£14,634
Generating plant and accessories	35,587
Mains, meters and public lamps, etc.	34,447
Total	£84,668

	Light and Power.	Tramways.	Total.
Output	763,293	1,106,267	1,869,560
Maximum load	468 kilowatts	676 kilowatts	1,144 kilowatts

The cost sheet for the year ended March last is as follows: coal, £1,642; water and stores, £220; wages, £1,011; repairs, plant, etc., £555; repairs, mains and meters, £390; rates and taxes, £568; management, etc., £1,042; interest and sinking fund on the whole of the capital, £5,254; a total of £10,682. Several of these items will, however, require revision before allocating them as charges against either lighting or tramway supply. The capital expenditure on mains, etc., of £34,447 is exclusively for light and power. This represents a payment for interest and sinking fund of £2,138, which, deducted from £5,254, leaves £3,116. Repairs to mains, meters, etc., at a cost of £390 and £30, included in management expenses for collecting light and power accounts, must also be eliminated from the cost sheet so far as the tramway department is concerned. Rates and taxes, management expenses, etc., depend principally on capital expenditure, so that a reduction from the sum of £1,580 must be made in the proportion that the capital outlay on mains bears to the total capital. This works out at £643, leaving £937 as the charge on account of the generating station and equipment. The total amount to be divided between lighting and tramways is therefore £7,481, made up of works costs, £3,428; rates and management, £937; interest and sinking fund, £3,116.

Dealing first with the costs for rates, management, interest and sinking fund, these charges are due to capital expenditure, and as lighting has demanded 468 kilowatts, and tramways 676 kilowatts, the allocation will be £2,395 to tramways and £1,658 to lighting, etc.

It is impossible to divide up the working costs without taking into consideration the load-factor of the different classes of supply. The term "load-factor" as usually used is the percentage obtained by dividing the actual output by the possible output, assuming the maximum load was used twenty-four hours a day. In the writer's opinion the figure obtained in this way is quite useless as a guide to the economical capabilities of a works. The maximum load invariably occurs during the month of December and is of short duration. It may be quite abnormal on more than one occasion without having any effect whatever on the total capital charges for the year or on the working expenses, yet the load-factor taken from this maximum load is commonly used as being the important factor governing the costs for the whole year. An average of the weekly load-factors would give one a good idea of the conditions under which a station is run if the plant is in regular use for twenty-four hours a day; but where batteries are installed and the steam plant entirely shut down for several hours, it would still be misleading.

To show the difference in the load-factors when worked out by the two methods mentioned above, the values are set out below:

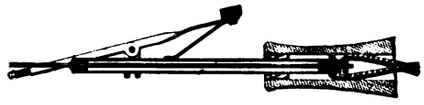
	Tramways. Per Cent.	Lighting. Per Cent.	Combined. Per Cent.
Load-factor	18.6	18.6	18.6
Average weekly load-factor	24.5	26.7	25.3
Maximum " "	29.6	32.8	29.8
Minimum " "	17.6	19.3	20.9
Average weekly plant load-factor	32.0	36.5	32.1
Maximum weekly plant load-factor	38.6	46.1	39.1
Minimum weekly plant load-factor	24.8	32.0	27.0

Assuming that the contention put forward is correct, we have now to divide up the works costs of £3,428 on the basis of a 36.5 per cent plant load-factor for lighting and thirty-two per cent for tramways. The works costs divided by the total output gives an average cost of 0.44*d.* per unit. Plotted out on a load-factor curve it will be found that the difference in cost between a thirty-two and 36.5 per cent load-factor is about four per cent. The cost of the tramway units will therefore be rather less than 0.45*d.*, say, a total of £2,060, and the lighting units slightly more than 0.43*d.*, a total of £1,368. The total cost of the tramway supply is therefore £4,455, equal to 0.966*d.* per unit, made up of works costs £2,060 and rates, management and capital charges, £2,395. The charge made for the tramway supply has been £5,300, at an average price of 1.15*d.* per unit, metered at the switchboard. Deducting the cost from this amount there is a balance of £845 left for depreciation. In some towns the supply department has provided the tramway feeder cables and has consequently to include in the price a sum to cover the capital costs on such expenditure and also repairs. The capital for this work has in this case been found by the tramway department and the maintenance is also carried out at their expense. It may, however, be of interest to state that these charges would add 0.11*d.* per unit to the cost mentioned above, so that the inclusive cost of the energy delivered to the trolley wires has been 1.26*d.* per unit.

Digitized by Google

Electrical Patents.

An improved electric igniter has been invented by Henry M. Kolb, Philadelphia, Pa. (825,664, July 10). This invention consists of a new and useful electric igniter which is adapted for use in connection with gas stoves and the like, or may be employed for igniting gases for other purposes. The invention consists of a handle, a tube secured therein and forming part of the electric circuit, a rod within the tube projecting therefrom and

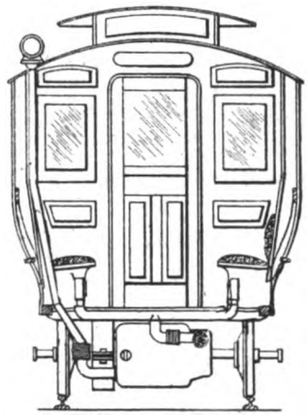


ELECTRIC IGNITER.

forming another part of the electric circuit, a contact device supported by and pivoted upon the tube in electrical contact with the tube and arranged to move transversely of the rod to make contact therewith and insulation between the tube and rod at the outer end of the tube, maintaining their relative positions.

Garrison Babcock, of Chicago, Ill., has obtained letters patent of the United States, No. 824,701, dated July 3, 1906, for an improved multiparty line exchange system, and he has assigned the same to Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y. The invention relates to multiparty telephone exchange systems, and has for its object improved central exchange apparatus and connections whereby the central operator may more readily establish circuit conditions necessary for such systems. The invention consists in the combination with a central exchange, of telephone lines leading therefrom, a plurality of substations connected with each line, a source of current and circuit-changing mechanism, whereby current impulses are sent into the associated lines to actuate the substation apparatus connected therewith. Means are provided at the exchange for automatically grounding the source of current only at predetermined numbers of current pulsations, whereby the substation apparatus is connected with said source of current and actuated thereby. Keys are provided for sending a current of opposite polarity to restore all the substation apparatus to its normal condition after actuation thereof.

Harold W. Buck, Niagara Falls, N. Y., has obtained a patent (825,298, July 10) for an improved electric car heater, which he has assigned to the General Electric Company. This invention relates to electric railways, and its object is to provide means whereby an electric railway car can be heated by utilizing the energy otherwise lost in heating the motor windings. Heretofore it has been customary to heat an electric railway car by means of resistance coils located under the seats or at any other convenient point in the car. In cold weather the amount of energy required to operate these heaters is frequently as much as fifty per cent of that required to drive the car. The load on the generators is therefore very greatly increased when the heaters are used, and any device which enables a part of this load to be removed is of great practical value. In the operation of an electric motor considerable heat is generated in the motor windings—so much that the problem of keeping the motor cool has engaged the attention of many engineers and inventors. The invention aims to utilize this heat for warming the car and

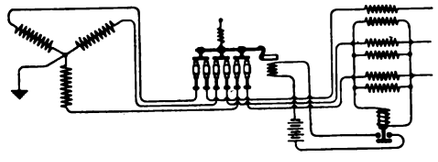


ELECTRIC CAR HEATER.

at the same time prevent the motor from getting overheated. To this end the invention consists in certain devices whereby the heat generated in the motor windings is conveyed into the car, preferably by a current of air, a supply of fresh, cool air being constantly supplied to the motor casing and the heated air conducted away to registers in the car. Means are also provided whereby the hot air can escape into the outside air without entering the car in case the weather is so mild as to make the heating of the car unnecessary.

Wilbur B. Driver, of East Orange, N. J., has obtained letters-patent of the United States (824,103, June 26, 1906) for an improved alloy. The invention consists of a new and useful improvement in alloys or compounds of copper-nickel and manganese which are designed primarily for use as electrical resistance to take the place of materials heretofore used for that purpose, especially German silver, which has for many years been regarded as a standard material for the purpose, but which possesses many disadvantages that are eliminated by using the alloy of this invention. The object is to produce an alloy that shall not only have a high and practically constant resistance, but one that is permanent and stable in its physical and electrical properties. The particular disadvantage of German silver is that after repeated heatings and coolings in service it crystallizes and breaks. This is due to the presence of zinc and is not an infrequent occurrence in any alloy of which zinc forms a considerable part, and for this reason zinc is omitted in the new alloy. "Eighteen per cent German silver," the grade most frequently used, is composed of eighteen to twenty parts nickel, ten to twenty-five parts zinc and fifty-five to seventy-two parts copper. In the improved alloy about the same proportions of copper and of nickel are used, but the zinc is replaced with about five parts of manganese. This makes an alloy consisting of about seventy-five parts copper, twenty parts nickel and five parts manganese. Nickel and manganese each has the effect of increasing the resistance of the alloy, the manganese, however, to a much greater extent than the nickel; but manganese has a tendency to make the alloy unstable, and therefore a considerable amount of nickel—ten per cent or more—is used for the purpose of "fixing" the electrical qualities of the resultant alloy.

Ernest F. W. Alexanderson, Schenectady, N. Y., has obtained a patent (825,286, July 10) for an improved ground detector and cutout, which he has assigned to the General Electric Company. The invention relates to protection against grounds of three-phase systems having a grounded neutral point, and its object is to provide protective means for detecting grounds or cutting out grounded lines or both, which is more sensitive and reliable than the devices heretofore employed. The invention consists of a three-phase system with grounded neutral point, parallel lines, relays at each end of each line, connections for supplying to each relay a current proportional to the algebraic sum of the currents in the three phases at each end of the line, means controlled by each relay for opening the circuit of the line at that end, and means for retarding the movement of the relays.



GROUND-DETECTOR AND CUTOUT.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

"Roaring" or "Corrugated" Steel Rails.

G. Moyle, engineer-in-chief of the Eastern Bengal State Railway, is the author of a technical paper on the above subject issued by the Indian government. "Roaring" may be defined as the noise caused by the development of furrows across the running head of a rail, usually oblique to its length, the tops of the furrows being very hard and the bottoms soft. Such rails are also described as "corrugated." They do not in the least resemble pitted rails. The common objection to these rails is that they occasion a deafening noise when trains are passing over them which causes great discomfort to passengers. To give an impression of how objectionable the noise is it may be stated that two persons can not possibly converse even by shouting when running over a continuous section of these rails. The engineers of Indian railways have had "roaring" rails under observation for the past eight years, but up to the present time no definite conclusion has been formed as to the real cause of the phenomenon, and no manufacturers' specifications have been drawn with a view to producing a metal likely to be exempt from its development. The paper is written for the purpose of bringing the phenomenon to the notice of rail experts, with the hope that a remedy for it may be discovered. The mean pitch of the corrugations has been found to be 0.74 inch, and the mean depth, 0.0035 inch. Both double-headed and flat-footed rails develop this phenomenon. It is not confined to any particular section. It is developed in rails rolled by various manufacturers, and develops with equal facility on banks or cuttings, grades or levels, straights or curves. It appears to be found more generally in extremely damp climates, especially when the atmosphere contains salt brought from the sea. It develops most rapidly where brakes are frequently used, but it is not necessarily produced by brake action, since it exists abundantly in parts of tracks where brakes are never put down. "Roarers" are almost invariably developed where the track is packed and boxed with brick or burned-clay ballast and on open-girder bridges, but they are scarcely ever found where the ballast is stone, and never where the track is packed and boxed with earth. On brick-ballasted road they can be made smooth if the brick boxing is removed and replaced by earth. The trains then wear the rail smooth. "Roaring" has only been found in steel rails and never in an iron rail. The ridges of a "roaring" rail resist a file, but the metal in the hollows is removed quite easily. Many explanations have been suggested by various engineers as to the cause of "roaring." An idea of the extent to which this phenomenon can develop under favorable conditions has been shown by an inspection of a section of single track on the Eastern Bengal State Railway between Dacca and Mymensingh, twelve and one-half miles long. All the rails were carefully counted, and it was found that eighty-nine per cent were "roarers." The traffic in this section is light, the speed low and the track maintenance excellent. No continuous brake is or ever has been used. On the other hand, the section examined is brick-ballasted, the climate is extremely moist, the rainfall excessive and the atmosphere is said to be charged with salts.—*Abstracted from the Mechanical Engineer (London), July 7.*

International Science.

Within the last century many problems have become urgent which could not be solved without some international agreement, and special organizations have come into life which have rendered a service, the importance of which can not be exaggerated. In a discourse delivered at the Royal Institution, London, May 18, Professor Arthur Schuster holds that international combination has become so necessary, and organizations have in consequence increased to such an extent, that they begin to overlap, and there has been some danger of mutual interference. Fear has also been expressed that any attempt to advance knowledge by an organized combination of workers might discourage private efforts, and therefore do mischief rather than good. Three types of international organizations may be distinguished. The first aims merely at collecting information, the second is intended to fix international units or to initiate agreements on matters in which uniformity is desirable, while by the third type of organization a more direct advance of knowledge is aimed at and research is carried out according to a combined scheme. The best example of an organization formed for the purpose of collecting information is furnished by the undertaking initiated by the Royal Society, having for its object the systematic cataloguing of scientific literature, both according to subjects and authors. Twenty-nine countries are actively participating in this work by furnishing slips containing the entries which form the basis of the catalogue. A still larger number of countries assist by subscribing to the annual volumes. The total number of slips received up to March, 1906, is about 700,000. The governing body of the catalogue is an international council composed of one representative from each of the countries taking part in the scheme. Passing on to an undertaking of a very different kind, but which must be included in the class which primarily aims at cataloguing, is the accurate determination of the positions of the stars for a particular period. This is a work which must precede all exact investigations of their proper motions, hence it constitutes a fundamental problem of astronomy. The multitude of stars seen on a bright night is bewildering to the casual observer, but when an actual count is made it is found that their number is really moderate, and it is doubtful if more than 2,000 stars have ever been visible to the naked eye at the same time. The international star catalogue, which is at present being constructed, owes its origin mainly to the hard work of Mouchez. The programme of work was determined upon at an international conference which met at Paris in the year 1887. Eighteen observatories were to take part in the work. Each observatory had a certain region of the sky assigned to it and undertook to cover this region four times, twice with plates of short exposure, twice with plates of long exposure, and to measure all the stars appearing on the short-exposure photographs. The long exposures were intended for reproduction in the form of charts. As there are about 400 stars on each plate, and it takes about 600 plates to cover the share of one observatory once, this means that each observatory has to measure nearly half a million star places, and that the complete catalogue will give the positions of nearly 4,500,000 stars. This includes all stars down to the eleventh magnitude. It is calculated that the series of maps, which it is hoped will be completed, will form a pile of paper thirty feet high, weighing about two tons. Pass-

Digitized by Google

ing on to those undertakings which are intended to fix standards of measurement or to establish a general agreement on matters in which uniformity is desirable, the foremost place in this division must be given to the Bureau Internationale des Poyds et Mesures, which was established in the year 1873 at Sevres, near Paris. This bureau was the outcome of an international commission constituted in 1869, which had for its object the scientific construction of a series of international metric standards. The work carried out at Sevres is not confined to the reproduction of metric standards, but measurements of precision in various directions have been made with conspicuous success. Scientific thermometry owes much to the international bureau, and, in some respects, it may be said that exact thermometry was created there. Professor Michelson's work, in which the length of the metre was compared directly with the length of a wave of red light, is another classical investigation carried on in the laboratories of the international bureau. There are other deficiencies of uniformity which perhaps appear trifling, but which lead to the waste of a good deal of time. Such, for instance, is the position of the index in scientific books. It is time we turned to the more serious aspect of those international associations which directly aim at an advance of knowledge. It is worth while investigating the extent of the direct knowledge of a third dimension. The question of measuring the size of the earth, geodetic work and other researches are all very prominent examples of the need for and value of international investigation.—*Abstracted from Nature (London), July 5.*

Interference in Wireless Telegraphy.

Professor R. A. Fessenden divides tests on cutting out interference into two classes —pseudo tests and tests properly so called. The pseudo test is a test made under conditions which have no bearing on the practical question and in which practical working obstacles have been carefully eliminated. A test properly so called is one made under practical conditions. He shows the difference between a pseudo test and a real test, and concludes that the pseudo tests have no bearing upon the real question as to whether wireless telegraph stations can work selectively. The statement has been frequently made that disturbing stations can be cut out by tuning. These statements were at first accepted by the general public and also by many engineers, but when the fact became known that interference still caused trouble the previous attitude of unquestioning belief changed to one of complete incredulity. When a certain company requested of the United States Navy Department in 1902 an opportunity to show that interference could be cut out it was informed by the department that nearly every other company was claiming the same thing and that in every case where the matter had been investigated it had been found that interference could not be cut out, and that the department attached no importance to statements of that kind. While Professor Fessenden considers that the action taken by various governments in regard to wireless telegraph work has been of a most oppressive and unfair character, at the same time he is free to admit that the wireless companies, considered as a whole, have only themselves to blame for the situation. Several years ago he pointed out that selectivity can never be accomplished by tuning. The amplitude of the oscillations in the resonant circuit can not increase indefinitely, for when the point is reached at which the losses in the resonant circuit become equal to the energy received by the resonant circuit, no further increase is possible. Assume that the resonant receiving circuit has an efficiency of ninety-nine per cent—that is, it wastes only one per cent of the energy which it stores up. This, it will be admitted, is a pretty high efficiency. Then, in this case, the strength of the signals at the resonant point will be one hundred times the strength away from the resonant point. He states that even with a resonant receiving circuit having an efficiency of ninety-nine per cent, an interfering station within ten per cent of the distance of the sending station will prevent the receipt of messages. This is approximately what is found in practice. In fact, in the United States Navy tests it was found that the interfering station prevented the reception of messages by all systems tested which depended upon tuning for selectivity, when within twenty per cent of the distance of the sending station. Ten or fifteen years ago, when the question of multiplex working by alternating currents came up, the question of loose-coupled circuits attracted a good deal of discussion. At first loosely coupled circuits were quite generally used in experiments on electrical oscillations, but those familiar with the laws of optics soon saw that, in most cases, it was advisable to use tightly coupled circuits. The electrical explanation of the phenomena of coupled circuits is comparatively simple. Let A be an oscillating circuit having a natural frequency, X, and let the circuit, B, whose natural period is also X, be brought into inductive relation with the circuit, A, so that B forms a secondary of which A is the primary. From the usual formulae it can be shown that the currents in the two circuits are not in the same phase. This being the case, the current in each circuit can be split up into two components, two of these components being in opposite phase to each other, and the other components being in the same phase. The two circuits, A and B, will therefore have two values of their coefficients of self-induction, according as we consider components in phase with each other or opposed to each other. There will, in general, be two natural frequencies for each of the circuits. There are two cases in which the two circuits have but a single frequency. The first case is when the coupling is infinitely tight, when there is no magnetic leakage between circuit A and circuit B; and the second case is where the coupling is infinitely loose. Unless the coupling between the two circuits is either infinitely tight or infinitely loose there will always be two oscillations of different frequencies. The advocates of loose couple have grasped the fact that by reducing the strength of the coupling between the two circuits, the frequencies of the two oscillations may be made to approach each other; but they have not grasped the fact that as the strength of the coupling is weakened and the frequencies made to approach each other, the transference of energy diminishes in a still greater degree, and that when finally the two frequencies are made to coincide, the primary circuit transfers no energy to the secondary circuit. Another vital point which the advocates of loose coupling have not grasped is the fact that even with a very small coefficient of couple, the difference between the frequencies will still be much too great for practical work. With the present methods of cutting out interference a difference of frequency of one and one-half per cent is a large difference, and in the author's work between Scotland and Massachusetts a difference of one-quarter per cent in frequency was sufficient to cut down the intensity of the signals more than twenty times. If the circuit were coupled so loosely that the maxima of both frequencies differed by less than one-quarter per cent, the amount of energy transmitted or received would be very little indeed.—*Abstracted from the Electrical Review (London), July 6.*

Digitized by Google

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

THE COMMERCIAL DEVELOPMENT OF ELECTRICAL UNDERTAKINGS.

At the recent meeting in London of the Incorporated Municipal Electrical Association, a paper on "The Commercial Development of Electrical Undertakings" was presented by H. Collings Bishop, borough electrical engineer and tramways manager, Newport (Monmouth), England, from which the following abstract is taken:

Advertising—The author considers the first step is to compile a good "brochure," which will put before the public, in a simple way without technicalities, the advantages to be derived from the use of electrical energy. Newport has been especially successful in this respect, having published, a few months ago, a book which has met with universal approval. It contains from seventy to eighty pages of reading matter. A number of pages are taken up with views of various premises belonging to consumers of electricity in the district. The brochure was compiled by the secretary of the electricity department, and is partly original and partly derived from information given by engineers of various electrical stations. The revenue from advertisements paid all publication expenses, and enabled the department to distribute some thousands of free copies to likely consumers. Another good form of advertising, in the author's opinion, is to send out picture postcards containing photographs of new additions to the consumer's register. Yet another means of advertising, and one that serves a canvasser as an introduction, is a series of letter circulars, dealing with the supply of energy for power, lighting, heating and cooking.

Canvassing—For this purpose a man must be found who, if possible, is well known in the town, and who possesses a thorough knowledge of his subject. He should be a good talker, and should be one who does not easily accept a rebuff. His mode of operation might be as follows: to make himself well acquainted with all the details of the consumption of current and the type and size of installations of all the most important consumers; to be thoroughly conversant with the relative costs of current used by the different classes of consumers; to be able to give the cost of current per hour of the various forms of illuminants, and to compare the other ways of obtaining power with that of electricity. A canvasser should have sufficient technical training to be able to give a prospective consumer some idea of his own requirements.

Exhibitions—These the author has found to be of the utmost value in promoting the development of an electrical undertaking. In the autumn of last year the local gas company at Newport, which is a keen rival of the electricity department, held what they called a gas exhibition. This, in effect, appeared to be a demonstration of inverted and intensified incandescent gas light and cooking stoves, accompanied by an almost unbearable heat, which amply demonstrated the heating power of gas. This heat was to some extent lessened by the introduction of electric fans. Shortly after the gas exhibition, a resolution was passed to hold an exhibition of electrical apparatus especially suited to the requirements of consumers of current derived from the central station. The committee obtained the use of the largest hall in the town, in which they were able to erect nineteen stands. These were allotted to the various contractors of the district, several being retained for the corporation's own exhibits. In view of the decision of the Manufacturers' Association regarding country exhibitions, the author was at first rather afraid of the response he would receive when asking for the loan of apparatus; he, however, found the majority of the manufacturers extremely willing to help. In only a few cases was a refusal given, and in most cases the only condition imposed was that the carriage of the goods sent should be paid by the committee. The exhibition was opened in January, a small string band during the afternoon and evening being provided as an extra attraction to visitors. There was also a tea room, in which all the tea and coffee was made in electrically heated vessels. The exhibits mainly consisted of electrical fittings, various types of radiators and convectors, and many different forms of incandescent lamps, arc lamps, flame lamps, etc. There were also decorative devices for tables and shop windows.

The exhibition lasted for a week, and the building was packed during the whole time it was open. No charge was made for admission. The total cost of the exhibition, after deducting the proceeds from the letting of spaces, and the small sum derived from the sale of current, was under £250. The effect of the exhibition was immediately felt in a large increase in the connections to the mains. The author can conceive no better means for the development of an electrical undertaking than such an exhibition.

Charges—As one of those who some years ago adopted the Brighton system of charging, the author has, after several years' trial, come to the conclusion that (equitable system as it is) it is not one that tends to further the development of an electrical undertaking. The system is difficult to explain, and one that, even if understood, is not appreciated. A charge by a sliding-scale rate seems to the author to be the correct solution of the problem, and the load-factor of the various classes of consumers should be taken into consideration in the arrangement of this scale.

As regards the charges for power, the author would make a maximum rate of three and one-half pence per unit for current used during the few hours of maximum demand, and one penny per unit during the whole of the rest of the day or night. This system has been used with conspicuous success in Newport; consumers of a large amount of current who have a load-factor of not less than twenty per cent should be charged eight pence per unit. Consumers of power should be given a specially low lighting rate, so arranged that it becomes possible for the largest consumers to have a uniform rate for both lighting and power. With reference to the charges for heating, the author considers the rate of one penny per unit the most satisfactory.

The question of the supply of wiring and fittings on the hire or hire-purchase system is one that is fraught with a good many difficulties, owing to the fact that it is often hard to make a mutual agreement with both tenant and landlord; such an agreement being very necessary in order to facilitate the removal of fittings, should the hiring agreement be cancelled. It is also very important that some system of wiring, that is unobtrusive and at the same time easily removed, should be adopted for use where there is a hiring agreement, and the author hopes some new suggestions on this point will be forthcoming.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Horizontal Type Direct-Current Curtis Steam Turbine Generators.

The accompanying illustrations show several views of the horizontal-type direct-current Curtis steam turbine generators placed on the market by the General Electric Company, Schenectady, N. Y. These units are now extensively used in commercial service, and are built in sizes of fifteen kilowatts, twenty kilowatts, twenty-five kilowatts, seventy-five kilowatts, 150 kilowatts and 300 kilowatts capacity, and can be arranged either for non-condensing or condensing operation. The fifteen, twenty and twenty-five-kilowatt sizes are equipped with two bearings and have a single-piece shaft, and the larger sizes with four bearings and a two-piece shaft connected by means of a flexible coupling. Fig. 1 shows a turbine generator of 150 kilowatts capacity. The speed is 2,000 revolutions per minute, the voltage 125 or 250, the length sixteen feet and the weight 25,500 pounds. In the illustration the turbine is shown without the sheet-iron lagging, to demonstrate the construction of the wheel casing. This turbine may also be connected to two seventy-five-kilowatt generators for three-wire operation.

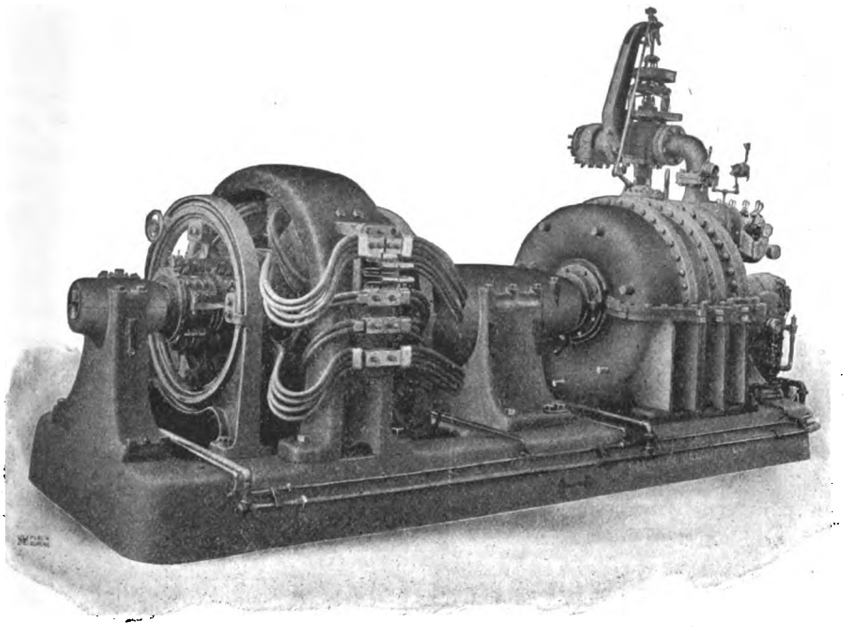


FIG. 1.—150-KILOWATT, HORIZONTAL TYPE CURTIS TURBINE-GENERATOR.

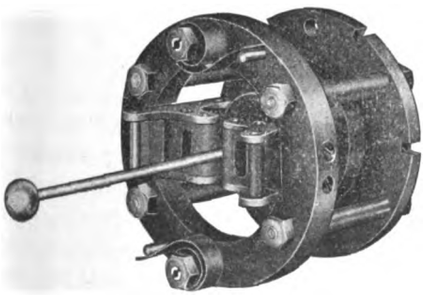


FIG. 4.—GOVERNOR.

The generators are of the most improved type and embody special features particularly adapting them for turbine units. The turbines built for condensing operation will have their full rated capacity when operating non-condensing. As there are no exhaust valves on the turbines, and as the exhaust passages are large, a high vacuum can readily be maintained. As no cylinder or other internal oil is used, the exhaust steam is free from oil.

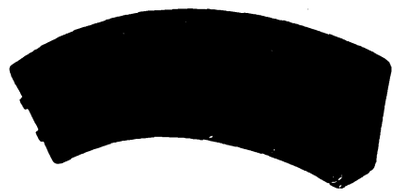


FIG. 2.—TURBINE NOZZLE.

Oil is supplied to the bearings at a slight pressure by means of a pump driven from the main shaft, supplemented by oil rings, or, in the smaller sizes, by oil rings alone.

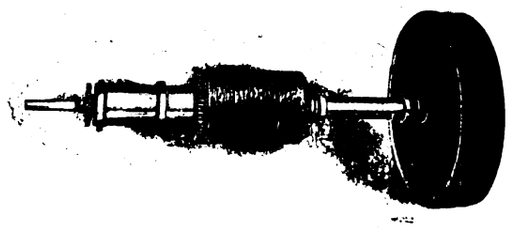


FIG. 3.—TWENTY-FIVE KILOWATT TURBINE WHEEL AND ARMATURE.

The speed is controlled by means of a centrifugal governor mounted directly on the end of the turbine shaft. This governor, through a suitable valve arrangement, controls the supply of steam entering the turbine, the speed being maintained practically constant independent of the amount of power supplied by the generator. In addition to the regular governing mechanism, an emergency governor is supplied, which immediately shuts off

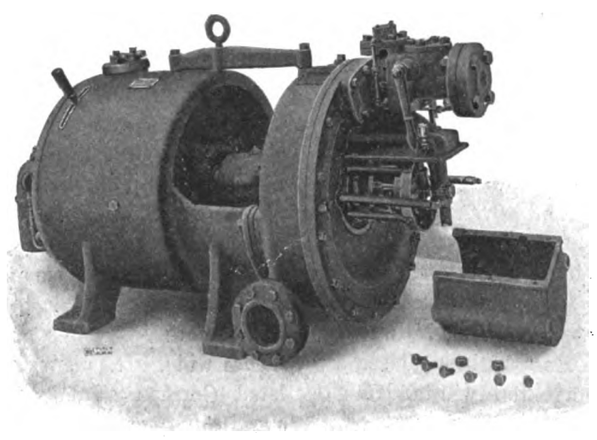


FIG. 5.—TWENTY-FIVE KILOWATT, HORIZONTAL TYPE CURTIS TURBINE-GENERATOR.

Digitized by Google

the steam supply if, through some abnormal condition, the speed should rise some predetermined amount above normal, preventing the machine from attaining a dangerous speed.

Foundations of but moderate size are required, due to the light weight and small size of the turbines and the absence of reciprocating parts. The smaller sizes may be arranged to operate at any steam pressure above eighty pounds, and the larger sizes at any pressure above 100 pounds. Superheated steam may be used, superheated to about 200 degrees Fahrenheit.

Fig. 2 shows the turbine nozzle, Fig. 3 a twenty-five-kilowatt turbine wheel and armature assembled on the shaft, Fig. 4 the governor, and Fig. 5 a twenty-five-kilowatt turbine generator for all classes of interior service. This machine has a speed of 3,600 revolutions per minute, a voltage of 125 or 250, a length of six feet and weighs 3,600 pounds.

The Electrical Equipment of the Indiana Steel Company, Gary, Ind.

The new Gary (Ind.) steel plant of the Indiana Steel Company when completed will be one of the largest adaptations of motor-driven apparatus in the country. It is estimated that the plant will be able to handle substantially 5,000,000 tons of ore a year, producing annually approximately 2,500,000 tons of steel. There will be sixteen blast-furnaces of 450 tons daily capacity each and eighty-four open-hearth furnaces each with a capacity of sixty tons. The necessary electrical generating equipment capable of handling such an output will have an initial capacity of 18,000 kilowatts. The plant will be so designed that extensions may be added indefinitely. Of the initial equipment, 14,000 kilowatts will be in 2,000-kilowatt, twenty-five-cycle, 2,300-volt units, and 4,000 kilowatts in 2,000-kilowatt, 250-volt, direct-current units. These generators have been ordered from the Allis-Chalmers Company, Milwaukee, Wis. The generators will be driven by Allis-Chalmers horizontal twin tandem gas engines.

The power-house building for the present is to be approximately 700 feet long, with a span in the main building of eighty-eight feet. An eighteen-foot extension under the same roof through the entire length of the structure has been planned in order to provide room for high-tension switches. The power-house will be located immediately adjacent to the blast-furnace blowing engine houses and between the blast-furnaces and the open-hearth furnaces.

A New Form of Flashing Sign.

The accompanying illustration shows the "Flash-I-Do" advertising sign, placed upon the market by Lindstrom, Smith Company, 59 Dearborn street, Chicago,

FLASHING SIGN.

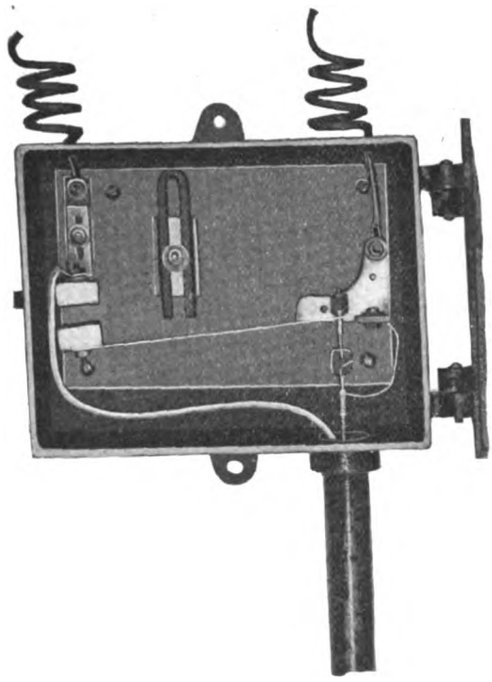
Ill. This is a double sign having a glass face on each side. It is equipped with a swivel socket, enabling the user to place it in any position. The signs are made of iron plate finely enameled white on the inside and black on the outside. They are provided with twenty-four five-sixteenths-inch holes around the edge, which serve to ventilate the sign. The swivel plug, which is especially made for these signs, is three and one-half inches long, and is made of porcelain with a brass cap on the outside to make connection with the socket. The plug has a corrugated rim around the top which makes it turn easily. There is a metal tube fastened to the body of the sign, and in this tube the swivel socket is placed in such a way that the sign never needs to be turned in fastening it to a socket. There is a socket fastened on the tube on the inside for holding the lamp. This is placed so that the lamp will always be in the centre of the sign.

The automatic thermostat or flasher is mounted on a porcelain base five and one-half inches long and one and one-half inches wide. It is wound with fine insulated German silver wire, insulated to stand any current up to 250 volts. The contact points are made of pure platinum and are fitted with an adjusting screw, by means of which adjustment can be made so that the thermostat will flash either fast or slow or make the lamp burn steady.

The frame holding the glass in place is made of brass, highly polished and lacquered. It is fitted with three brass thumbscrews on the side for maintaining the glass in position. The sign is furnished with ground glass plates and the letters making up the sign may either be painted or gummed on the glass.

The "Hylo" Flasher.

The accompanying illustration shows a new form of flasher which the Phelps Company, Detroit, Mich., has placed upon the market. This flasher is designated as the "Skedoodle J." The operation of the flasher is easily understood from the illustration. In the "Skedoodle J" the manufacturer utilizes the sticking of the magnet to ensure a very clean make and break. The current normally passes from the terminal stud on the left through the carbon contacts across the spring of the flasher and out through the terminal stud



"SKEDOODLE J."

at the right-hand side, which completes the main lighting circuit. A shunt-circuit will be noticed passing around the lower carbon block and including a resistance winding about a rod, the resistance winding terminating at the stud at the right-hand side of the flasher. The permanent magnet tends to draw the lower carbon block into contact with the upper block. The tension on the wire rod, however, holds the blocks separated until the current passing through the resistance wire heats it so that, upon expansion taking place, the carbon blocks are pulled together and held tightly closed by the sticking effect of the magnet until the contraction of the rod is sufficient to pull the carbon blocks apart with a clear break. The illustration shows the single-pole

Digitized by Google

type of "Skedoodle J." This type has been built to carry as high a current as thirty-five amperes experimentally, and twenty-five amperes for a steady load. This single-pole type, however, will probably be standardized at six amperes' capacity, and a similar design with a double-pole construction will be placed upon the market for twenty-five amperes' capacity.

Allis-Chalmers Company and the Manufacture of Christensen Air-Brakes.

Since the announcement, made some weeks ago by the Allis-Chalmers Company, Milwaukee, Wis., of the acquisition of exclusive rights to build and sell Christensen air-brakes, the company has been busily organizing its new department for the extensive manufacture of this well-known device.

J. H. Denton, who was general superintendent of the National Brake and Electric Company, has been engaged to act as manager of the new air-brake department, and he will be surrounded by a staff of men who have been especially trained in this branch of manufacture. Shop facilities are being provided as rapidly as possible, and it is expected that shipments may be made from stock within seventy-five days from date. The entire second floor of the north shop, "Reliance" works, Milwaukee, now occupied by the company's general offices, will be devoted to the manufacturing and assembling of air-brake equipments, following the removal of the offices to the West Allis works.

The following men, all of whom are thoroughly conversant with air-brake practice, are now associated with the Allis-Chalmers organization: F. C. Randall, formerly vice-president and general manager of the National Electric Company, for the past year has been manager of the New York district office of the Allis-Chalmers Company, and, owing to his intimate acquaintance with the manufacture and application of air-brakes, is exceptionally well qualified to advise with traction men on this subject; W. W. Power, formerly manager of the National Brake and Electric Company's Philadelphia office, was recently appointed manager of the Philadelphia district office of the Allis-Chalmers Company; George C. Voigt, formerly of the National Electric Company, has lately identified himself with the Allis-Chalmers Company and will have charge of air-brakes sales in western territory, and George C. Dresser, until recently with the National Brake and Electric Company, is to be attached to the Allis-Chalmers Company's New York office, as a special representative of the air-brake department.

American-Ball Engines and Generators.

One of the principal advantages of the American-Ball duplex compound engines is their compactness. This engine, it is stated, occupies no more floor space than a simple engine of less power. The high and low-pressure cylinders are cast together, one directly below the other. One cross-head carries both piston rods, while a single continuous valve of improved design controls the emission and exhaust in both cylinders. The emission and exhaust are simultaneous in both cylinders, securing an even distribution of the work between the two pistons.

One of the chief characteristics of this engine is the inertia governor, which maintains a speed regulation within one-tenth of one per cent from no load to full load suddenly applied. A continuous oiling system is provided, which, while not depending upon the splash principle, is said to be positive in its action.

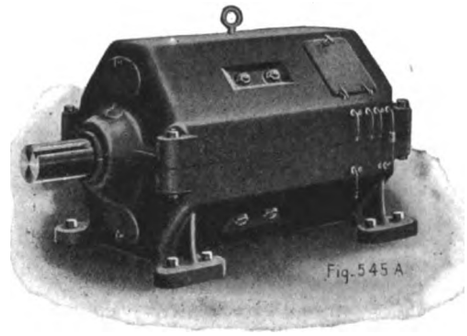
The manufacturer of these engines, the American Engine Company, Bound Brook, N. J., is specializing in the construction of complete generating sets. The American-Ball dynamos conform with the most approved principles of modern practice. Special attention has been devoted to the matter of armature ventilation. Heating is kept as low as possible by a single large air-duct dividing the armature transversely into halves. This acts as a centrifugal blower, drawing a volume of fresh air through the armature and giving thorough ventilation to the machine. The armature coils are formed of solid bar copper, wound with cotton and thoroughly insulated, allowing a large cross-section of copper.

Among recent sales may be mentioned the following: two eighty-horse-power duplex compound engines for the De Lamar Copper Refining Company, Perth Amboy, N. J.; three duplex compound engines for the E. I. du Pont Company, Wilmington, Del.; two 200-kilowatt engine-type generators to be water-wheel-driven, for the W. D. Boyce Paper Mills Company, Marseilles, Ill.

Rolling Mill Motors.

The accompanying illustration shows a new line of form "W" rolling-mill motors placed upon the market by the Crocker-Wheeler Company, Ampere, N. J. The form "W" motor is built for outputs of twenty-five, thirty, seventy-five and 100 horse-power. The parts are simple and heavy, and the strength of the parts, the manufacturer announces, corresponds approximately to the parts of ordinary motors of about twice the rated capacity of these machines.

The bearings are completely enclosed, the ends of the bearings being concealed, so that no particles of dust can enter. The motor can be completely disassembled, however, by lifting off the top half after removing four external bolts.



FORM "W" ROLLING-MILL MOTOR.

The armature is so designed and proportioned with reference to the field that the motors operate in both directions under ordinary overloads without sparking. The motors are insulated with fireproof material and can be operated in the hottest places.

The field frame is of steel, octagonal in shape, with four poles, and is divided horizontally, the halves being held by four heavy bolts on the outside. In the twenty-five and fifty-horse-power sizes removing the upper half removes also all of the brush rigging which is connected to the top half of the frame. The connections are all made outside of the shells of the machines, so as to be plainly visible and easily handled. The machines are jig made and therefore interchangeable. The frame is of the enclosed type with hand-hole covers suitably placed on the front and rear ends for inspecting the interior.

The pole shoes are built up of steel laminations and are bolted to the poles by bolts having square heads sunk in pockets on the face of the pole shoes, and with nuts on the outside of the field frame. Each foot is drilled for two heavy hold-

Digitized by Google

ing-down bolts which will retain the motor securely on its foundations.

The commutator is constructed in the usual way and insulated with the best mica. The clamping bolts are accessible from the front of the commutator, facilitating its removal.

The shafts are of forged steel turned and ground to exact dimensions. They have extensions on both ends, so that the pinion may be placed on either end and a brake on the opposite end. In case the shaft is damaged it can be removed without disconnecting the windings from the commutator, as the commutator is keyed to a sleeve extension of the flange forming one end of the armature core. The armature windings are simple and substantial, each coil consisting of a single turn without joint except where soldered to the commutator bar. The armature conductors are made of flat strip copper separated from each other by asbestos. The coils are placed below the surface of the core and held in place by wedges. No band wires are used on the armature core, except one at each end outside of the core to hold down the coil ends below the surface of the core.

The brushes are carried in cast bronze boxes clamped to large square steel studs. The brushes fit accurately in the boxes and slide in machined ways, and are held against the commutator by curved fingers actuated by coiled springs.

The motors are wound either series or compound.

The Electric Locomotives for the New York Central Lines.

Last October the first half of the 50,000-mile endurance run of the first high-speed electric locomotive, No. 6,000, built jointly by the General Electric Company and the American Locomotive Works, was completed on the test tracks of the New York Central lines at Schenectady, N. Y. On June 12 this locomotive completed the second half of this exhaustive service test. The maintenance expense per mile for the complete 50,000-mile run amounted to $0.0126. This figure includes all maintenance expense on motors, brake shoes, tires, inspection and other miscellaneous items. Moreover, the operating conditions were much more severe than those to which the thirty-five locomotives which have been ordered will be subjected. The test locomotive hauled a train averaging from 200 to 400 tons over a six-mile track, and high-speed running under these conditions involved higher braking and accelerating duty than in regular operating service.

The accompanying illustration shows eight of the thirty-five 100-ton, 2,200-horse-power electric locomotives which have been built for the New York Central lines, following the same design as No. 6,000, which has made such a satisfactory record. In all fourteen machines are now building. Of the eight locomotives shown, Nos. 3,401 and 3,402 have been shipped to New York. These locomotives have been tried out by the operating department of the New York Central Railroad and the test, it is understood, was thoroughly successful. The trials were made on a mile and a half of track at Kingsbridge. The remaining locomotives are well under way at the shops of the General Electric Company and the American Locomotive Works, and it is expected that the whole number, thirty-five, will be ready for service early in October.

EIGHT OF THE 100-TON, 2,200 HORSE-POWER ELECTRIC LOCOMOTIVES BUILT FOR THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

Gas-Blowing Engine Plant for the Indiana Steel Company.

The Westinghouse Machine Company, East Pittsburg, Pa., has secured a contract for eight large gas-driven blowing engines to be installed in the plant of the Indiana Steel Company at Gary, Ind. The machines comprised in this initial order will be uniform in size and capacity. Each gas engine as an electric unit will have a rated capacity on blast-furnace gas of nearly 3,000 horse-power, corresponding to a rating of 4,000 horse-power on natural gas. The unit will be arranged in twin-tandem fashion, each side consisting of two double-acting gas cylinders and one blowing cylinder in the opposed or *vis-a-vis* arrangement. The power cylinders are forty-two inches and the air cylinders sixty-eight inches in diameter, with a common stroke of fifty-four inches, the unit running at a maximum speed of seventy-five revolutions per minute for blowing and eighty-four revolutions per minute for electric work. The capacity of air delivery at this speed will be 33,000 cubic feet of free air per minute at eighteen pounds pressure, with a maximum pressure delivery of thirty pounds per square inch.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TACOMA GAS AND ELECTRIC COMPANY—The Tacoma Gas and Electric Company, Tacoma, Wash., has been sold to Deane & Company, of Grand Rapids, Mich., the price paid being approximately $1,000,000.

WESTCHESTER INTERESTS MERGE—A certificate of incorporation has been filed at Hartford, Ct., for the Northern Westchester Securities Company, of Bridgeport, Ct. The capital given is $2,400,000. The incorporators are: F. A. Stratton, Mount Vernon, N. Y.; Louis B. Grant, Brooklyn, N. Y., and Charles H. Werner, New York city. It is said that the new company is really a merger of the gas and electric lighting companies and trolley lines in northern Westchester and eastern Connecticut, under the management of F. A. Stratton, formerly president of the Westchester Lighting Company.

MOHAWK VALLEY COMPANY INCREASES ITS CAPITAL STOCK—The Mohawk Valley Company, Utica, N. Y., has filed a certificate increasing its capital stock from $10,000,000 to $20,000,000. The papers show that the company has issued the full amount of the $10,000,000 capital, and that it is held by the New York Central & Hudson River Railroad Company and Horace E. Andrews, the Central company holding $6,000,000, and Mr. Andrews $4,000,000. The Mohawk Valley Company is the operating company of the trolley lines which have been purchased in recent years by the New York Central, including the Utica & Mohawk Valley Railroad, the Syracuse Rapid Transit Company and the trolley lines in Rochester, N. Y.

TO BUILD NEW ELECTRIC LINE—The Fort Dodge, Des Moines & Southern Railroad Company has secured the money necessary to connect Fort Dodge and Des Moines by an electric line. A mortgage has been filed with the Old Colony Trust Company for bonds to the amount of $12,150,000 for the immediate construction of the line to connect with the Newton & Northwestern and the Ames & College Railroad. The trustee provides also for the issuance of $300,000 more bonds to be used in the purchase of real estate and $750,000 additional to be used in the purchase of coal lands. There has also been filed the transfer of the Northwestern Construction Company to the Fort Dodge, Des Moines & Southern. Homer Loring, of Des Moines, Iowa, signs the papers for the electric line.

PUEBLA PUBLIC UTILITIES PURCHASED—The Mexican Light and Power Company, Limited, has completed the purchase of the Puebla (Mexico) Tramway, Light and Power Company, which includes the electric light company and the urban tramways at Puebla. The company has also completed the purchase of the Tuxipango water power of the Rio Blanco, which is located just south of Orizaba, and which was owned by Oscar and Thomas Braniff. The Mexican Light and Power Company, Limited, intends to develop 30,000 horse-power from this river and bring it to Puebla, making the city independent of power supply from Mexico City. The work that the company will do in the matter of the electrification of the tramways, the reconstruction of the plant, and the development of the water power will mean the expenditure of about $6,000,000.

THE CINCINNATI GAS AND ELECTRIC COMPANY—Efforts are being made to obtain underwriting to the extent of $5,000,000 to carry out a plan of financing the acquisition of the Cincinnati Gas and Electric Company, Cincinnati, Ohio. Archibald S. White, formerly president of the National Salt Company, has acquired an option and lease on the Cincinnati Gas and Electric Company. He proposes to sell it to a projected corporation, to be known as the Union Gas and Electric Company, which will have a capital of $20,000,000, half of which is six per cent preferred stock. The balance is common stock. He has made an agreement with A. B. Leach & Company, George W. Young and Oscar L. Gubelman, who are the syndicate managers. The underwriting syndicate will buy $5,000,000 of the preferred stock of the Union Gas and Electric Company. To each subscriber for five shares of preferred stock at par, two shares of common stock will be given as a bonus. According to the terms of the agreement the syndicate managers may borrow, on behalf of the underwriters, from one or more trust companies funds not to exceed the amount of the unpaid subscriptions of the underwriters. It is stipulated that the agreement shall not become binding until at least $3,000,000 of preferred stock shall have been subscribed. The agreement contains the information that the Union Gas and Electric Company proposes to guarantee, as a result of a lease of the Cincinnati Gas property, four and one-half per cent on the outstanding stock during the first two years, four and three-quarters per cent during the next two years, and five per cent for the remainder of the lease. The lease has been acquired for ninety-nine years. The contract made by White also provides that $3,000,000 shall be deposited with trustees as security for the payment of the rental, and that within the first five years of the term $2,000,000 shall be expended in extensions and additions to the property.

POWER PERMITS GRANTED—Under an act to protect Niagara falls, Secretary Taft has granted these temporary permits to take water: Niagara Falls Power Company, 8,600 cubic feet per second; Niagara Power Company, 4,000 cubic feet per second; Lockport Hydraulic Company, 500 cubic feet from the Erie canal, and 333 cubic feet from the lower level of the Erie canal at Lockport. The Niagara, Lockport & Ontario Power Company is granted permission to receive into the United States electric current equivalent to 25,000 horse-power daily from the Ontario Power Company, of Niagara Falls, Ontario; and the Niagara Falls Power Company not to exceed 25,000 horse-power electrical current daily from the Canadian Niagara Power Company. These permits are the only ones granted for the taking of electricity generated in Canada into the United States. The secretary of war states that it will be necessary to make a thorough investigation before granting permanent permits for such transmission.

OBITUARY NOTICES.

MR. RUSSELL SAGE, the well-known capitalist, died at his country home at Lawrence, L. I., on Sunday, July 22. Mr. Sage was born at Verona, N. Y., August 4, 1816. He began his career as an errand boy in his brother's grocery store at Troy, N. Y., where he advanced very rapidly, becoming a wholesale grocer in 1837. He was alderman for Troy in 1847 and a member of congress for the term of 1853-1857. In 1863 he removed to New York city, where he became engaged in business in Wall street. Mr. Sage was reputed to be very wealthy, and was a director in a large number of corporations, among them being the Manhattan Railway Company, the Western Union Telegraph Company, the Fifth Avenue Bank, the Consolidated Coal Company, the Iowa Central Railway Company, the Missouri-Pacific Railway Company and the Pacific Mail Steamship Company.

MR. JOHN SALTAR, JR., died suddenly on July 12. Mr. Saltar was a graduate of the Rensselaer Polytechnic Institute, of Troy, N. Y., class of 1867. Upon graduation he accepted a position as civil engineer with an eastern railroad, later being appointed city engineer of Saratoga, N. Y., where he served some time, giving much satisfaction. Later his services were required by the government of Ecuador, where he was given charge of important works going on at that time. Upon the successful completion of this work Mr. Saltar again turned his attention to railroad work in the United States, finally accepting a position with the North Illinois Steel Works. This position he resigned in 1881 to accept the management of the western department of the Otto Gas Engine Works, Philadelphia, Pa. About seven years ago he was elected president of the company, which position he held at the time of his death. Under his efficient management all the larger sizes of the Otto engine were perfected and placed on the market. The name of John Saltar, Jr., is probably best known to the engineering world as the inventor of submarine engines. Mr. Saltar was an active member of the Masonic order and of the Western Society of Mechanical Engineers. The interment took place at Rockford, Ill., where Mr. Saltar was born.

Digitized by Google

NEW INCORPORATIONS.

INDIANAPOLIS, IND.—Cedar Line Telephone Company, Amboy. $1,000.

DOVER, DEL.—People's Home Telephone Company, Chicago. $300,000.

PHILADELPHIA, PA.—Citizens' Electric Light Company, Philadelphia. $100,000.

COLUMBUS, OHIO—Moxahala & Bristol Railway Company, Moxahala. Increase of capital from $25,000 to $50,000.

DENVER, COL.—Stratton Telephone Company. $6,200. Incorporators: J. J. Pugh, A. J. Pugh and C. S. Wellman.

VINCENNES, IND.—White River Power Company. $500,000. President and general manager, Eugene Rush, Detroit, Mich.

NEWARK, N. J.—People's Light and Power Company. $500,000. Incorporators: Philip N. Jackson, Oliver W. Jackson and Joseph I. Conlon.

AUGUSTA, ME.—Ripley Telephone Company. $1,000. Officers: president, William H. Farrar, of Ripley; treasurer, Charles S. Boynton, of Ripley.

SPRINGFIELD, ILL.—Camp Point Electric Light and Power Company, Camp Point. $10,000. Incorporators: E. F. Hollister, F. H. Whitney and G. C. Gill.

BEACH CITY, OHIO—Beach City Home Telephone Company. $2,500. Incorporators: A. B. Wingate, Jacob Musand, O. E. Oberlin, J. M. Ramsey, M. W. Briggs and J. T. Hay.

INDIANAPOLIS, IND.—The Gary & Hammond Traction Company. $10,000. Directors: K. K. Knapp, William Duff Haynie, Gilbert R. Call, Mark Breeden and William Beye.

CLEVELAND, OHIO—The Cleveland Railway Promotion Company, Cleveland. $10,000. Incorporators: W. M. Hayden, A. W. Thomas, Max P. Goodman, F. B. Krause and C. F. Buxton.

SALT LAKE CITY, UTAH—The Alpine Light and Power Company, of American Fork. $100,000. Officers: A. J. Evans, president; D. C. Strong, vice-president; J. H. Clarke, secretary; S. L. Chipman, treasurer.

INDIANAPOLIS, IND.—Evansville, Princeton & Vincennes Interurban Railroad Company. $10,000. Directors: Henry W. Marshall, S. T. Murdock, Robert Todd, J. M. Barrett, W. V. Stuart, William Wallace and L. C. Neely.

RICHMOND, IND.—Ardmore Heat and Light Company. $200,000. Directors: John W. Smith, of Muncie, Ind.; L. G. Neely, of St. Mary's, Ohio; S. T. Murdock, of Lafayette, Ind.; J. D. S. Neely, E. R. Curtain, J. B. Kerr and E. J. Mair, all of Lima, Ohio.

AUGUSTA, ME.—North Dakota Independent Telephone Company. For the purpose of constructing and operating local and long-distance telephone lines. $3,000,000. Officers: president, L. J. Coleman, of Gardiner; treasurer, A. M. Macomber, of Augusta.

TRENTON, N. J.—Peoria Light Company. To purchase, hold and sell stocks, bonds and mortgages of railroad, street railway, electric light and gas companies. $3,500,000. Incorporators: R. S. Kearney, Jacob Heckma and William H. Carr, all of Jersey City.

JEFFERSON CITY, MO.—Versailles & Sedalia Railroad Company, of Versailles. To build a road six miles long within the county. $60,000. Incorporators: J. Applewhite, W. W. Fauss, J. M. Goodbar, J. C. Ottinger and S. W. Tate, of Memphis, Tenn.; G. D. Abell, Joel D. Hubbard and J. A. Petty, of Versailles.

SPRINGFIELD, ILL.—The De Kalb, Sycamore & Interurban Traction Company. To construct a road from De Kalb to Belvidere, from Sycamore to Elgin and from De Kalb to Yorkville, with branches from De Kalb to points in the counties of Boone, McHenry, Kane, Ogle, Lee, Kendall, La Salle and Dupage. $100,000.

GUTHRIE, OKLA.—Clinton, Cheyenne & Canadian Interurban Railway Company. To build from Clinton through Custer, Roger Mills and Kay counties to Canadian, in Hemphill county, Tex., and passing through Cheyenne in Roger Mills county, whence a branch line will be built through Greer county to Mangum. $1,000,000. Incorporators: C. S. Gilkerson, president; L. L. Collins, vice-president; R. V. Converse, secretary and treasurer; L. W. Pate and W. T. Bonner, directors, all of Cheyenne.

TELEPHONE AND TELEGRAPH.

MOBILE, ALA.—The Western Union Telegraph Company is reconstructing its line from Mobile to Bayou La Batre.

LITTLE ROCK, ARK.—The Southwestern Telegraph and Telephone Company is installing a line between Little Rock and Fort Smith.

NORWICH, CT.—The Southern New England Telephone Company has filed with the secretary of state a notice of an increase of its capital stock from $5,000,000 to $6,000,000.

KALAMAZOO, MICH.—E. W. Bowman and associates have incorporated the Citizens' Telephone Company with $250,000 capital. They purpose having a plant for 20,000 subscribers ready within a year.

HORNELL, N. Y.—Application has been made to the common council of Hornell by the New York & Pennsylvania Telephone and Telegraph Company for permission to put its wires under ground. The improvements will cost about $200,000.

MOULTRIE, GA.—The Moultrie Telephone Company has arranged for a larger telephone exchange, to meet the growing demand for service. The new exchange will accommodate 400 telephones, and will be put in in a short time.

SALT LAKE CITY, UTAH—Directors of the Rocky Mountain Bell Telephone Company are planning improvements which will involve an expenditure of $384,000. Increased business, necessitating a new switchboard and an additional amount of office room, is the explanation of the expenditure. The switchboard alone will cost $275,000.

NORWALK, OHIO—The Bell Telephone Company has begun the work of rebuilding its system in Norwalk. The contemplated improvements include the stringing of new wires all over the city, the erection of new poles where needed and the placing in the new offices of the company of a new switchboard. The work will necessitate the expenditure of many thousands of dollars.

PENN YAN, N. Y.—At the annual meeting of the Crosby & Barrington Telephone Company officers for the ensuing year were elected as follows: president, Charles E. Guile; vice-president, Howard S. Fullagar; directors, Isaac Crosby, Samuel I. Thayer, Thomas W. Windnagle, David Hoover, Herbert C. Ovenshire, Howard S. Fullagar and Charles E. Guile. The company now has thirty miles of pole lines and nearly sixty-five miles of wire.

CLEVELAND, OHIO—One of the improvements the United States Telephone Company will make with the $200,000 it will expend during the next year perfecting its system through Ohio is to be the main line it will complete between Cleveland and Wheeling. The line will be of special value to the company, because it can be used by the company's patrons through the southern and eastern parts of the state for connections with Pittsburg.

ALBANY, N. Y.—The Unadilla Valley Farmers' Telephone Company has been incorporated with the secretary of state to build and operate a line beginning at Trestle, Chenango county, and running thence to Mount Upton, Rockwell's Mills, White Store, Holmesville, and terminating at South New Berlin, with short lines connecting with several farmhouses in the vicinity, and one line running out from Rockwell's Mills to North Guilford, and there connecting with another line running to Oxford. The capital stock is $1,500, consisting of shares of $10 each. The directors are: C. D. Cornell, of Rockwell's Mills; Charles Prentice and John Rose, of Rockdale; A. C. Frate, of Guilford; I. J. Padgett and O. S. Meader, of South New Berlin, and N. S. Pearsall, of Mount Upton.

BOISE, IDA.—The Rocky Mountain Bell Telephone Company will this season expend upwards of $150,000 in extending, enlarging and perfecting its system in the district of which Boise is the headquarters. The new operating rooms, switchboards and attachments of the Boise office, which have just been put in service, add to its capacity to the extent of 9,600 telephones. The long-distance equipment has been increased to permit of the employment of six additional operators. The company has completed, or has in course of construction, the reequipment of the offices at Nampa, Caldwell, Weiser, Payette and Council, Ida., and Ontario, Ore. These improvements result in adding two circuits between Boise and Caldwell, one between Caldwell and Weiser and two between Weiser and Council.

Digitized by Google

ELECTRIC LIGHTING.

GROTON, S. D.—The electric light plant at Groton is being enlarged.

ATLANTIC, IOWA—Work has been commenced on the erection of an electric light plant for the town of Lewis.

BELLE PLAINE, MINN.—Local capital will install an electric lighting plant for the borough of Belle Plaine. The company will be incorporated with a capital stock of $10,000.

TELLURIDE, COL.—The Telluride Power Company has contracted with the Westinghouse Electric and Manufacturing Company for some additions to its power transmission plant, consisting of two 7,500-horse-power generators and a number of transformers.

RACINE, WIS.—The explosion of a boiler destroyed the electric lighting plant at Camden, S. C., owned by Frank K. Bull, of Racine, Wis., causing a loss of $50,000. Mr. Bull sent his representatives to Camden with instructions to have the plant rebuilt. Camden is now without lighting and street railway service.

TONAWANDA, N. Y.—At a meeting of the directors of the Tonawanda Power Company and Suburban Power Company, held at the office of the Tonawanda Power Company, the following officers were elected: D. O. Mills, president; de Lancey Rankine, vice-president; F. L. Lovelace, secretary; W. Paxton Little, treasurer; F. M. Gordon, assistant treasurer.

KEWANEE, ILL.—All the holdings of the Kewanee Light and Power Company have been sold to the American Gas Company, of Philadelphia. In the transaction the electric light and gas plants and the heating plant, as well as the new ice-making plant, are included. The last two plants mentioned were the property of the Lighting and Heating Company, of Kewanee.

MEMPHIS, TENN.—A new electric light plant is being erected in Memphis, the present size of which will be 2,000 horse-power. The underground district of the city will be thoroughly wired this season for the distribution of the current generated. The plant will be owned by Edward G. Cowdery, of St. Louis, Mo., and several associates. It was erroneously stated in the issue of the ELECTRICAL REVIEW for July 14 that this plant would be owned and operated by the Laclede Gas Light Company.

SARATOGA SPRINGS, N. Y.—The stockholders of the Halfmoon Light, Heat and Power Company at their annual meeting elected the following directors: John C. Duncan, Edward H. Strang, Herbert O. Bailey, William L. Howland, Adelbert J. Harvey, Stephen Lee, William R. Palmer, of Stillwater; George Hudson, of Stillwater; G. F. Best, of Round Lake; William C. Tallmadge and John W. Gibson. The directors elected the following officers: president, John C. Duncan; vice-president, Edward H. Strang; secretary, Herbert O. Bailey; treasurer, William L. Howland.

CHATTANOOGA, TENN.—In order to facilitate the enlargement of the plant and the extension of its service the stockholders of the Citizens' Light, Heat and Power Company, of Montgomery, Ala., have organized a corporation under the name of the Citizens' Light and Power Company, and have taken stock in exchange for their holdings in the old. The change was made to take advantage of the new corporation laws of Alabama, which are more liberal. As with the old company the officers are: Alexander Rice, president; E. Meertieff, vice-president; P. R. Whiting, secretary, and J. L. Cobbs, treasurer.

PORTLAND, ORE.—All the electric wires and cables of the Portland General Electric Company will be placed under ground in the business districts of the city in the near future. Engineers of the corporation are now preparing plans for the proposed underground conduit system, which will be presented to the city council within the next sixty days. It is proposed that these plans, if acceptable, will be incorporated in an ordinance which will affect all electric light and power companies operating in the city. It is estimated that the outlay for placing the wires under ground will be not less than $500,000.

ELECTRIC RAILWAYS.

SAN ANTONIO, TEX.—The bonds have been sold and the contract let for the construction of an interurban electric line to run from San Marcos, Hays county, to Smithville, Caldwell county, a distance of about forty miles.

READING, PA.—A contract has been let for the construction of the trolley line from Trooper to Souderton, by the Montgomery Rapid Transit Company, to John Bane & Company, of New York. The road is a link of the Schuylkill Valley Traction Company.

EAST HOUGHTON, MICH.—At a meeting of the East Houghton village council a franchise was granted to the Houghton County Street Railway Company to build an extension of the street car line to East Houghton and as far as the easterly boundaries of the village.

HAGERSTOWN, MD.—A movement is on foot to build an electric road on South Mountain from Pen-Mar Park to High Rock, Quirauk, Brinkwood and Ragged Edge. Preliminary plans have been placed in the hands of Jason Bell and Simon Wiener, supervising engineers.

CHICAGO, ILL.—The Du Page County Railway, with principal office in Naperville, has been incorporated. The contemplated road is from Wheaton to Naperville. All of the incorporators are residents of the latter city, and are: W. F. Keeney, A. M. Royce, Alvin Scott, J. F. Royce and Samuel Mather.

GOSHEN, IND.—It is announced that the builders of the Indianapolis, Huntington, Columbia City & Northwestern Interurban Railway have secured $1,500,000 by bonding the property to the Central Trust Company, of Indianapolis, and will proceed at once and build the road from Goshen to Lake Wawasee, thirteen miles, equipping it for operation this fall.

WINCHESTER, VA.—The Frederick county board of supervisors has granted the application of the Winchester & Washington City Railway Company for a franchise for a right of way through Frederick county for its electric railroad, which is to be built between Winchester and a number of towns, connecting with the Southern Railway at or near Blue Mont, Loudoun county.

BENTON HARBOR, MICH.—President J. M. McMichael, of the Benton Harbor-St. Joseph Railway and Light Company, has given out a statement that his line will be extended from Benton Harbor to Kalamazoo, and that work will be started this fall. A line to Eau Claire will be in operation in August. Cars are now running as far as Tabor's resort, twelve miles from Benton Harbor. The line will go from Eau Claire to Dowagiac.

ROCHELLE, GA.—Some time ago J. A. J. Henderson, president of the Ocilla & Valdosta Railroad, made a proposition to the citizens of Rochelle that if they would subscribe for $16,000 of stock in the road he would agree to extend the line from Fitzgerald to Rochelle. The stock has been subscribed for and Mr. Henderson notified to that effect, which makes the road for Rochelle assured. Mr. Henderson expects to extend the road from Rochelle to Macon *via* Hawkinsville.

NEW HAVEN, CT.—The Consolidated Railway Company is preparing plans for an addition to its power plant in New Haven. The structure will be a brick building, one story high, sixty by seventy feet. Additions to the equipment, consisting of three 500-horse-power boilers, with a large generator set and condensers, will also be made. The company will likewise enlarge its power plant at Branford. The present building will be carried up two stories, and several new boilers of 200-horse-power capacity will be installed.

LEWISTON, IDA.—President G. W. Thompson, of the Lewiston Southeastern Electric Railroad and the Central Idaho Development Company, has wired from New York to his Lewiston representatives that the double enterprise has been financed by New York and Philadelphia capitalists. He says the sum pledged by them is $4,000,000, sufficient to build the road as far as projected and to develop the electrical power proposed by the latter company. The Lewiston Southeastern is being projected from Lewiston to Grangeville, Ida., a distance of ninety miles. It also intends to run a line from Westlake to Nez Perce. It is hoped to have twelve miles of the main line ready within the next month.

Digitized by Google

NEW CASTLE, PA.—The power-house of the New Castle & Harmony Electric Railroad, which will build a trolley line from New Castle to Pittsburg, will be at Eidenau, in Butler county.

EVANSVILLE, IND.—The Evansville & Henderson Traction Company, whose franchise was revoked by the Evansville board of public works because the line was not commenced within the specified time, will make application for a new franchise. Most of the surveying for the proposed road has been done. The line will be built by the Tennis Construction Company, of Cincinnati.

ROANOKE, VA.—The Twin City Electric Company has applied to the Roanoke common council for a franchise to operate an electric railway in the city. This company has been organized with the following officers: C. Markley, president; C. G. Cannaday, vice-president; A. L. Rife, secretary and treasurer, and M. A. Rife, general manager. The above, with G. T. Ellis and B. B. Dillard, compose the board of directors. The company proposes to extend the line to Salem.

ST. LOUIS, MO.—The Hillsboro, Kimmswick & Northern Railway Company, which has been chartered by the secretary of state, will connect with the United Railway Company's line at Jefferson barracks, and will unite that place with Hillsboro, Jefferson county, Mo., a distance of twenty-three miles. The company is capitalized at $300,000. The incorporators are: Charles A. Gutke, H. W. Gutke, Anthony F. Furrer, James J. Ring, Charles F. Crane and Lee A. Hall.

HARTFORD, CT.—Judge Robinson, of the Hartford County Superior Court, has authorized the Stafford Springs Railway Company, which is owned by the Consolidated Railway Company, to transfer certain rights under its charter to the Hartford & Springfield Street Railway Company. The franchise which is to be transferred will permit the Hartford & Springfield system to extend a line from Somerville to Stafford, connecting with the road which the Consolidated Railway Company is to build from Rockville to Stafford Springs.

BALTIMORE, MD.—Alva A. Lamkin, counsel for the Kent Traction Company, which proposes building a trolley line between Tolchester and Chestertown, has been notified that practically all the right of way has been secured, and that work will shortly be started on the road. The route surveyed is about ten miles long, and it is intended to locate the power-house about midway between the two places, at Fairlee. The original intention was to use gasoline motor cars, but after a careful investigation the promoters decided upon electricity as a motive power, and it is now proposed to have the company sell current as well as operate the railway. The capital stock of the Kent Traction Company is $200,000. The line which it will build will be for freight as well as passenger use.

SYRACUSE, N. Y.—Members of the Vanderbilt-Andrews syndicate of electric railroads have been elected to the directorate of the Rochester Electric Railway Company, said to be the most profitable electric line in western New York. It is leased for $16,000 a year to the Rochester Railway Company, which pays a dividend of eight per cent on its $200,000 capital stock and has a surplus of $42,500. The road runs to Ontario Beach. The directors elected are: Horace E. Andrews, of Cleveland, Ohio, president of the Rapid Transit Company; W. K. Vanderbilt, Jr., E. V. W. Rossiter, John Carstensen, W. C. Brown and W. J. Wilgus, New York Central officials; John J. Stanley, general manager of the Rapid Transit and the Mohawk Valley companies; A. H. Harris, C. T. Chapin, G. E. Roth, G. A. Holister, W. M. Eaton and W. C. Barry, of Rochester.

PERSONAL MENTION.

MR. M. H. DONAHUE, who has been manager of the Postal Telegraph Company at Oswego, N. Y., has resigned to accept a position in the electrical department of the Pennsylvania Railroad at Olean, N. Y.

MR. EDGAR JAY RAUCH, of Norwalk, Ohio, has been appointed superintendent of the Saginaw & Bay City Railways and the Interurban line. Mr. Rauch was formerly general superintendent of the Canton-Akron Railway, the Canton-New Philadelphia Railway and of the Tuscarawas Traction Company, a system of Ohio interurban roads.

MR. R. M. SEARLE, general manager of the Westchester Lighting Company, with offices at Mount Vernon, N. Y., has been appointed general manager of the Rochester Railway and Light Company, succeeding Mr. W. M. Eaton, who is relieved of these duties to take up the work connected with the vice-presidencies of the Rochester Railway and Light Company and the Rochester Railway Company.

MR. E. W. T. GRAY, who has for years been manager of the New York sales office of the Westinghouse Electric and Manufacturing Company, resigned recently to take up commercial work in another field. Mr. Gray's decision to sever his connection with the Westinghouse company was received with great regret by the management, he having been one of the pioneer employés of the company. Mr. Gray began his work with the Westinghouse company about the year 1890, starting in the laboratory of its original works in the heart of the city of Pittsburg. Later he took up installation work for the company, installing the first railway motors the company made, on cars in Lansing, Mich., about the year 1901. Following a short period spent in installation work, Mr. Gray was called by the company to its sales organization, with headquarters at Pittsburg. In 1898 Mr. Gray received the appointment of manager of the New York office. Mr. W. C. Webster, who succeeds Mr. Gray as manager of the New York sales office, has a broad general knowledge of the company's commercial policy, and on account of his close association with the sales department in the past enjoys a personal acquaintance with the entire sales force, which should be of great advantage to him in his new work. Mr. Webster entered the employ of the company in 1898, and has always been identified with the sales department.

MR. FRANK C. MASON, the well-known superintendent of the police telegraph system in Brooklyn, N. Y., has retired from active service and is receiving the congratulations of his many friends throughout the electrical industry. Mr. Mason is gifted with a rare faculty of making and holding friends, and the universal wish is expressed that he will now enjoy the fruits of his labors at the beautiful farm upon which he will live, near Utica, N. Y. The Brooklyn *Standard Union*, commenting upon Mr. Mason's retirement, speaks as follows: "Mr. Frank C. Mason, who for twenty years had been superintendent of the police telegraph system in Brooklyn, has received several big offers from electrical companies in Greater New York since the latter knew of his retirement from the police department. He will not accept any of them, however, he says, although in most cases the salary offered is greatly in advance of what he had been receiving from the city. He declares that he will not enter into business of any character. By his present plans Mr. Mason will try to obtain plenty of much needed rest, spending eight months at his old homestead in Washington Mills, N. Y., four miles south of Utica, where he was born and raised, and the remaining four of the year in Greater New York, in order to keep in touch with electrical matters and with his old friends. At the time of his appointment to the position in the police department from which he has just been retired, Mr. Mason led the list in a competitive examination for the office. He was appointed March 11, 1884. The commissioner of police at the time was John N. Partridge, who was serving during Seth Low's second administration as mayor of Brooklyn. The telegraphic equipment in the police department was far from being as perfect then as it is now. In fact it was even crude. Communication between the precincts and headquarters was maintained by means of the dial telegraph instruments. There were nine precincts then to the thirty-three in existence now. All these are furnished with modern telephone and telegraph facilities, mainly through the work of Mr. Mason. Mr. Mason was manager for the Atlantic & Pacific Telegraph Company in Poughkeepsie before he came to Brooklyn. His early education was obtained in the public schools of Utica. As a lodge member Mr. Mason is very widely known. He belongs to the Commonwealth Lodge 409, F. and A. M.; the Scottish Rite bodies, Masonic, of Brooklyn; Kismet Lodge, of the Mystic Shriners, and is also a member of the Brooklyn Lodge of Elks. In 1886 he organized the International Association of Municipal Electricians in the Clarendon Hotel. This organization is flourishing to-day, and contains some of the best-known municipal electricians in the United States and Canada. Mr. Mason also organized the Long Island Telephone Company, from which sprung, later on, the present New York & New Jersey Telephone Company."

Digitized by Google

NEW PUBLICATIONS.

THE SUBMARINE *VERSUS* THE SUBMERSIBLE—The paper by Simon Lake, entitled "The Submarine *versus* the Submersible," has been reprinted from the *Journal of the American Society of Naval Engineers.*

PRATT INSTITUTE FREE LIBRARY LIST OF BOOKS ON ELECTRICITY—Pratt Institute, Brooklyn, N. Y., has published an annotated list of books on electricity, in connection with the Pratt Institute free library. This list will be sent to any address on receipt of request.

NEW YORK ELECTRICAL SOCIETY—The address entitled "Fundamental Principles of Gas Engines and Gas Producers," delivered by Robert T. Lozier before the 257th meeting of the New York Electrical Society, February 21, 1906, has been reprinted as No. X of the society's transactions.

TRANSACTIONS OF THE ASSOCIATION OF CIVIL ENGINEERS OF CORNELL UNIVERSITY—The Association of Civil Engineers of Cornell University has published its transactions for 1905-1906. These include addresses by non-resident lecturers, miscellaneous papers, and a list of members of the association. The frontispiece is a reproduction of the Cornell inter-college baseball challenge cup, won in 1905 by the College of Civil Engineering.

JOURNAL OF THE WORCESTER POLYTECHNIC INSTITUTE—The July issue of the *Journal of the Worcester Polytechnic Institute* is designated as the commencement number. The contents include the commencement address, entitled "Technical Education in Relation to Industrial Development," by Charles G. Washburn, and the commencement lecture delivered by Leonard P. Kinnicutt, entitled "Sanitary Science and the Public Health." Reports are given of the thirty-third annual dinner and meeting of the Alumni Association and of the reunions of the classes of 1871, 1894, 1895, 1896 and 1902. In addition to this there are institute notes and alumni notes.

THE TECHNOLEXICON OF THE SOCIETY OF GERMAN ENGINEERS—About 2,000 firms and individual collaborators in Germany and abroad are assisting in the compilation of the "Technolexicon of the Society of German Engineers." This will be a universal technical dictionary in three languages—English, German and French. The work of preparation was commenced in 1901. Over 3,000,000 word-cards have been collected. Alphabetizing has so far advanced that printing will begin early in 1907. The work will be printed and published by the well-known firm of J. J. Weber, Leipsic. The editor-in-chief is Dr. Hubert Jansen, Berlin (N. W. 7), Dorotheenstrasse 49.

THE MACHINE TOOL POCKET LIST—The "Machine Tool Pocket List," formerly published by the Angus Ballard Company, has been purchased by the George H. Gibson Company, New York city. The size of the book will be increased from three and one-half by six inches to four by nine inches. The buyers' finding list of machine tools and supplies will be made more complete and definite, although the present list covers over a thousand firms and about 2,000 articles and types of tools. Brief articles of interest to manufacturers of machinery will be added, and the list will be combined with *Manufacturing*, a journal in which the George H. Gibson Company describes and lists important patents and other industrial opportunities.

CARBON BRUSHES—A practical treatise on the use of carbon brushes for electric motors and generators, entitled "Carbon Brushes," by J. S. Speer, has been published by the Speer Carbon Company, St. Marys, Pa. This is one of the most interesting and instructive treatises which has been published upon the subject. The work includes a study of the functions of carbon brushes, the elements which are necessary for successful operation, and a chapter on commutator troubles. In addition to this there is given a series of curves showing graphic results of heat tests, brush friction tests, brush voltage drop tests, brush tension tests, contact resistance tests, wattage loss tests and coefficient of friction tests. The chapter concerning contact devices for carbon brushes is very interesting and indicates very clearly the close study which the author has given to this important subject.

ELECTRICAL SECURITIES.

While speculation during the past week was very dull, prices made general gains as against a week ago, and a higher level is evident all along the line. This rally was made despite the fact that there was no increase in Amalgamated Copper's dividend, and in spite of the sensational rumors of panic at St. Petersburg and declines in Russian bonds. A number of very favorable railroad earnings were reported, notably Baltimore & Ohio showing a gross gain for the fiscal year of $9,702,000, and a net gain of $4,897,000. Missouri Pacific for May reported a net gain of $303,000. Further evidence of the prosperity of the railroads is provided in the Interstate Commerce Commission's preliminary report, to the effect that for the fiscal year just ended the railroads show a gross gain of ten per cent over the $2,073,000,000 reported in 1905. Trade reports also reflect prosperity in the iron and steel industry.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JULY 21.

New York:	*Closing.*
Allis-Chalmers common	16½
Allis-Chalmers preferred	45
Brooklyn Rapid Transit	74¾
Consolidated Gas	139
General Electric	163
Interborough-Metropolitan common	37¾
Interborough-Metropolitan preferred	76¾
Kings County Electric	165
Mackey Companies (Postal Telegraph and Cables) common	71½
Mackey Companies (Postal Telegraph and Cables) preferred	71¼
Manhattan Elevated	148
Metropolitan Street Railway	103
New York & New Jersey Telephone	125
Western Union	92
Westinghouse Manufacturing Company	151

Boston:	*Closing.*
American Telephone and Telegraph	130¼
Edison Electric Illuminating	240
Massachusetts Electric	68
New England Telephone	120
Western Telephone and Telegraph preferred	90

The directors of the Edison Company, of Boston, have declared the regular quarterly dividend of 2½ per cent, payable August 1, to stockholders of record at close of business July 18.

The Western Telephone and Telegraph Company has declared a regular semi-annual dividend of 2½ per cent on the preferred stock, payable August 1 to stockholders of record July 20. Books will be closed from July 20 to July 31, inclusive.

The instrument statement of the American Telephone and Telegraph Company for the month of June is as follows: gross output, 217,243; returned, 54,973; net output, 162,270. For the six months of 1906 ending June 30 the net output was 803,522. The total now outstanding is 6,501,780.

Philadelphia:	*Closing.*
Electric Company of America	11⅜
Electric Storage Battery common	68
Electric Storage Battery preferred	68
Philadelphia Electric	7⅞
Philadelphia Rapid Transit	29¼
United Gas Improvement	83½

Chicago:	*Closing.*
Chicago Telephone	118
Chicago Edison Light	135
Metropolitan Elevated	68
National Carbon common	81¾
National Carbon preferred	117
Union Traction common	4
Union Traction preferred	14

At the regular July meeting of the directors of the Metropolitan Elevated Railroad Company, of Chicago, the dividend question was not discussed, and the meeting was devoted to purely routine matters. The next meeting will be held on August 20, and it is generally understood that the declaration of a dividend on the preferred stock will not be deferred longer than that time. The earnings this year indicate the probability of a surplus closely approximating $1,000,000 by September 1.

Digitized by Google

INDUSTRIAL ITEMS.

THE AJAX LINE MATERIAL COMPANY, Chicago, Ill., is sending out a sample of "Ajax" rainproof rope. Each strand is waterproofed before being braided into a solid rope.

THE MICHIGAN CENTRAL RAILROAD, "The Niagara Falls Route," is sending out some interesting and artistic literature respecting Topinabee and Mullet Lake, Mich., popular summer resorts reached by this road.

THE ABBE ENGINEERING COMPANY, 220 Broadway, New York city, has published a handsome catalogue descriptive of its complete line of pebble mills and various other machines for the reduction of all hard and soft materials.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., announces that a report from its San Francisco (Cal.) office states that, as nearly as can be determined during the present unsettled state of that city, the number of its office recently opened there is 206 First street.

THE OSWEGO BOILER AND ENGINE COMPANY, Oswego, N. Y., has issued bulletin No. 40, dealing with steel tanks. This describes and gives the dimensions of circular black steel tanks for gas, gasoline, air and water. These are to be used for blowoff, receiving, drip, pressure or hot-water tanks.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., has ready for distribution a booklet describing its mine telephone system. In addition to the descriptive matter and illustrations there are a number of testimonials from different mining companies commendatory of this system.

ROYLE & AKIN, Ossining, N. Y., wire manufacturers, have issued a very practical and substantial wire gauge, clearly printed on celluloid. This wire gauge is in vest-pocket size, and will be found of great utility by electricians in general. The company will be pleased to send one of these wire gauges to any one interested in the subject, upon request.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., reports a greatly increased demand for the "Sunbeam" lamp. This is the eighteenth consecutive year of the sale of this lamp. The company announces that it will answer promptly all enquiries concerning this product, and that it is in a position to furnish without delay lamps suitable for all circuits.

KEOUGH BROTHERS & COMPANY, Boston, Mass., have appointed V. C. Gilpin, 120 Liberty street, New York city, their general sales agent. Among the electrical specialties manufactured by Keough Brothers is the Keough cord-grip, a device that fulfills the requirements of the underwriters and permits the use of reenforced cord with one-eighth-inch socket.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., in connection with the Cleveland convention of the National Electrical Contractors' Association, issued a unique folder in the shape of a railroad ticket calling attention to the bulletins issued by the company, the list of district offices and other information concerning the company's products.

THE COOPER HEWITT LAMP COMPANY, Pittsburg, Pa., has published a handsome booklet entitled "The Economical Lighting of Industrial Plants." In addition to the text, which gives a very careful discussion of the advantages of the Cooper Hewitt mercury vapor lamp, there are numerous illustrations showing the practical application of this form of lighting to industrial plants.

THE STANDARD VARNISH WORKS, 29 Broadway, New York city, announces that it has installed, for experimental purposes, a complete plant of the Passburg system, and is now in a position to work out practically all problems in the vacuum drying and impregnating of armature and field coils with solid compounds. Any one wishing to test this method practically may send the company small armatures, armature coils or field coils, which the company will dry under vacuum and impregnate with a solid compound free of charge and return. Coils submitted should be marked "Insulating Department, Standard Varnish Works, 29 Broadway, New York city," and freight and express charges prepaid.

M. W. DUNTON & COMPANY, Providence, R. I., announce the opening of an office for the sale of "Nokorode" soldering paste throughout the state of Indiana, with Alpha H. Kling, Peru, Ind. Mr. Kling carries a large stock of "Nokorode" in all sizes of packages, and is prepared to accept orders for immediate shipment at prices quoted from the home offices, thus saving transportation charges from Providence to Indiana.

W. S. BARSTOW & COMPANY, 56 Pine street, New York city, are the engineers for the New Jersey Company, Matawan, N. J., making improvements and additions to its plant. The remodeled plant will have double the capacity of the old one. In order to meet the increased shop requirements a large dock will be built on Matawan creek and a new power-house will provide for electric drive and lighting throughout the plant.

THE DE LA VERGNE MACHINE COMPANY, foot East One Hundred and Thirty-eighth street, New York city, the sole licensee for the manufacture of the Koerting gas engine and producer in the United States, has issued a ten-page folder describing the Koerting four-cycle gas engine and suction producer. These engines have met with remarkable success in Europe, where a large number have been installed in municipal lighting plants, factories and other places.

THE CATARACT ELECTRIC SUPPLY COMPANY, Buffalo, N. Y., with offices and store at 1113 West Swan street, carries a large stock of general electrical supplies and small fittings of all descriptions, as well as dynamos and motors and heavier electrical machinery. D. F. Potter is the general manager of the company, and the board of directors is comprised of the following well-known men: Charles R. Huntley, William R. Huntley, Daniel T. Nash and de Lancey Rankine.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has issued several new catalogues. Catalogue No. 19,062 deals with motor starters for speed control by field regulation; No. 19,063, motor starters equipped with tight casings; No. 19,064, theatre dimmers; No. 19,067, electric soldering irons. A discount sheet for motor-starting rheostats, armature speed controllers, etc., has also been issued, and the company is sending out a number of index leaves to facilitate the filing of its trade literature.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has received orders for gas engines aggregating 68,000 horse-power. Among these are the following: Illinois Steel Company, 15,000 horse-power; Homestead plant of the Carnegie Steel Company, 4,000 horse-power; Indiana Steel Company, 35,000 horse-power. The company is also building large gas-blowing engines for the United States Steel Corporation. During the month of June the orders received by the Allis-Chalmers Company were the largest in its history, aggregating over $3,000,000.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a unique blotter calling attention to "Okonite," printed in two colors, which is causing favorable comment throughout the trade. The inscription reads as follows: "By using this blotter on an order for Okonite you are entitled to a life membership in the Society of Satisfied Users, composed exclusively of those who use and endorse Okonite as the standard for rubber insulation." The company suggests that any one desiring to become a member of this society write for one of these blotters.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has ready for distribution bulletins Nos. 3110, 3203, 3204 and 3802 describing and illustrating, respectively, single-phase induction motors with worm-gear speed-reduction device, one-twentieth to one-fourth horse-power; direct-current motors with worm-gear speed-reduction device, bi-polar enclosed types, one-twentieth to one-fifth horse-power; bi-polar enclosed motors for direct current, class 412 and 422, one-twentieth to one-fifth horse-power, and motor-driven air-pumps for direct and alternating current.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 5. NEW YORK, SATURDAY, AUGUST 4, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. L. W. MARSHALL, Manager
BOSTON OFFICE: Delta Bldg., 10 Post Office Square, M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad St., London, E. C., HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.
Copyright, 1906, by Electrical Review Publishing Co.
Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

CONTENTS.

EDITORIAL:
Municipal Telephony in Great Britain 157
Developing Interurban Railway Territory 158
The Electric Drive in the Envelope Factory 159
Domestic Electricity 159
Measurement of Friction in Gas Engines, by A. H. Burnand 160
Wireless Telegraph Conference 161
Election of Directors of the Westinghouse Electric and Manufacturing Company 161
Death of Charles A. Bragg 161
Meeting of Nebraska Independent Telephone Companies 161
Another Alpine Tunnel 162
Charles J. Glidden and His Automobile Trophy 162
New Power Plant for the San Joaquin Light and Power Company 162
Raise the Horseshoe Falls, by Alton D. Adams 163
The Faraday Society 164
Standardization of Brake Shoes 165
Live Steam-Heated Feed-Water—Its Effect on the Output and Efficiency of Steam Boilers, by G. Wilkinson 166
BOOK REVIEW 169
Alfortville Central Station and the System Controlled by the Est-Lumière Company (Near Paris), by C. L. Durand 170
The Circular Tour of the Institution of Electrical Engineers, of Great Britain 175
Electrical Mining Notes, by Sydney F. Walker 176
ELECTRICAL PATENTS 177
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 178
METHODS OF GETTING NEW BUSINESS—"Organization and Conduct of a New-Business Department Suitable for Central Stations in Cities of 50,000 Population and Under," by S. M. Kennedy 180
INDUSTRIAL SECTION:
The Gould Telephone Storage Battery 183
An Improved Indicator for Enclosed Fuses 183
A New Line of Magneto Telephones 184
Portable Desk Telephones 185
CURRENT ELECTRICAL NEWS 187

The demand for current technical literature is evidently increasing. The ELECTRICAL REVIEW is not informed as to the growth of its neighbors in this respect, but is pleased to acknowledge a steady stream of new readers who have been sending in their names during the present year. What is remarkable, they have not ceased during the hot summer days. We presume, by proper reasoning, that other technical journals receive their proportion and should have more readers instead of less, if the publications are worthy of this growing science and industry. There is a fascination about the study of electrical problems and an interest in keeping in touch with electrical advances that seem to appeal to progressive minds perhaps more than any other branch of industrial endeavor.

MUNICIPAL TELEPHONY IN GREAT BRITAIN.

For some time it had been predicted that municipal operation of the telephone system in Glasgow, Scotland, was doomed to failure if continued along the lines which have been followed for the past two or three years. Quite recently the announcement was made that the experiment in municipal telephony at Glasgow had come to an end by the transfer of the system to the British post office for a purchase price of £305,000. The total capital expenditure on the system now amounts to some £380,000. The difference between that figure and the purchase price will be made up by payments to the sinking fund and by contributions from the ratepayers, whose service, it is expected, will be charged for upon a basis of sensible cost-keeping, and not upon a basis which aims to show how cheaply a thing can be done when it is run by the municipality.

The National Telephone Company, in competition with the municipality for the Glasgow service, it appears, was willing to purchase the system at its full value, which possibly would have been a price £25,000 higher than that offered by the government. With true competitive spirit, however, the municipality preferred to shoulder the additional loss upon the ratepayers, rather than to sell out to the private corporation, which had, by leaps and bounds, grown all around the municipal system. Commenting upon this matter, *Engineering* (London) has this to say: "On several occasions during the past three years we have shown that the Glasgow Corporation telephone business was on wrong lines, both technically and financially. The errors made in the original plans and estimates and in the class of plant and method of work adopted were radical and far-reaching. Their effect was quickly evident, and could only have been overcome by a complete reconstruction of the plant and of the business. This has been practically admitted in Glasgow, as on several occasions it has been proposed to reconstruct the switchboards and telephones and raise the rates. But to do these things would have upset the finances, upset the service and upset the public."

The prime fault with the management and operation of the Glasgow municipal telephone system, it appears, is identical with that which characterizes so many other municipal experiments both in Great Britain and in this country. The want of the realization that the telephone business is one which requires the services of specialists for its proper management, and can not be operated successfully as a haphazard venture, is responsible, to a greater degree probably than is recognized, for the lack of success of municipal operation. The determination, too, on the part of newcomers in the field to cut the rates, notwithstanding the assurance on the part of those already established that these are equitable, or nearly so, is attended also, in most

Digitized by Google

cases, with ultimate dissatisfaction and disaster. Following this line of thought, we quote again from our British contemporary: "The public invariably has to pay the price of the errors of government officials. . . . Fortunately for the government, municipal telephone systems are few and far between. In every instance the municipal telephone systems are carried on at uncommercial rates, and, even so, have failed to attract more than a small proportion of the telephone-using public. Under these circumstances the transfer of the municipal telephone concerns to more capable hands has been inevitable, and it is only municipal pride that has hitherto stood in the way."

DEVELOPING INTERURBAN RAILWAY TERRITORY.

The announcement was made last week that the Brooklyn Rapid Transit Company had abandoned all efforts to construct new lines or to extend present ones into the undeveloped territories of the borough. This decision, it is understood, has not been made officially by the board of directors, but is the construction that President Winter puts upon the company's case in commenting upon the alleged obstructions which the borough officials have placed in the way of the development of the suburban facilities of the railway system. On the one hand, the borough officials stoutly claim that the railway company is bluffing, and that the only obstacle which has been placed in the way of development is the determination that the company shall deal fairly with the city in making use of valuable franchises. On the other hand, the real estate dealers and property owners in the territory which will be affected if President Winter's announcement is carried out in fact are up in arms and are decrying the obstructive policy of the borough representatives. Now, as a matter of fact, it is hardly the function of a street railway company serving such a territory as is covered by the network of the Brooklyn Rapid Transit Company to say that it will go no further in developing its system. Again, it is hardly the function of live borough officials to say where the development shall stop and to interpose unreasonable obstacles in the way of legitimate development. The borough of Brooklyn, particularly in the outlying sections, owes everything to the electric railway. We can remember, not many years ago, when the citizen who had the hardihood to move far from the city hall had to be glad to toddle anywhere in a slow-going, poorly lighted and badly heated horse car. The coming of the trolley car, with all of its advantages, made possible the spreading out of the borough limits, and built up a traffic proposition which, it can be said without fear of contradiction, is second to none in the country. But unless the railway company, which has practically a monopoly of the present situation; and the borough officials, who have it in their power to foster development along right lines, get together on a sane basis and work out their traffic salvation within the next few years, there is a very definite likelihood of a change in the trend of daily travel. Already hoardings around town are being covered with alluring views of peaceful resident sections in Long Island and New Jersey, and, to make the matter more definite, the projected tunnel and bridge routes are plainly marked, showing the ease with which these sections may be reached when once the traffic facilities have been established; and these traffic facilities, it must be remembered, are not imaginary, they are concrete propositions, the utility of which we shall be realizing almost before we know it. The splendid system which the Long Island Railroad is preparing in the electrification of its Atlantic avenue line, Brooklyn, and its branches to Long Island proper and to the Rockaway section, connecting, as it does, with the Manhattan-Brooklyn tunnel now under construction by the Interborough Rapid Transit Company, will offer a quick means of transit to Hollis, Long Island, where there is a fine opportunity for building up a residential section. The new Manhattan-Brooklyn bridge, while hardly begun, is another entrance to the city, and the rapid transit commissioners have plans for making use of this structure, sending an extension through Flatbush and Fourth avenues to Fort Hamilton, where, in the Bay Ridge section, there is still room for a considerable development. The Belmont tunnel from Forty-second street, Manhattan, to the borough of Queens, and the tunnels of the Pennsylvania, New York & Long Island Railroad's system, afford access, *via* subway connections, to the almost rural territory of Long Island, to which many residenters are now flocking, antedating the arrival of these facilities. The New York Connecting Railroad has a franchise to connect its lines in the borough of Brooklyn with the lines of the New York, New Haven & Hartford Railroad Company in the borough of the Bronx, passing through the borough of Queens and across Wards Island and Randalls Island. This railroad, in connection with the Harlem River & Portchester system, which has secured a franchise after a bitter fight, will offer the workers in New York the opportunity of spreading out in various directions to territory which at the present time is hardly occupied.

Turning our backs on the Long Island and Bronx development, we find no less than three tunnel companies actively at work, franchises all secured, making connections between the borough of Manhattan and the state of New Jersey. The Hudson & Manhattan Railroad Company is tunneling from approximately the foot of Cortlandt street, Manhattan, to the present station of the Erie Railroad in Jersey City. In conjunction with the Public Service Corporation of New Jersey this will offer to the worker in New York the advantage of a very large residential section, the attractiveness of which has already caused a considerable development to take place. A little further up-town in the borough of Manhattan, in the block bounded by Christopher, West Tenth, Greenwich and Hudson streets, the New York and New Jersey Railroad Company is making ready for a terminal, and, with one tunnel completed, is hard at work upon another, reaching over to form a connection with several railroads in the state of New Jersey.

The Pennsylvania, New York & Long Island Railroad Company has been duly incorporated under the laws of the state of New York for the purpose of constructing and operating a tunnel railroad in New York city, to be connected with any

Digitized by Google

railroad or railroads within the state of New York or any state adjoining, forming a continuous line for the carriage of passengers and property between points within and without the city; and, more particularly, a tunnel railroad connecting the Pennsylvania system with that of the Long Island Railroad Company. This system is ostensibly for the carrying of freight and for the creation of a closer business relation between the industrial communities of Long Island, New York and the centres touched by the Pennsylvania system, but it will also offer the advantages of passenger traffic to outlying sections, both in Long Island and New Jersey, which are now very hard to reach.

So it may be seen that if the present street railway company in the borough of Brooklyn ceases its efforts to develop, standing still will mean going back. If the borough officials do not do everything in their power to foster the growth of the present system, aiding the company where possible, urging it where necessary, they are not doing their full duty toward the municipality. In order that the system of the Brooklyn Rapid Transit Company may continue as a successful enterprise and that the borough of Brooklyn may continue to grow as at present, there can be no standing still. Not only must the present facilities be improved, but the improvements must be improved upon.

THE ELECTRIC DRIVE IN THE ENVELOPE FACTORY.

A recent important application of electricity to industrial service is found in the motor-driven envelope factory. Very few envelope plants have as yet been equipped on a large scale with individual motors, but, so far as this has been tried, the results in the way of production intensifying have been typical of the successful accomplishments of the motor drive in many other industries.

The manufacture of envelopes is not a complicated process in regard to the number of operations performed in carrying the stock from the raw material state to the finished product, but it is most essential in this work that cleanliness shall obtain in every department. There is no room for the line shaft and overhead belt, with their tendency to drop oil and dust upon the product, in the most modern envelope plants. The machinery of an envelope factory, therefore, offers an ideal field for the application of the individual motor drive, which is certain to be absolutely without menace to the finest quality of paper if properly installed.

As for the intensifying of production, it was found in a recent instance that the output of each machine in a group of folding and gumming machines was increased from a production of 60,000 envelopes per day to 70,000 in the same period, when the machines were electrically driven by individual motors in comparison with the old belt, shaft and pulley drive. In the modernized plant each machine was equipped with an eight-point speed controller, so that the highest output which any special product would stand could be obtained, and this with a considerable saving in power on account of the elimination of line shaft and belting losses. Each machine consumed power only when it was actually turning out its product. As a folding machine capable of producing 70,000 gummed envelopes in ten hours requires only a one-half-horse-power motor to drive it individually, it is easy to see that in the driving of a large group of such machines by the old line-shaft method it may easily happen that more power is lost in the shafting and belts than is actually consumed per day in the individually driven machines themselves. Still another advantage is found in the ease with which a motor-driven machine can be relocated in case it becomes desirable to alter its position in the sequence of factory operations. It is probably not too much to say that the output of an envelope plant can in general be increased from fifteen to twenty per cent by the installation of the individual electric drive, and this field of application is well worth considering in the light of the foregoing points.

DOMESTIC ELECTRICITY.

During the past month there appeared in no less than three well-known semi-popular magazines illustrated articles calling attention to the multifold advantages of electrical heating and cooking apparatus. The hold that electrical utensils have taken upon the popular mind indicates that the spirit certainly is willing, but that the opportunities are far too few. In pushing the sale of electrical appliances for domestic use the manufacturer and the central station man need not devote very much of their time to reciting the utilities of the apparatus. The strong work should be done in inducing builders of new structures to utilize electric wiring with the same freedom as has been the case in piping for gas. The public at large has very little fear of using electricity for domestic purposes. The price of the electrical apparatus and, in fact, the cost of electric service, would keep very few from making use of current if there were pushbuttons and receptacles to tap the circuit with the same convenience as we now turn on the gas.

On another page of this issue we publish the first portion of one of the prize papers secured by the Cooperative Electrical Development Association on the organization and conduct of a new-business department suitable for central stations in cities of 50,000 population and under. This paper is the winner of a $300 prize, and was prepared by Mr. S. M. Kennedy, of the Edison Electric Company, Los Angeles, Cal. The Cooperative Electrical Development Association aims to give these papers the widest possible publicity, and, following their presentation in the technical papers, they will probably be put in pamphlet form and distributed to the central stations throughout the United States. In turning over the prize money to the president of the National Electric Light Association at the recent convention at Atlantic City, N. J., when the winners were announced, Mr. J. Robert Crouse, who is the accredited father of this enterprise, stated that the manufacturers who had contributed the money felt that it was the best-spent $1,000 that they had at any time appropriated. It is to be hoped that among all the suggestions contained in this series of papers much of real value will be found, and that, in its application, the average central station will be largely benefited.

Digitized by Google

MEASUREMENT OF FRICTION IN GAS ENGINES.[1]

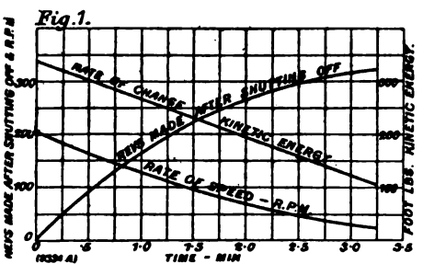
BY A. H. BURNAND.

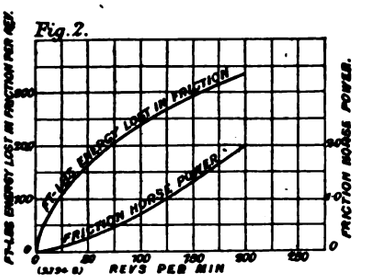
The general methods in practice for ascertaining the work lost in friction by prime movers leave much to be desired on the score of accuracy, and of a really satisfactory statement of the laws which govern friction.

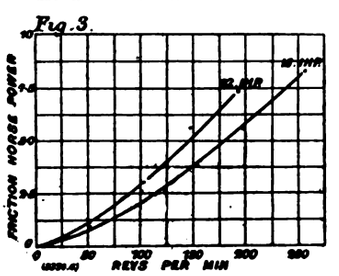
In a series of experiments made by the author, in the mechanical laboratory of Hartley University College, on an Otto type of gas engine, with a cylinder of six and eleven-sixteenths-inches diameter and a stroke of fifteen inches, running at 200 revolutions per minute, the friction horse-power, as measured by the indicator, was approximately two, the positive area only of the diagram being measured. On taking a series of bottom loop diagrams, the mean back pressure—suction and exhaust—was 3.8 pounds per square inch for an impulse cycle, and 5.3 pounds for a "cutout." With eighty idle and twenty working cycles per minute this represented 18,600 and 3,340 foot-pounds of work per minute respectively, or a total of 21,940 foot-pounds = 0.665 horse-power. This neglects a slight loss occurring through compression and reexpansion of air only, during the idle cycles. The area of the bottom loop diagram for a given engine is a function of the engine speed, as may easily be shown by taking diagrams at various speeds.

It is known that the mechanical efficiency of a gas engine rarely exceeds eighty per cent, especially in small sizes; and considering the constructional simplicity of these engines, the friction seems very high, unless due allowance is made for the work lost as above. The particular engine experimented upon could develop from 7.5 to eight brake-horse-power; and with the latter figure and a friction horse-power of two, the mechanical efficiency is eighty per cent, while taking the friction as 2 — 0.665, or 1.33, its value is raised to eighty-six per cent.

With a view to ascertaining what losses occurred through piston friction, the piston was disconnected and the pull necessary to keep it moving measured. This was found to be thirteen pounds, although an initial pull of forty pounds was required to overcome the friction of repose. Assuming no increase at the working velocity of piston, the work lost would be, stroke × 2 × revolutions per minute × 13, or 6,500 foot-pounds, or very nearly 0.2 horse-power. The flywheel, which was specially heavy for electric light work, and weighed approximately a ton, probably caused considerable loss at the crank-shaft journals, but some difficulties prevented the measurement of this. The presence of such a heavy wheel suggested, however, a method by which the influence of the engine's speed upon its total friction might be ascertained with a degree of accuracy not offered by any other means, and to this end the flywheel was carefully measured and its kinetic energy calculated. The average speed of the engine was taken during three minutes, and at a given instant the gas was shut off and the revolution counter thrown into gear. Readings were then taken either at ten







GAS ENGINE FRICTION TESTS.

or fifteen seconds intervals (the latter was found most reliable and satisfactory), and the results tabulated and plotted on squared paper. An equation was found of the form $R = N\,t - a\,t^2 + c\,t^3$, connecting the revolutions made after shutting off gas (R) with the revolutions per minute at the moment of shutting off (N) and the time in minutes after shutting off *(t)*. The values of *a* and *c*, and also N, were obtained by simultaneous equations with values taken at one, two and three minutes. As a check on the accuracy of the formula, the intermediate values were calculated from it. These are given in table i, column iii, the greatest discrepancies being in the first and the last observations. In the first some error might be anticipated from the speed of the engine and from not reading the counter at the exact instant, while in the last the engine was dragging over the final compression stroke previous to reversing its direction of rotation. The value of *a* was 42.5, and of *c*, 3; but these amounts did not necessarily remain constant in other trials, although the difference was not great. Although the value of N was averaged at 208.16 revolutions per minute before shutting off, its value by formula was 206.5, a difference which may be accounted for by the fact that the engine was running light, and that its speed just before an explosion would be less than just after one, the shutting off being effected during the cutouts.

If the formula is differentiated with respect to time, we obtain $\frac{d\,R}{d\,t}$ as $N - 2\,a\,t + 3\,c\,t^2$, or the rate of revolutions per minute at any instant. Values for this are tabulated in column iv. In Fig. 1 the results of column ii and column iv are plotted on a time base. It is interesting to notice that the curve of the former is analogous to the path of a projectile discharged at an angle of elevation whose tangent is $\frac{N}{t}$. The nature of its equation shows this; *a* being half the retardation in revolutions per minute, while *c* is a constant due to the fact that the negative work in drawing in and expelling the air varies as a function of the speed, as previously mentioned.

If we successively differentiate with respect to time, we obtain $\frac{d^2\,R}{d\,t^2} = -2\,a + 6\,c\,t$, a value which gives us the rate of change of the revolutions per minute at any instant of time.

If, now, we consider the changes of speed, we see that they are due to the yielding up of the kinetic energy of the flywheel in overcoming the frictional resistance of the engine. It only remains, therefore, to determine the rate at which the flywheel is giving up its energy and connect it with the corresponding revolutions per minute of the engine to know just how much energy is required per revolution at varying speeds. The kinetic energy E of a flywheel may be expressed as $E = N^2\,k$, where N = revolutions per minute, and *k* = a constant. The value of *k* for this flywheel is very nearly 2, and is taken at this.

If, now, we differentiate E with respect to N, we obtain $\frac{d\,E}{d\,N} = 2\,k\,N$, or, in other words, the kinetic energy changes 2 *k*

[1] Abstracted from *Engineering* (London), July 18.

Digitized by Google

times faster than the revolutions per minute. It was found above that the rate of change of the revolutions per minute was $-2a+6ct$ (the minus sign showing that the revolutions per minute are decreasing), and therefore the kinetic energy will change at the rate of $2k(-2a+6ct)$, or, substituting numerical values, $-340+72t$.

This expression is represented by the straight line in Fig. 1, sloping from 340, where $t=0$, to 106, where $t=3\frac{1}{4}$. Taking the curve representing the revolutions per minute, with its corresponding values, on the same ordinates, of rate of change of kinetic energy, a new curve can be plotted (Fig. 2), in which revolutions per minute form the abscissæ, and the energy equivalent the ordinates. This represents graphically the friction loss per revolution at various rates of speed, and it only remains now to find an expression connecting the two. Various methods may be employed for this purpose, one of the simplest being to plot the logarithms of friction energy and revolutions per minute as coordinates, and determine whether they lie in a straight line, and, if so, the slope of the line. For this particular case it was found that the relation could be expressed as follows:

$$E_f = 18.33\ R^{0.551},$$

or from the logarithmic relation

$$\text{Log } E_f = n \log R + \log. 18.33,$$

where

E = foot-pounds energy lost.
R = revolutions per minute.
n = 0.551 (the slope of the line).
18.33 = a constant depending on engine.

It is interesting to notice that this relation shows that the friction is approximately proportional to the square root of the revolutions per minute, or, in other words, the $\sqrt{}$ velocity of the rubbing surfaces, a point which has already been shown by experimenters on the friction of lubricated surfaces.

Taking the expression above, $E_f = 18.33\ R^{0.551}$ and multiplying by $\frac{R}{33{,}000}$, we have

$$\text{F.H.P.} = \frac{18.33}{33{,}000} R^{1.551},$$

as the relation between friction horse-power and revolutions per minute, the curve of which is also plotted in Fig. 2. It will be noticed that the part of this from 150 revolutions per minute upward approximates closely to a straight line, so that experiments made at about these speeds only would lead to the impression that the friction horse-power was directly proportional to the revolutions per minute; and in some previous experiments made by the author, by taking the indicated horse-power at from 180 to 230 revolutions per minute, light, this appeared to be the case. The equation to the data obtained, however, took the form of FHP $= aR - C$, which was clearly impossible, as when $aR = C$ the FHP $= 0$, thus showing the futility of generalizing from insufficient data.

In examining the results of this method of determining frictional losses it is unnecessary to say that the absolute accuracy will depend on correctly obtaining the kinetic energy of the flywheel, but the general law is unaffected by it, and in some cases the latter is of greater value than the former. Its application to steam engines presents difficulties not existing in the gas engine.

In Fig. 3 two curves are plotted from trials B B and D D in the work of the steam engine research committee. The loading is up to thirty-two indicated horse-power in one case and fifteen in the other, showing in the diagram that friction does increase with load. In themselves the curves exhibit similar characteristics to that of the gas engine in Fig. 2.

TABLE I.

EXPERIMENT ON GAS ENGINE COMING TO REST FROM MEAN OBSERVED SPEED = 208.16 REVOLUTIONS PER MINUTE. ENGINE LIGHT (NO BELTS ON.)

I. Time. Seconds.	II. Revolutions by Observation.	III. Revolutions by Calculation from Formula.	IV. Rate, Revolution per Minute.
0	0	0	206.5
15	47	49	185.81
30	92	93	166.25
45	131	132	147.91
60	167	167	130.5
75	197	197.5	114.31
90	223	224.2	99.25
105	247	247.3	85.31
120	267	267	72.5
135	283.5	283.6	60.81
150	297.5	297.5	50.25
165	309	308.8	39.81
180	318	318	32.5
195	323.5	325	25.25

While no novelty is claimed for the method of estimating friction by retardation curves, the author is not aware of any previous attempts to use it for measurement of gas engine friction.

Wireless Telegraph Conference.

Announcement has been made that the following will represent the United States at the international wireless telegraphy conference which begins in Berlin on October 3: Ambassador Tower, representing the Department of State; Rear Admiral H. N. Manney, U. S. N., retired, representing the navy; Brig.-Gen. James Allen, chief of the Signal Corps, representing the army, and John I. Waterbury, representing the Department of Commerce and Labor.

Election of Directors of the Westinghouse Electric and Manufacturing Company.

The annual meeting of the stockholders of the Westinghouse Electric and Manufacturing Company was held in Pittsburg on Wednesday of last week. There were represented at the meeting 367,884 shares of stock, which was voted for directors of the company as follows:

Anthony N. Brady, N. W. Bumstead, George W. Hebard, E. M. Herr, Brayton Ives, P. F. Kobbe, T. W. Siemon, George C. Smith, W. D. Uptegraff, H. H. Westinghouse and George Westinghouse.

Mr. Siemon and Mr. Uptegraff are new members of the board. They replace James Hazen Hyde, who has removed to Europe, and Frank H. Taylor, who has withdrawn from the company. Mr. Siemon is treasurer of the company, and Mr. Uptegraff has long been identified with the Westinghouse interests.

Meeting of Nebraska Independent Telephone Companies.

A meeting of the representatives of independent telephone companies was held in Beatrice, Neb., on July 21, and an organization of the fifth district of the Nebraska Independent Telephone Association was perfected. This district comprises the counties of Thayer, Jefferson, Pawnee, Richardson, Johnson, Nemaha and Gage.

The session was devoted to discussing matters of interest to independent telephone companies and methods of extending the business and perfecting the service.

The following officers were elected for the ensuing year: president, C. W. Bartlett, Jr., Fairbury; vice-president, A. R. Morris, Blue Springs; secretary-treasurer, C. W. Poole, Tecumseh.

It was announced that there are in operation in Gage county 2,226 independent telephones.

Death of Charles A. Bragg.

Charles Addison Bragg, district office manager of the Westinghouse Electric and Manufacturing Company, Philadelphia, Pa., died at that place on Sunday, July 29, after an illness of over two months' duration. Mr. Bragg was one of the pioneers in the electrical business, he having been associated with the United States Electric Lighting Company as early as 1882. His connection with the Westinghouse Electric and Manufacturing Company began in the year 1889, when he was made the manager of the Philadelphia office which position he filled successfully up to the time of his death. Mr. Bragg possessed a most genial disposition, which endeared him to all with whom he came in contact. He was born and reared in Franklin County, Mo. Following his early education, he attended Yale college, from which he was graduated. He was fifty-six years old. Mr. Bragg is survived by his wife and one daughter.

Digitized by Google

Another Alpine Tunnel.

Consul Edward Higgins, of Berne, reports that the legislature of the Canton Berne has accepted the project for a trunk line called the "Lötschberg," with electricity as motor power, to pass through the Bernese Alps and connect at Brig with the Simplon.

This new road will require five and one-half years to build, and necessitates a tunnel thirteen and one-half kilometres (kilometre = 0.62137 mile) long out of an entire length of fifty-six kilometres. The cost will be about $17,100,000. The steepest gradient will be twenty-seven one-thousandths. It will serve as the most direct means of communication between northern Italy (Milan and Genoa) and the vast district lying to the north and northwest of Switzerland. It will shorten the approach to the Simplon, that now must be reached *via* Lausanne, and will compete with the Gotthard tunnel railroad. In addition to its value as an international trunk line it will prove of vast commercial importance to central Switzerland, and particularly to the Canton and city of Berne, by affording a direct line with the south that now has to be reached by means of the Gotthard on the east or through the Simplon, which requires a roundabout deviation *via* Lausanne on the west. The road that has to be constructed will commence at Frutigen, a town near Spiez, a few miles from the lake of Thun, which is in direct communication with the towns of Thun and Pontarlier and with the cities of Berne and Basel. It will merge into the Simplon at Brig and virtually form the completion of that great project. The distance from Frutigen to Brig will be fifty-six kilometres, from Spiez to Brig seventy-one kilometres, and from Berne to Brig 113 kilometres. From an international standpoint Paris will be fifteen miles nearer the cities of Italy than *via* the new Lausanne-Simplon tunnel route and about 100 miles nearer than *via* Gotthard. From Calais northern Italy can be reached with fifty-two miles less travel than by Lausanne, through the Simplon.

A Federal concession was granted covering the Lötschberg in 1891 and amended in 1897. The Canton has turned over its concession to a syndicate, and the cost will be borne by issuing subvention shares, $4,000,000; preferred shares, $4,600,000; four per cent first mortgage bonds, $5,600,000; and four and one-half per cent second mortgage bonds, $2,900,000, or a total of $17,100,000. The subvention shares will receive no interest until the road is in working order, but the preferred shares will be paid four per cent interest during the period of construction. The Canton Berne participates by the purchase of $3,300,000 subvention shares. The syndicate is composed of Swiss and French banks. It is expected that ultimately the Swiss Federal railways will buy the Lötschberg. The work will commence at once.

Charles J. Glidden and His Automobile Trophy.

Charles J. Glidden, for many years active in the telephone field, is the donor of a trophy for an automobile contest which began at Buffalo, N. Y., on July 13. About 100 motor-cars started in this third annual contest for the Glidden trophy. The contest ended at Bretton Woods, N. H., on July 28, after a distance

MR. CHARLES J. GLIDDEN.

of 1,200 miles had been covered. The rules of the contest are very exacting, but as the honor of winning the trophy is considered of much distinction, the most strenuous efforts were made to conform to the regulations. At the finish thirteen cars were tied for the trophy, but, after a committee meeting held on July 29, it was decided that each of the thirteen contestants should receive a silver medal in token of their work. The trophy itself will remain in the custody of Percy Pierce, of the Buffalo Automobile Club, who won it last year. Mr. Pierce, it is said, did the most consistent driving in this tour, and made no repairs to his car.

Mr. Glidden, whose portrait is presented on this page, is an enthusiastic automobilist, and he and his wife have traveled probably more extensively than any other patron of this modern medium of transportation.

New Power Plant for the San Joaquin Light and Power Company.

About fifty miles northeast of Fresno, on the north fork of the San Joaquin river in the Sierra Nevada mountains, a new hydroelectric plant owned by the San Joaquin Light and Power company of Fresno, Cal., was put in operation in April of this year. The actual work for construction of this plant was begun in May, 1905, but has been somewhat delayed by the fact that all material, except lumber, had to be transported into the mountains on freight teams.

The conduit supplying water for the operation of this plant has a total length of 4.3 miles and comprises open canal, tunnels, flumes and pipe line. These structures are designed for a flow of 100 cubic feet per second and, with the total head of 400 feet, give a total capacity of 3,600 horse-power. The canal is five feet wide on the bottom and three feet deep. It is lined throughout with concrete. The intake basin and the forebay are concrete structures and the tunnels are also lined with concrete. The flumes are of steel plate one-eighth inch thick, semi-circular in form and six feet wide. The pipe line is 3,000 feet long and fifty-two inches in diameter; the thickness of steel varying from three-sixteenths inch to one-half inch.

The water-wheels are of the tangential type, two in number, and develop eighty-three per cent efficiency under full load.

The electric generators, two in number, are of the standard Allis-Chalmers water-wheel type, 1,000 kilowatt, 300 revolutions per minute, 550 volts, three-phase. Each machine is provided with a base and two bearings, the shaft at each bearing being extended to carry an overhung water-wheel. The exciters are direct connected, having armatures mounted on the generator shaft between the bearings. Each exciter has sixty-two and one-half kilowatts output and is easily capable of furnishing exciting current for both alternators.

The revolving field type of alternator is used with the rotor specially constructed for high peripheral speed, which in these machines reaches as high as 7,500 feet per minute.

The plant is the second one constructed by the San Joaquin Light and Power Company. The original plant is to be reconstructed and enlarged and there are plans for other new plants to be built later.

Digitized by Google

RAISE THE HORSESHOE FALLS.

BY ALTON D. ADAMS.

Horseshoe falls must be raised to give some of the electric plants in Queen Victoria park enough water. This move is not required at once, but there is much in the logic of events to make it appear necessary in the not distant future. One factor tending in this direction is the known variation of as much as 7.6 feet in the surface elevation of Niagara river, at a point about a mile above the falls, due to wind and other natural causes. Another and even more menacing condition exists in the rights held by certain parties to divert unlimited quantities of water from the upper Niagara river, and in the pressure that is constantly being exerted in the United States and Canada for the grant of additional rights. The situation of some of the power plants along the water front of Queen Victoria park is rendered still more precarious by the plants above them. Having regard to all of these factors, it is highly probable that another decade of development like the last will make it necessary to erect a dam in the lower part of the Canadian channel, to maintain a sufficient head of water for the operation of the power plants nearest to the Horseshoe falls. It may be noted in this connection that while the six great power plants about Niagara falls operate under heads of water that range from 136 to 210 feet, yet a variation of the level of the upper river by as much as ten per cent of these heads downward from the normal would suspend their operation by laying bare the tops of the various penstocks where they enter their forebays. For the purpose of understanding the causes that may lead to the construction of a dam near the crest of Horseshoe falls, it is well to have some features of the channel between Goat island and the Canadian bank of the river in mind. This channel starts with a width of some 3,700 feet between the head of Goat island and Queen Victoria park, and ends with a width of only 1,360 feet in a straight line between Horseshoe point, where the crest of the falls meets the Canadian bank, and Terrapin point, where this crest touches the shore of the island just named. Nearly all of the line directly between Horseshoe and Terrapin points, however, lies over Niagara gorge, for the crest of the falls has receded up stream so that its centre is about 880 feet above the line joining its two ends. In this way the crest of Horseshoe falls has come to have a length of 3,010 feet, with two parts that come together near the centre at an acute angle. On its way down this funnel-like channel and into Niagara gorge, the water that goes over that half of the Horseshoe crest next to the Canadian bank turns an angle of nearly ninety degrees. This angular change in the direction of the water takes place mainly in the lower third of its course after passing the head of Goat island, and is brought about by the concave shore-line of Queen Victoria park, which corresponds in outline to the change made in the direction of the water. So strange is the current toward this concave part of the Canadian bank, 500 to 1,000 feet above Horseshoe point, that the water there piles up five to six feet higher than the centre of the river surface. Owing to this piling up of the water along that part of the Canadian bank where the lower power plants are located, any considerable reduction of the volume of water moving down this part of the channel will result in a more than corresponding reduction of head at these plants. Before any of the present power plants were constructed in Queen Victoria park, the variation of water level at the sites of those nearest to the Horseshoe falls was frequently as great as 2.5 feet in twenty-four hours, and several times this figure on some occasions, to correspond with the change of as much as 7.6 feet in the river surface, above the head of Goat island. Near the sites of the two power plants that are nearest to the crest of the Horseshoe, the natural depth of water was eight feet, but at the intake of the larger of these two plants the depth has been increased by excavation to a maximum of fifteen feet, where the width is 250 feet. With this depth of water at the intake, its surface there is 516.5 feet above sea level, while the surface elevation at the crest of Horseshoe falls, 1,200 feet distant, is about 492 feet, or some twenty-four feet lower. At the intake of the smaller power plant, about 1,000 feet down stream from that just considered, the distance from the brink of Horseshoe falls is only 480 feet, and here again the shore level of the water is some feet above that at the crest of the cataract. Down toward this concave portion of the Canadian bank, where the two lower power plants are located, the water comes over 3,000 feet of breakers with velocities of eight to seventeen feet per second. Proof that the current of the river moves approximately parallel with the curved shore-line of Queen Victoria park was obtained by casting off a number of barrels from a trestle over the river bank, at the upstream end of Queen Victoria park, and then noting their positions when crossing the first row of breakers, some 2,700 feet from the Horseshoe falls, and also when they arrived opposite to the intake that is only 1,200 feet from the brink of the same cataract. Draw a straight line from the river bank at the upstream end of the park, where these barrels were cast off, to the downstream side of the large intake that is located some 1,200 feet from the crest of the Horseshoe. From the point where this line cuts the highest row of breakers, to the point where they were crossed by one of the barrels, was about 270 feet, and this barrel was some 215 feet from this same line when it reached a point on a line at right angles to the intake in question, nearly 2,400 feet below the breakers. A second barrel crossed the first breakers about 540 feet from the line named, and was 325 feet from the same line at a point opposite to the intake in question. For a third barrel the distance from the line in question was some 350 feet on the first row of breakers, and about forty feet opposite to the intake named. Still a fourth barrel was distant about 380 feet along the upper breakers, and 175 feet opposite the intake, from the defined line. The fifth barrel was nearly 1,200 feet distant at the upper breakers, and 1,400 feet opposite the intake below, from the same line. In both of the positions named, this last barrel was in approximately the centre of the channel, and at its lower position it was within several hundred feet of the toe of the Horseshoe.

From all of these facts it follows that the diversion of large quantities of water from the Great lakes and the upper Niagara river will have a double effect on the head available at the two lower power plants on the Canadian channel. One effect will be the less depth, due simply to a smaller body of water in this channel, and then comes an additional decrease of the depth in front of these two power plants, due to lower velocity and less piling up of the water along the concave bank.

With constructions completed and under way that are designed to divert no less than 80,000 cubic feet of water per second from Niagara river, with power companies operating on both sides of the falls that are authorized to divert additional water in unlimited volumes, and with promoters making strenuous efforts to obtain further water rights on the same river from New York and Canada, the erection of a dam near the crest of the Horseshoe falls will probably be a necessity at no

Digitized by Google

very distant day, if the water supply for the two power plants nearest to these falls is to remain unimpaired. Such a dam might properly start from the shore of Queen Victoria park between Horseshoe point and the intake of the lowest power plant, several hundred feet above the falls, and run approximately parallel to their crest-line for a distance of 1,000 feet, or even to the international boundary line, which is some 1,700 feet from the Canadian shore and 200 feet nearer Goat island than is the point of greatest recession at the centre of the Horseshoe. As the depth of the Canadian channel is much less in the part next to Goat island than in that next to the Queen Victoria park, it would not be necessary to extend the dam beyond the international boundary in order to maintain nearly the present water level at the intakes of the lower power plants. Such a dam would probably have its height so limited that it would be entirely submerged, and it would thus create a minor cataract a little above the crest of the Horseshoe falls. The construction of this proposed dam would simply be following the precedent fixed by the two companies whose power plants are nearest to the head of the Canadian channel, for at the intake of each of these plants a long wing dam runs out into the river. At the highest intake, just above the first line of cascades, the diverting dam is some 780 feet long, runs out into the river to a distance of 375 feet, and shuts off an outer forebay of eight acres from the remainder of the channel. For a distance of 680 feet from its upper end, this diverting dam has a top elevation of 553 feet above sea level, then comes a length of fifty feet at elevation 551, and then another fifty feet at elevation 549 above the sea. At the line of intake piers that runs from the upstream end of this diverting dam to the shore of Queen Victoria park, the low-water level of the river is about level with the top of the dam, but outside of the downstream end of the dam, where its overflow section is located, the river surface is some ten feet below that of the forebay. With this great stone arm stretched out into the river, the intake at the head of the Canadian channel is sure to divert enough water for its plant until the depth at this intake is much reduced below its present minimum figure of thirteen feet. The next lower intake in the Canadian channel also has a great diverting dam, some 900 feet long, that runs diagonally out into the river to a distance of 600 feet from the shore of Queen Victoria park. At its upstream end and along the greater part of its length, this diverting dam has a top elevation of 533 feet above the sea, corresponding approximately to the low-water level of the river along the intake line. This dam is estimated to divert twice as much water as the wheels in its power plant can discharge.

When the commissioners of Queen Victoria park granted water rights above the two power plants nearest to the crest of the Horseshoe falls, the engineers of these plants earnestly contended that a sufficient supply of water for their works could only be assured by the construction of a diverting dam far out into the channel, a short distance above the cataract. The increasing diversion of water certainly adds weight to this view, and so does the course of the two power companies whose intakes are nearest to the head of the Canadian channel, in building the great diverting dams above described. A somewhat similar dam, a little above the falls, would put the lower plants in a much more secure position.

The Faraday Society.

The twenty-second ordinary meeting of the Faraday Society was held on Monday, July 2, at the Society of Arts, John street, Adelphi, London, W. C. (England). Professor Silvanus P. Thompson was in the chair.

Professor Kr. Birkeland, of the University of Christiania, read a paper on "The Oxidation of Atmospheric Nitrogen in Electric Arcs."

The paper deals principally with recent developments of the Birkeland-Eyde process for the fixation of atmospheric nitrogen as carried out in the nitrate manufactory at Notodden and at the experimental works at Arendal.

By way of introduction extracts are given from the presidential address delivered before the British Association in 1898 by Sir William Crookes, showing the urgent importance of the subject in consideration of the rapid rate of exhaustion of the world's present stock of fixed nitrogen—the great fertilizer for wheat—and it is pointed out that out of the air over each square mile of the earth's surface more saltpetre can be made than is to be found in the whole of Chili. A brief history of the oxidation of nitration by means of electricity includes references to the pioneering work of Priestley and Cavendish (about 1780), to the more recent work of Spottiswoode and Dewar (1880), Crookes (1892) and Rayleigh and Ramsay (1897), and finally to the technical applications developed by Bradley and Lovejoy (1903) and by Kowalski and Moscicki (1904).

The essence of the electrical side of the problem consists in the production of a stable and practical form of high-tension arc in which to effect the oxidation. This the author produces by placing an alternate-current arc equatorially between the poles of a powerful electromagnet. The arc thus formed moves across the electric field with enormous velocity, while its length, and thus its resistance, increases so that the tension is heightened until a new arc forms at the points of the electrodes, and the long outer arc is extinguished. The positive and negative arcs move in opposite directions, and in this way a complete, luminous, circular disc of flame is formed. When the proper conditions are attained, and the arc is stable, one arc only, as shown by oscillograph records, is formed at each reversal of the current. The potential employed is 5,000 volts, and the frequency fifty. The electrodes, which are eight millimetres to one centimetre apart, are made of copper tubing fifteen millimetres in diameter, and are water-cooled; 7.5 per cent of the energy is wasted in this way as heat. The electrodes are removed for repair every 300 hours.

The disc-flame is enclosed in a special furnace, which is described in the paper. The fire-chamber of this is only five-fifteenths centimetre wide, and air is driven into the central region by a Root's blower. At Notodden there are three such furnaces each employing 500 kilowatts. In the new 30,000-horse-power plant, now in course of erection, the furnaces will each absorb from 750 to 850 kilowatts. Figures showing cost of erection and upkeep are given.

The air (75,000 litres per minute at Notodden), which after passing through the furnaces contains about one per cent of nitric oxide, discharges its superfluous heat into a steam boiler, cooling from 700 degrees centigrade to 200 degrees centigrade, and, finally, at fifty degrees centigrade, it enters the oxidation chambers in which the nitric oxide becomes nitric peroxide. It then passes to the absorption towers to be dissolved in water, forming, finally, fifty per cent nitric acid. The unabsorbed nitric fumes are converted in a fifth, milk-of-lime, tower to calcium nitrite and nitrate, which in turn is completely oxidized to nitrate by means of nitric acid. This nitrate lye, mixed with the bulk of nitric acid, reacts on limestone, and is converted into a solution of neutral calcium nitrate which may be crystallized

Digitized by Google

out either in the normal or basic form. The yield of the furnaces is given as 500 kilogrammes of anhydrous nitric acid per kilowatt-year, but this is a minimum yield. The inclusive cost of production is stated to be £4 a ton, the selling price being £8 a ton; at Notodden about twenty-five shillings per electrical-horse-power-year is paid for power, but the cost is less than half of that.

The author finally discusses the theory of the oxidation of nitrogen in electric arcs, and incidentally he describes experiments made to determine the thickness of the arc threads. According to the simple thermochemical theory at every temperature a definite amount of NO is in equilibrium with a fixed mixture of air and nitrogen; at 3,000 degrees centigrade, for example, an entire five per cent will be nitric oxide. To retain this quantity at a lower temperature the cooling must take place with very great rapidity. The great difficulty in making theoretical calculations is that of knowing the temperature of the arc. The author compares results obtained during a very careful trial run at Arendal with those calculated from Nernst's formula, assuming various temperatures for the arc, and he finally, after allowing for the length of time the maximum temperature is effective, assumes an average temperature of 3,200 degrees centigrade. A higher temperature should be arrived at in practice, for the maximum theoretical output coincides with about 5,200 degrees centigrade. The paper concludes with an estimate of the number of molecules in the arc that are split up into ions, and suggests comparisons with air ionized by means of radium. It may be that the proportion of gas ionized will be of determinative importance to the chemical equilibrium of gas compounds.

Dr. H. Borns asked for further information relating to the absorption of the combined gases.

Dr. R. S. Hutton discussed the figures given relating to power consumption. In reply, the author stated that less than 0.07 per cent of the total energy was absorbed in the magnets, and that in the new works only about three per cent of the total power would be used for auxiliary purposes outside the furnaces.

In reply to Dr. R. M. Walmsley, the author stated that greater efficiencies than 179 grammes per kilowatt-hour had been obtained recently.

Dr. O. J. Steinhart referred to the low cost of water power given by the author. In reply, it was stated that the power at Notodden for which twenty-five shillings per electrical-horse-power-year was paid cost only eleven shillings.

In reply to Dr. F. M. Perkin, it was stated that the flow of gas can not exceed a certain amount, or the flame would be extinguished.

The chairman described the careful and elaborate trial to which the process had been put by the commission referred to in the paper, and which entirely confirmed the claims made by the inventors regarding efficiencies and costs. He alluded to the well-known important work of Professor Birkeland on the aurora borealis and on the action of magnetic fields on cathode discharges, and showed how those purely scientific investigations led up to the working out of the present important industrial process.

Dr. Eugene Haanel, of the Department of the Interior, Ottawa, presented a "Preliminary Report on the Experiments Made at Sault Ste. Marie, Under Government Auspices, on the Smelting of Canadian Iron Ores by the Electrothermic Process." The paper was communicated by F. W. Harbord.

The experiments described were made for the purpose of amplifying the results obtained at La Praz and Livet by the Canadian commission in 1904, in view of the special conditions obtaining in Canada.

The furnace, which is fully described and illustrated, was of the Héroult type; it absorbed 5,000 amperes at thirty-five to forty volts (power-factor 0.919), being fed from a transformer of 225 kilowatts capacity. The official experiments, of which a selected number are explained in detail with full chemical, electrical and thermal data, lasted nearly two months, and during that time 150 casts were made, yielding fifty-five tons of pig iron. The experiments indicated that under normal conditions about 11.5 tons were produced by an expenditure of 1,000 electrical-horse-power-days; with an improved furnace of, say, 1,500 electrical-horse-power capacity, a figure of twelve tons should, it is stated, be reached. The mean figure provisionally adopted by the commission was only 7.8 tons per 1,000 electrical-horse-power-days. The consumption of electrode was about eighteen pounds per ton of pig iron; it was greater for white than for gray iron.

The results obtained are summarized as follows:

1. Magnetite (which is the chief Canadian ore) can be economically smelted by the electrothermic process as hematite.

2. Ores of high sulphur content not containing manganese can be made into pig iron containing only a few thousandths of one per cent of sulphur.

3. The silicon content can be varied as required for the class of pig to be produced.

4. Charcoal, which can be cheaply produced from mill refuse or wood which could not otherwise be utilized, can be substituted for coke as a reducing agent, without being briquetted with the ore.

5. A ferro-nickel pig can be produced practically free from sulphur and of fine quality from roasted nickeliferous pyrrhotite.

6. The experiment made with a titaniferous iron ore containing 17.82 per cent of titanic acid permits the conclusion that titaniferous iron ores up to perhaps five per cent titanic acid can be successfully treated by the electric process.

The paper concludes with an estimate of Dr. Héroult for a 10,000-horse-power plant capable of producing 120 tons of pig iron in twenty-four hours.

A paper on "Electrolysis of Dilute Solutions of Acids and Alkalis at Low Potentials: Dissolving of Platinum at the Anode by a Direct Current," by George Senter, was taken as read.

When dilute solutions of sulphuric acid and of sodium hydroxide are submitted to electrolysis at a potential below that at which oxygen is evolved in the gaseous form, an oxidizing agent is formed in very small amount at the anode. The substance is very stable and is not destroyed by boiling; it is not hydrogen peroxide.

In the course of the experiments with dilute sulphuric acid, it was observed that traces of platinum went into solution from the anode, although the average current density was only about 1.5×10^{-7} amperes per square centimetre; the bearing of this result on the conclusions of Ruer with regard to the action of simultaneous alternating and direct currents on platinum anodes is discussed.

Standardization of Brake Shoes.

The Engineering Association Committee of the American Street and Interurban Railway Association has addressed a circular to the general managers and engineers of street and interurban railway properties in America, asking for information concerning the standardization of brake shoes, journals and journal boxes, tread and flange of wheels, and rails for street and interurban railways. In addition to information the data sheet asks for sketches with dimensions. The information obtained will be carefully collated by the committee, and, together with other material upon this subject, will form the basis of the report of this committee to the convention, which will be held at Cleveland, Ohio, October 15-19.

Digitized by Google

LIVE STEAM HEATED FEED-WATER—ITS EFFECT ON THE OUTPUT AND EFFICIENCY OF STEAM BOILERS.[1]

BY G. WILKINSON.

In comparing modern electric generating works with similar works equipped ten or fifteen years ago, one of the most striking features in the former is the increase in output of the generating units in the engine room and their relative decrease in size. This contrast is especially emphasized when steam turbo-electric generators are compared with those driven by slow-speed reciprocating engines, and it is now common practice to install three or four times the amount of power in a given size of engine room which was then possible.

Again, in many of the early generating works small plants of, say, twenty-five to 100 kilowatts were installed; these soon became too small, and their places are now filled by units occupying practically the same floor area, but of greatly increased power.

No such evolution and improvement has taken place in the boiler house; probably in every case the same boilers are at work, doing practically the same duty and at approximately the same efficiency as they gave when first put to work. The consequence is that they are unable to supply sufficient steam for the larger generating units now installed in the engine room—to supply this extra steam more boilers have had to be installed; thus the boiler-house equipment becomes longer than the engine room, and complicated and wasteful arrangements of steam pipes ensue which are expensive and undesirable.

In any steam boiler the transmission of heat is most rapid through those portions of the heating surface on which evaporation is actually taking place, and if the feed-water on admission to the boiler be raised to the temperature of the steam in the boiler, then those portions of the heating surface which, under ordinary conditions, are occupied in raising the temperature of the admitted feed-water toward the temperature of evaporation, will then be occupied in producing actual evaporation, and thus a greater amount of heat per unit of heating surface will be transmitted from the fire to the water side of the heating surface in a given time, or to put it in another way: to substantially increase the output of any boiler without decreasing its efficiency (but rather increasing it) it is necessary to raise the temperature of the feed-water to the temperature of the steam within the boiler (or as near to it as possible) before passing such feed-water into the water space of the boiler, and thus a larger proportion of the whole heating surface of the boiler is converted into actual evaporating surface. The temperature of all heating surfaces, where evaporation is actually taking place, is kept lower than the temperature of those surfaces which are occupied in raising the feed-water to the temperature of evaporation; due to this lower temperature the surfaces have greater heat absorption power, and therefore more intense fires can be usefully employed without serious increase of temperatures in the gases passing to the chimney, and in this way the output of any boiler can be greatly increased.

The theory in a third form is as follows: to turn water into steam, it must be first heated till it attains the temperature of ebullition, and this elevation of temperature is sensible to the thermometer. This may be termed stage 1.

Next, the water, *viz.*: such portion of it as is lying adjacent to the heating surface is immediately converted into steam by the instantaneous absorption of an amount of heat varying from about three to five times (according to the working pressure) the number of heat units absorbed in stage 1. If, therefore, the whole body of water in any boiler could be maintained at the temperature of evaporation, a maximum absorption of heat would take place on every portion of the heating surface, the water picking up the latent heat necessary for its conversion to steam at an extremely rapid rate, this action in turn producing such a rapid cooling of the boiler plates that a high rate of coal consumption would be required to make good the demand. Thus, under these altered conditions the limit to the capacity of any boiler becomes less a question of heating surface as at present and more a question of the capacity of the furnace for consuming fuel.

HEAT TRANSMISSION THROUGH BOILER PLATES.

A common impression prevails that it is dangerous to employ abnormally high temperatures, or to apply heat in too concentrated a form to boiler furnaces owing to the liability of the furnace plates or tubes to become overheated and seriously weakened, rendering the boiler unsafe to work.

The researches of Blackynden, Durston, Hirsch, Witz and Miss E. M. Bryant, B. Sc., amply prove that this idea is entirely without foundation, provided the heating surfaces are kept clean and the internal surfaces free from scale and grease, and these are essential conditions of first importance in any boilers designed for high duty.

From his experiments, Hirsch concluded that sound and clean plates in a boiler could not be overheated so long as water was being evaporated from them at rates up to seventy-five pounds per square foot of surface per hour; and Miss Bryant in her investigations on "The Thermal Condition of Iron, Steel and Copper when Acting as Boiler Plates," demonstrated that at fifty pounds per square foot evaporation a one-half-inch plate has a temperature of 303 degrees Fahrenheit, and at seventy pounds a temperature of 338 degrees Fahrenheit.

Present practice with modern boilers reveals the astonishing fact that the average evaporation amounts to from two and one-half pounds to seven pounds, rarely more, and, say, exceptionally to ten or twelve pounds of water per square foot of heating surface per hour. Until this rate is very much increased, boiler-house plant can not be considered as worthy to rank alongside present-day engine-room equipment.

It is high time engineers ceased to be satisfied with the boiler equipments offered them by manufacturers at the present time. The author is of opinion that maximum evaporations of from ten to twenty pounds per square foot of heating surface per hour can be obtained in regular practice with suitably designed boilers and accessories, and, given the opportunity, a boiler-house equipment can be designed and put down which, with a single row of boilers, would supply steam to any British power-house existing to-day with a maximum evaporation of fifteen pounds of steam per square foot of heating surface and with a total heat loss not exceeding twenty per cent.

RANGE OF TEMPERATURE IN BOILER WATER.

Another important point which does not appear to receive the attention it merits is the large variation in the temperature of the water within steam boilers. From data published in the report on "Red-Hot Surface Crown Experiments," by the Manchester Steam Users' Association in 1889, the difference in temperature between the top and bottom of the water in Lancashire and Galloway boilers carrying pressures varying from fifty to eighty pounds, after they had been working with others on the steam range for periods

[1] Abstract of a paper read before the meeting of the Incorporated Municipal Electrical Association, London, England, June 22.

Digitized by Google

varying from half an hour to one and one-half hours, was found to be as follows:

Boilers fed with cold water	(a mean of on 5 boilers)	113° F.
Boilers fed with tepid water	(" " 2 ")	106° F.
Boilers fed with hot water from economizers	(" " 3 ")	108° F.

As the temperatures of the feed-water, strength of draught, intensity of the fires, and the conditions under which the boilers named above were worked are not stated, it would not be fair to draw minute comparisons between the results given, but the figures clearly show that the circulation of water with shell-type boilers is sluggish, and if heavy strain on the plates is to be avoided, very hot feed-water should be used, and a vigorous and positive circulation between the bottom and top water should be maintained. The difference in temperature between the top and bottom water in the thirty feet by eight feet six inches Lancashire boilers in the Harrogate works[1] ranges between twelve degrees and thirteen degrees, and the difference in temperature is likely to be further reduced. The author has no data as to the variation of temperatures in the water within water-tube boilers, but it probably shows a wide range, especially in the numbers of boilers which are working without economizers or steam-feed water heaters. According to some writers the circulation within water-tube boilers is so rapid, due to the furnaces being at the bottom of the tall structures, that the hot water from the steaming area is carried over to the cooler downtakes at the back, and thus the difference in temperature between the gases outside the downtake tubes and the steam-heated water within is so small that the transmission of heat through the tubes is practically of no value in helping the boiler to produce steam.

Some engineers consider the back banks of tubes in their large boilers as feed-water heaters, but if they are to be utilized for this purpose, then the steam-temperature water from the furnace end of the boiler should not be allowed to circulate through them, as such steam-temperature water displaces the cooler water and drives it forward to the front end, thus reducing the temperature toward the front end and reducing the active steam-producing area within the boiler.

To use the back end of any boiler for the purpose of heating feed-water is to be condemned, as the tubes are often bad conductors of heat, due to the dirt and soot upon them, and better efficiency would be obtained by cutting out the back part of the boiler, letting the gases away at a higher temperature and utilizing the waste heat in an economizer which has self-cleaning and efficient heating surfaces, and in which the range of temperature between the gases and the feed-water is greater than in the case of the back end of a water-tube boiler, where the feed-water is immediately raised in temperature by the hot water circulating from the active steaming end of the boiler.

Mr. Patchell, in his description of the Charing Cross Company's works at Bow, read before the Institution of Electrical Engineers, said:

The question of economizers was considered, but it was decided that, except at top load, the large heating surface available in the boilers would render the necessity for an economizer doubtful.

This is a view with which the writer can not agree; in his opinion, the heating of water to steam temperature and the production of steam are two distinct and separate operations, each of which should be provided for separately if high duty, economy of space and efficient working are to be fully realized.

Another improvement which the writer expects to see in water-tube boilers is the raising of the furnaces nearer the surface of the water, the hot gases being carried down and through the banks of tubes or flues located below.

For reasons which are embodied in this paper, it will be clear that if steam boilers are to give continuous high duty, the whole of the water within them must be maintained at high temperatures, and the nearer the maximum temperature approaches that of the steam the greater will be the output of any boiler.

METHOD OF HEATING FEED-WATER TO APPROXIMATELY STEAM TEMPERATURE.

In order to approach this ideal condition of affairs it is necessary to employ some special method of heating the boiler feed-water to steam temperature. One practical method of doing this is found in the well-known Druitt Halpin thermal storage.

In commenting on thermal storage at the discussion of Messrs. Booth and Kershaw's paper on "Fuel Economy in Steam-Power Plants," read before the Institution of Electrical Engineers in 1905, Colonel Crompton said:

The next point I want to touch upon is that great puzzle to us all, thermal storage. I only wish to say, as a user of thermal storage, that it has come to stay. It is going to be one of the greatest advantages that electrical engineers who have a peak load have introduced into their stations. Not only does it greatly reduce the quantity of boiler plant required, but it also produces economy of a kind which is altogether inexplicable at the present time. It is probably due to causes which have hitherto escaped the attention of physicists. In my discussion with Mr. Halpin as to the remarkable increase of boiler output which we undoubtedly obtain from the use of thermal storage, we have not yet been able to say with any certainty how it is that when we add storage reservoirs to a boiler, and draw from them at the time of heavy load, the increase in boiler output is not confined to the twenty-five per cent that we would be led to expect by calculation, but we get sometimes an output of at least 150 per cent for two hours in excess of the maximum output which we obtain from the same boilers if the feed-water enters the boiler direct from the economizer at about 250 degrees Fahrenheit. I can not, therefore, pretend to tell you the cause of this remarkable phenomenon, but there is no doubt it exists. Many tests have been made, the measurements repeated so many times, that there can be no possible doubt that thermal storage is a proved fact, and is certain to be a great benefit to power station engineers where a peak load has to be dealt with. I therefore do not agree with the authors that before we use thermal storage we must wait until we have discovered the cause of the phenomena. It is sufficient to us engineers that we have proved the useful effect, and this ought to be sufficient for us. But, in addition, to the increased output, the effect of thermal storage in increasing the boiler economy of a station is very remarkable. One power station that I am connected with, which had previously obtained very good boiler economy, has had this increased nearly twenty-five per cent since thermal storage has been added. The cause of this increase in economy is not so inexplicable as the increase of output, as we can evidently account for part of it by the fact that since we added thermal storage we are able to utilize many of the heat units wasted in the brickwork of our furnaces.

The boilers referred to in the above remarks are the Babcock boilers fitted with thermal storage vessels at the Wood Lane works of the Kensington and Notting Hill Electric Lighting Company, the details of which are as follows:

Each boiler contains 3,654 square feet heating surface, sixty-three square feet of grate area, and carries a thermal storage vessel holding 21,000 gallons of hot feed which we will assume is at the full temperature of the steam, though it is probably considerably less. The steam pressure is 200 pounds per square inch. The normal duty of each boiler is rated at 12,000 pounds per hour, and this normal

[1] Mr. Wilkinson is chief electrical engineer, Borough Works, Harrogate, England.

Digitized by Google

output can be raised to 30,000 pounds for one hour when using the hot feed, and this is considered an extraordinary performance.

Examining these figures in detail, however, we find nothing extraordinary has been achieved, and results equal to the emergency output should be obtainable without the aid of thermal storage.

At normal output the evaporation averages only 3.28 pounds of steam per hour per square foot of heating surface, or 190 pounds of steam per hour per square foot of grate area. Compared with these results the Harrogate boiler gives at normal duty (*viz.*, consuming twenty-four pounds of fuel per square foot of grate area per hour) an average evaporation of 5.98 pounds of steam per hour per square foot of heating surface or 205 pounds of steam per hour per square foot of grate area.

Taking now the emergency duty of 30,000 pounds available for one hour only, we find that the hot water in the thermal storage vessel, assuming its temperature to be equal to that of the steam, gives to the boiler in heat units during the hour the equivalent of 6,800 pounds of steam at 200 pounds pressure. This leaves 23,200 pounds of steam for the hour as the work of the boiler, which equals an average evaporation of only 6.34 pounds of steam per square foot of heating surface, or 368 pounds per square foot of grate area per hour, and assuming 6.5 pounds of steam evaporated per pound of coal, the combustion of fuel per hour per square foot of grate area equals 56.7 pounds.

Again, comparing the Harrogate boiler without steam-heated feed-water, we obtain on high duty—after making a deduction due to heat from the economizer—an average evaporation of ten pounds per square foot of heating surface, or 397 pounds per square foot of grate area, and with a consumption of 63.4 pounds of fuel per square foot of grate area per hour. With steam-heated feed-water the Harrogate results would be higher and the already higher figures would thereby be considerably increased.

A disadvantage with the hot-feed system of Mr. Halpin's is that only a certain amount of hot feed is available, and when this supply is exhausted the boilers drop down to their normal steaming power, and the process of preparing and storing hot-feed water must commence again. A continuous method of securing steam-temperature feed water is to be preferred to a spasmodic one, especially in works occupied in carrying continuous heavy loads.

Since commencing to write this paper, the author came across a very interesting paper read before the Belfast Mechanical and Engineering Association in 1902 on "Live Steam Feed-Water Heating," by A. W. Hamilton, in which it is shown that exhaust-steam heaters and other feed-water heaters, such as Green's economizers, always save more fuel than can be accounted for by the heat units which they return to the boiler in the feed-water, and Mr. Hamilton quotes several carefully made tests on economizers showing four per cent, 4.3 per cent, 5.7 per cent and 4.6 per cent saving respectively over and above the actual theoretical saving. In this paper attention is drawn to the results obtained by the late Sir W. Anderson as far back as 1872 concerning experiments carried out with steam-jacketed pans. He found that the quantity of heat passed through the metal per square foot per degree per hour was 260 units when heating water, but that the number of units was 606 after the water began to evaporate, showing a greatly accelerated passage of heat when evaporating; two and one-half times as much, indeed, as when only heating. In another experiment, while heating the water to the boiling point, the heat transmitted per square foot per degree per hour was 368 units; but after evaporation began the heat transmitted was 660 units. Here the passage of heat for evaporating water was 1.8 times as much as in heating without evaporation.

The late Sir Frederick Bramwell made similar experiments with a jacketed copper pan with steam successively of five, ten, fifteen and thirty pounds pressure, raising the water in temperature from 58 to 212 degrees and evaporating it. In the first experiment he found that the rate of transmission of heat per square foot per degree per hour was 162 units, while the water was being heated up to 200 degrees; whilst in heating from 200 to 212 degrees the rate advanced to 327 units, and when ebullition commenced the rate increased to 427 units. It is thus proved that the hotter the water in the boiler the greater is the amount of heat which passes through the boiler plate per unit of superficial area, the measure of relative efficiency being the gain in temperature of the water when not steaming and the water evaporated when steaming. The increased heating power when steaming represented a gain of over 160 per cent over the heat transmission to water at a less temperature than 200 degrees and over thirty per cent over the heat transmission to water at a temperature between 200 and 212 degrees.

The quantity of the draught of steam from a boiler has also an important effect upon the rate of transmission whatever the kind of feed may be, as it is the act of evaporation which produces a more or less rapid rate, and the lowering of the pressure (or maintenance of a pressure) by draught produces the condition of ebullition.

After explaining in a clear and consistent manner the remarkable gain in economy and output due to heating feed-water with live steam, Mr. Hamilton sets out his conclusions as follows:

1. Live steam heaters do save fuel, and economizers show a greater saving than has been accounted for.
2. Evaporating water absorbs heat more rapidly than water which is being only heated.
3. The rate at which heat passes through a plate depends upon the difference of temperature on the two sides of the plate.
4. Evaporation always cools the surface upon which it takes place.

The live steam feed-water heater advocated by Mr. Hamilton consists of a number of perforated trays inserted in the steam space within the boiler; the feed-water is conveyed up the centre stem and drips through the holes from tray to tray until finally it reaches the water level, and during its transit through the steam space it picks up a considerable amount of heat from the steam.

This heater, while it is an undoubted improvement on former types of live-steam heaters of the Berryman type, suffers from the serious disadvantage of having no provision for deaeration of the feed-water, and all the gases occluded are introduced into the boiler; these gases have a detrimental effect on the boiler plates, and experiment has also proved that they prevent in some curious manner the steam from getting freely at the water during its transit; the gases appear to cling round the drops of water and more or less insulate them from the steam.

This is proved by the fact that if water is deaerated it will pick up the heat from the steam more freely than it does if the deaeration cocks are closed, and to get full benefit of the steam heat, effective deaeration must be first secured. Also Mr. Hamilton's heater does not provide for the removal from the boiler of the sulphates and other salts thrown down during the heating process. The removal of these is of the greatest importance if boilers are to be worked on high duty.

Another and more recent method of increasing the temperature of the feed-

Digitized by Google

water to approximately that of the steam is by means of an ingenious and simple feed-water heater made by Messrs. Dales & Braithwaite, engineers, of London, and the author's experiments with this apparatus in the Harrogate electricity works appear to confirm the theories propounded in the earlier portion of this paper.

Before describing the author's experimental work and setting out the results, a short description of Mr. Dales' early experimental work which led to the development of this feed-water heater may be interesting.

MR. DALES' EARLY EXPERIMENTAL WORK.

Mr. Dales set out to find the amount of the difference in the rate of heat transmission to which reference has been made, through surfaces exposed to the absorbing action of water, (1) before it reaches the boiling point, and (2) after that point has been passed, looking for a minimum commercial difference rather than for any minute effects of scientific interest. In this he provided a good spring balance, on which was placed a small ordinary Bunsen flame gas stove, and over this a suitable water-heating vessel was fixed and equipped with a reliable thermometer. The water vessel was covered to prevent evaporation below boiling point at atmospheric pressure. A definite weight of water (say four pounds) was placed in the vessel and the temperature of the water was raised by the gas stove to 100 degrees Fahrenheit. From this temperature the time of an increase to 200 degrees Fahrenheit was carefully noted. This signified the transmission of a definite number of units of heat from the Bunsen flame to the water within a definite time. Then the thermometer, vessel cover, etc., having been removed, the weight shown on the balance-dial was carefully noted, and the water, after reaching the boiling temperature, was allowed to evaporate during the same period of time as in the former test. The weight of water lost by evaporation in the time again denoted the units of heat absorbed in that period. Careful adjustment of the gas flames was made so that they should produce uniform boiling all over the bottom of the vessel to which the heat was applied, also precautions were taken to secure uniformity in the supply of heat, by retaining a regular gas pressure. The experiments were repeated many times in each of the many different sets of conditions.

Mr. Dales found that the rate of heat transmission to the water after ebullition had commenced was twenty per cent greater per unit of time than the transmission during the time occupied in raising the temperature from 100 degrees to 200 degrees Fahrenheit, and that this difference in the rate of transmission under the two conditions of non-evaporative and evaporative heating was the minimum which he could bring about.

It is well known in a general way that almost all the evaporation in a boiler takes place in the region of the fire-box and in a comparatively small area, as the hottest part of the heating surface fixes the temperature and consequent pressure of the steam (excepting so far as this is influenced by the draught of steam from the boiler) while the pressure fixes the boiling point. It will thus be evident that the pressure prevents evaporation in all parts of the boiler where the temperature is at all under the boiling point due to the pressure; and so long as the feed temperature is under the boiling temperature, the boiling area will be less than the total heating surface. This restriction of boiling area will exist to a greater or less extent dependent on the difference in temperature of the feed-water and the temperature of the steam. If all the water which is in contact with all the heating surface in any boiler could have a temperature which is equal to the boiling temperature, and if such heating surface is exposed to a higher temperature than the boiling temperature, ebullition must take place all over the heating surface, the rate of ebullition being in proportion to the different rates according to the supply of heat on such surfaces, and the maximum efficiency producible, for the supply of heat, will be the result. The extent of the boiling area depends on the temperature of the feed, and to a lesser extent upon the distribution of the heat, assuming a constant draught of steam. Following on this, it is evident that the maximum general rate of transmission of heat through the heating surface can only be attained by full temperature feed, which produces a maximum boiling area, which again has a maximum efficiency.

It follows from the foregoing that in all cases where the feed-water of a boiler is injected at any lower temperature than the steam the actual boiling area will be less than the total heating surface, as the water must be in some parts at a lower temperature than the steam, in spite of the continual absorption of the heat from the flues or furnace, and that the whole question of area of evaporation depends upon the temperature of the feed.

The injection water if of a lower temperature than the steam, and if constantly fed, keeps down the temperature of almost the whole of the water of the boiler below that of the hottest part, a graduation of temperature existing according to the supply of heat to the different parts of the boiler. If the fire be forced, while at the same time the temperature of the water differs in parts of the boiler, the heat will only be absorbed at a relatively increased rate temperature for temperature in the boiling area. The boiling area in such a case would be extended, as also it would be by an increase of the temperature of the feed, but the boiling area could only be equal to the whole of the heating surface if the water could be fed to all parts of the boiler at the full temperature due to the steam pressure. It is assumed that the higher efficiency of evaporative as compared with non-evaporative, heating surface has been fully established, and in that case it is therefore clear that any temperature of feed has its corresponding boiling area of heating surface, all of which has a minimum greater efficiency than non-boiling area of at least twenty per cent.

The objective, then, of boiler arrangements and feed is an absolute maximum of boiling area of heating surface.

(To be concluded.)

BOOK REVIEW.

"Continuous-Current Armatures." C. Kinzbruner. New York. D. Van Nostrand Company. Cloth. 80 pages. 5½ by 8½ inches. 79 illustrations. Supplied by the ELECTRICAL REVIEW at $1.50.

"Alternating-Current Windings." C. Kinzbruner. New York. D. Van Nostrand Company. Cloth. 80 pages. 5½ by 8½ inches. 89 illustrations. Supplied by the ELECTRICAL REVIEW at $1.50.

While the literature on the subject of armature winding has not been wanting, it has, in general, been buried in abbreviated form in textbooks on more general subjects or else given in elaborate and expensive works which have treated the subject at great length; and from which it is difficult for the practician to pick out the information he wants. Mr. Kinzbruner has therefore done the student and the practical man a service in preparing these two short and clear treatises—the one on continuous-current armatures, and the other on alternating-current windings. He explains briefly the object sought in constructing an armature, and shows how the forms of winding now employed have been developed. He gives the general winding formulae and illustrates their application. The various types of winding are all explained, their particular features being pointed out. The first book deals with hand and form-wound armatures for direct-current machines of various types, and the second explains the windings employed in single and polyphase generators and motors.

Digitized by Google

Alfortville Central Station and the System Controlled by the Est-Lumiere Company (near Paris).

By C. L. Durand.

AMONG the large stations in the district of Paris may be mentioned the plant which has been erected within recent years in order to supply a part of the eastern suburbs. The system which is controlled by the Est-Lumière Company includes a large central station and two substations, together with a considerable length of underground and overhead lines, covering a large extent of territory. These circuits supply a number of communes throughout the suburbs of the city, such as Alfortville, Charenton, Ivry, Saint-Mandé and many others, and reaches a large population. Before erecting the central plant, the company already operated three separate stations, each covering a certain extent of territory. In order to work on a larger scale, it was decided to consolidate these systems in a single plant and to extend the field of operations. Accordingly the company proceeded to erect a large central plant on the banks of the Seine at Alfortville, producing three-phase current at 5,000 volts. The present plant has been equipped by the Société d' Applications Industrielles, using the Alioth system of electrical apparatus.

The buildings comprise the main station, which is 200 feet in length and seventy-five feet wide, a small building for the general offices, another for the lodgings of the station superintendents, a well-equipped repair shop and a storeroom. About one-half the ground remains for the erection of a second plant similar to the present one, should it be necessary to do this at a later period. The present plant is laid out to contain six main generating units having a capacity of 800 to 1,000 horse-power each. At present four of these sets have been installed and they are constantly running.

The situation of the plant on the banks of the Seine, while it gave many advantages as regards the coal and water supply, had one drawback in that the ground, which is composed of alluvial soil and sand, is very unstable. On this account the whole of the main building, as well as the smoke-stacks, had to be mounted upon piles, and more than 1,200 were driven for this purpose. On the top of the piles was built a foundation of cement above the high-water lever of the Seine, and serving to support the metallic framework of the building.

In the accompanying view (Fig. 1) will be noticed the general arrangement of the alternator groups. On either side of the central space are placed the main groups, while the middle space contains the direct-coupled motor-generator sets which are used to convert the three-phase current at 5,000 volts to direct current at 125 volts for exciting the fields of the machines and for the local circuits of the station. On one side of the station is mounted the large switchboard. The boiler room, which is built alongside the main dynamo hall, has the same length as the latter, but is not as high. At present only one-half this latter building is constructed. At either end of the boiler house is a large smoke-stack some 360 feet high and eighteen feet in outside diameter at the base.

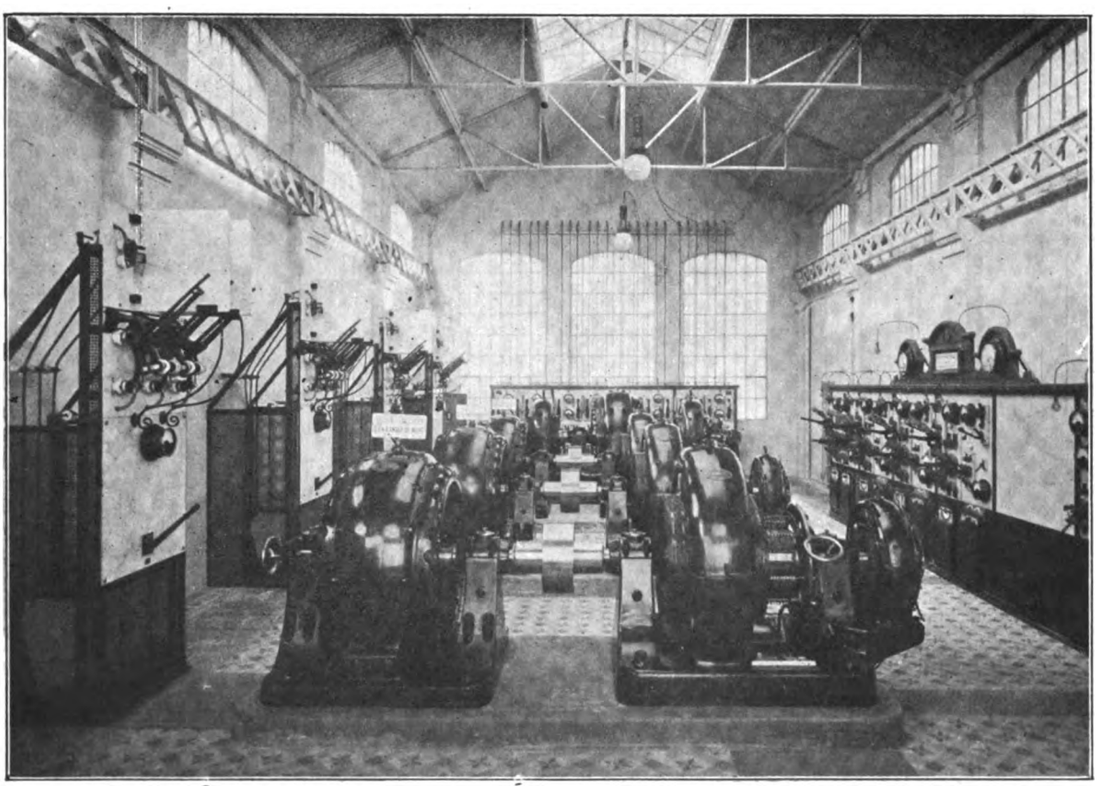


FIG. 1.—GENERAL VIEW OF STATION, SHOWING MOTOR-GENERATOR SETS AND SWITCHBOARDS.

As regards the boiler plant of the station, it is laid out on modern lines, and contains six batteries of two boilers each. These boilers are of the Roser multitubular pattern and have 300 square yards heating surface each. One of these boilers can produce 6,670 pounds of dry steam per hour. The supply and discharge piping of the boilers is placed in trenches below ground and covered with iron grat-

Digitized by Google

ings. The underground conduits for the smoke, which are formed of vaults of considerable section, are built double, so that one set may be cleaned out without stopping the plant. Between the boilers and the smoke-stacks is placed a set of two Green economizers. Each of the latter contains 288 tubes having about ten feet height. In connection with the economizers are mounted a number of small electric motors of two horse-power which are placed in the upper part of the masonry.

The feed-water for the boilers is taken from an underground reservoir which has a capacity of 160 cubic yards and is placed near the boiler room. This reservoir can be fed as desired by means of two different sets of piping, one of these coming from the condenser pump water system and containing cold water, and the second bringing the water from the outlet of the condenser water, which latter furnishes it at a temperature of thirty or forty degrees centigrade. A set of gate-valves placed upon this piping allows of utilizing either of these sources of supply as well as of regulating the flow. The level in the reservoir is shown at all times by a float indicator placed in the boiler room. Pumps worked by electric motors take the water from the reservoir to the economizer. These pumps are two in number and are of the vertical type, having a capacity of twenty-five cubic yards per hour. They are placed in a small outbuilding near the smoke-stack, and are connected by gearing to electric motors of twelve horse-power, excited in series, so that the speed can be easily regulated. This system of feed has proved very satisfactory, and a continuous feed may be secured even when only one of the boilers is working with but very little attention on the part of the firemen. A small steam pump is used as a reserve in this connection, in case the current for the electric motors should fail from any reason. The steam passes by a double piping into the basement of the dynamo hall and passes first through a drier, from whence it goes to the high-pressure cylinders of the steam engines.

Tandem-compound engines of the Sulzer make are used for the main groups (Fig. 2 and Fig. 3) of the station. The engines are built by the Casels Company, of Ghent. When working at a pressure of 130 pounds per square inch and at a speed of 100 revolutions per minute, they will supply from 700 to 1,000 horse-power according to the proportion of the cut-off between the large and small cylinders. The principal data for these engines are as follows: diameter of the high-pressure cylinder, twenty-four inches; diameter of the low-pressure cylinder, thirty-eight inches; stroke, forty-two inches. The fly-wheels of these machines are formed by the revolving parts of the alternators, which are mounted directly on the shaft and have about forty tons weight. The coefficient of irregularity is 1/268 at full load. Passing suddenly from no load to full load, or inversely, the speed varies six per cent, and then comes to three per cent after fifteen seconds, owing to the efficient action of the governor. The condensers of the engines are placed below each of the latter in the basement of the dynamo hall. Piping and valves are also provided to allow the engines to run upon free exhaust, if need be. The air pumps of the condensers are operated by a transmission direct from the engines. The alternators are of the Alioth system, and each of these machines is designed for a capacity of 540 kilowatts. The alternators deliver 5,250 volts at the terminals, with $\cos \phi = 0.75$, or 720 kilovolt-amperes. The frequency is fifty cycles. The total diameter of the alternator is about twenty-one feet, while the revolving part is nearly seventeen feet. Sixty poles, which carry the field windings, are fastened to the cast-iron flywheel, which is made in two pieces fastened together by four bolts at the outer part and four at the hub.

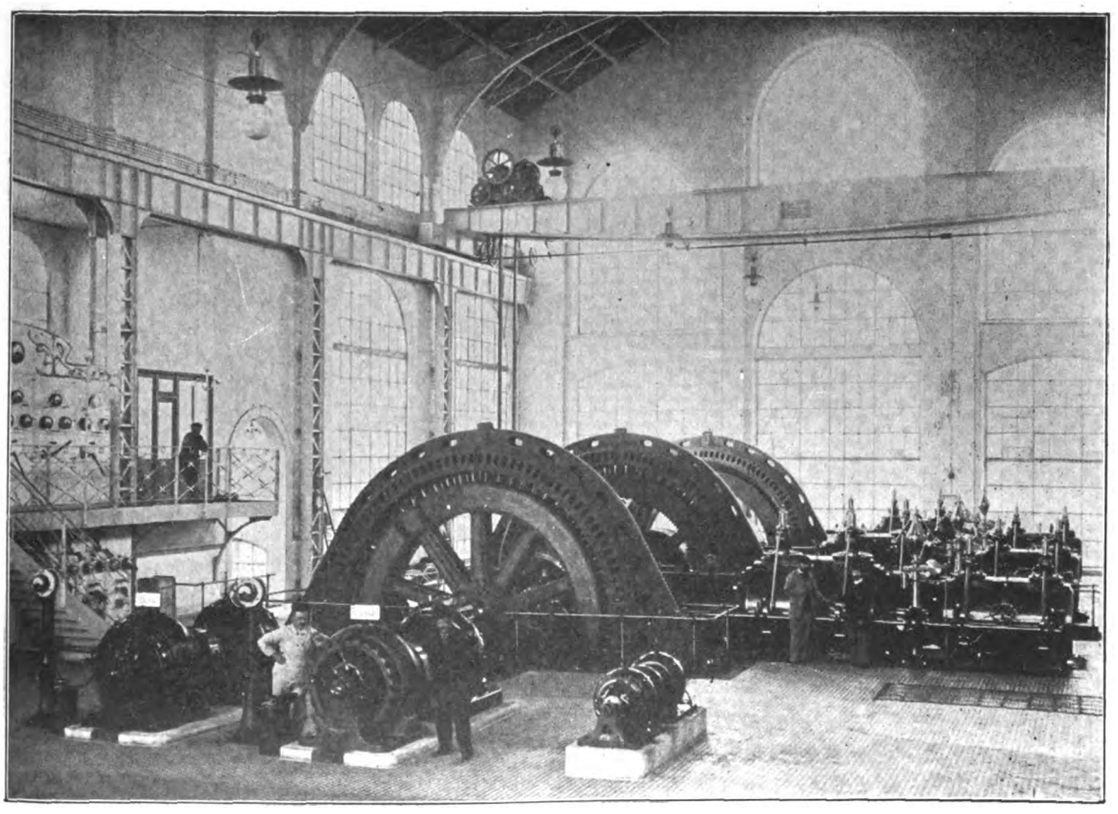


FIG. 2.—GENERAL VIEW OF STATION, SHOWING THE ARRANGEMENT OF MACHINERY.

The outer part of the machine, which forms the armature, is made in four parts. The lower part is supported by a bed-casting placed at the bottom of the pit. The main diameter of the armature lies about two feet above the level of the station floor. On the foundation plates are fitted a set of screws in order to regulate

Digitized by Google

the height of the armature casting and adjust the air-gap. As in the standard form of the Alioth machines, the armature winding is protected by an open-work casting of ring form which is bolted on to each side of the armature casting. The total weight of each of the alternators is about sixty tons.

The alternators are installed in pits which are of such a depth that the shaft of the machine lies at a short distance above the level of the station floor. These pits have a continuous and solid wall, so that the machines are well protected at the lower part, the only openings in the sides of the pit being those which are needed to pass the main cables of the machines. As these openings are well above the high-water level of the Seine, there is no danger that the windings of the machines will suffer any damage from water. Even in case the basement of the building should be flooded, the engines can still be kept running by operating them with a free exhaust.

Direct current, which is needed for exciting the fields of the alternators, as well as for the pumps of the station and the lighting circuits, is furnished by small machines of seventy-five kilowatts operating at 125 volts and coupled direct on the shafts of non-synchronous three-phase motors. These latter machines work upon 5,000 volts, and are designed for 100 horse-power. At present there are two of these groups (Fig. 4) installed in the central part of the dynamo hall, and when the plant is entirely completed a third group will be erected here. The three-phase motors which are used in this case are of the well-known type having a set of collector rings and an outer starting resistance working in oil. To start up the motors, near each of them is placed a column carrying an ammeter and the operating lever of a high-tension three-pole switch, the latter being placed in the basement upon a marble panel. The fuses for the motors are also placed on panels near the former. In order to start up the exciter groups, which are thus composed of a three-phase motor and a generator, one of the main alternators of the station must be running to supply this current. At first, therefore, a source of direct current is needed to excite the fields of the alternator, and for this the station is provided with a small battery of accumulators, upon which is also connected the emergency lighting circuit of the station. The latter is used should the machines stop on account of an accident. This battery, which has a capacity of 400 ampere-hours at a ten-hours' discharge rate, is placed in two chambers situated at each side of the motors of the centrifugal pumps. One of these rooms is used at the same time as the starting point of the main feeders which leave the station. The main switchboard, which lies on one side of the dynamo room, occupies a length of about fifty feet in all. It is raised eighteen feet above the level of the floor, being placed in a gallery which is reached by an iron staircase on each side. Behind the switchboard is an annex which has been built against the station in order to contain the outfit for the numerous cables as well as for the switches and rheostats, which are all placed back of the switchboard. In front of the panels runs a long platform for the attendants, giving a view over the station.

The cables which bring the current from the alternators pass first by the fuse-blocks fixed upon the foundations, then along the ceiling of the basement to the left-hand side of the switchboard. This part of the board comprises six marble panels, upon which are mounted the apparatus for the six machines. On each panel is mounted a lever which works at a distance a 100-ampere, 5,000-volt switch with carbon shunt break, the hand-wheel of the outer field rheostat with a discharge resistance, an ammeter which receives the main current, a voltmeter mounted in shunt upon a small transformer, which also supplies the phase-lamps, and two meters giving the total for each alternator.

On the right-hand side of the switchboard are six panels like the former, which

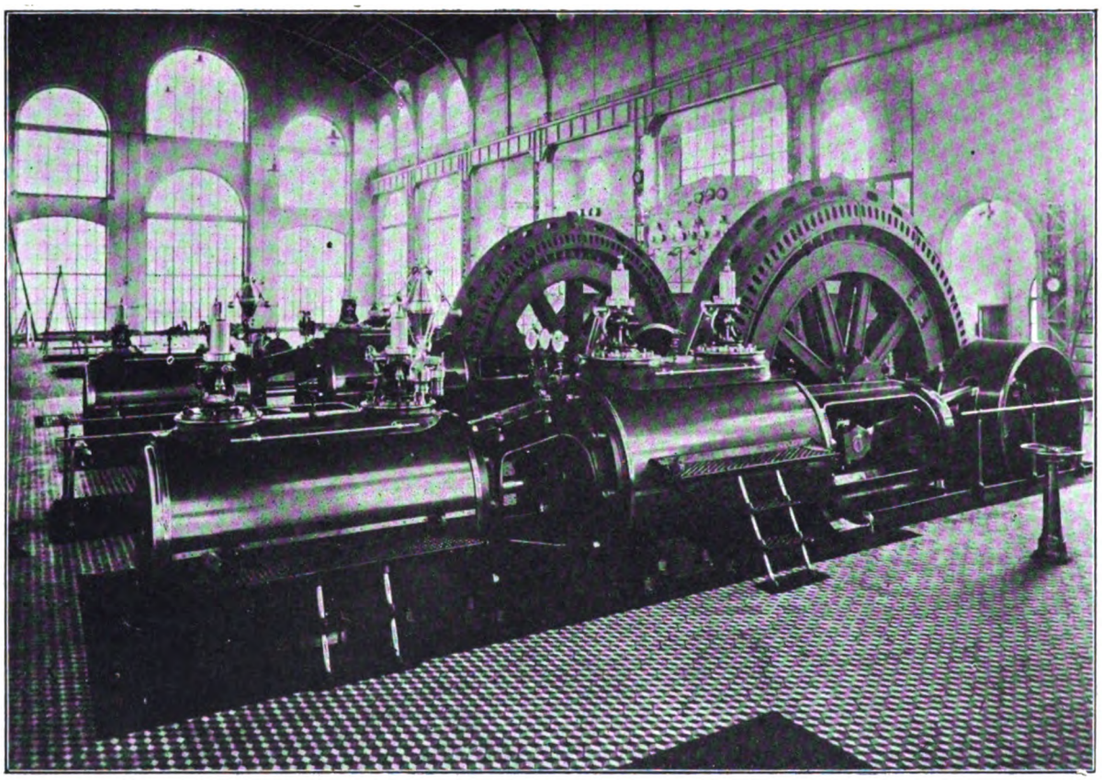


FIG. 3.—NEAR VIEW OF SULZER TANDEM-COMPOUND ENGINES, 700-1,000 HORSE-POWER.

Digitized by Google

are used for the feeders leaving the station. Each of these panels carries a main switch and three ammeters showing the reading for each phase. Placed above this half of the switchboard is a top panel of ornamental form which runs across the board and is used to contain three main voltmeters. In like manner the right-hand half of the board has a similar top panel which contains four wattmeters for the alternators, one for each machine. Behind the switchboard is a well-designed series of bus-bars for the different circuits. Numerous branching switches are used to connect the different parts of the bars, so that part of the switchboard can operating columns for the exciter groups, were installed according to the designs of the Société d' Applications Industrielles, by the Ellison Company.

Above the switchboard has been installed a testing laboratory for taking the insulation of the cables and for standardizing the meters. To avoid the vibrations caused by the machines of the station, the Deprey-D'Arsonval galvanometers are supported by a suspension of the Julius type, which gives almost perfect steadiness to the spot of light. Cables of high-insulation are arranged so as to make the desired connections either at points in the rear of the switchboard or at the junction-

of the plant. The firemen are encouraged by a system of premiums to keep down the amount of coal consumed to the lowest possible figure.

An important part of the Alfortville plant consists in the extensive system of underground cables and the different substations which have been erected. The current from the station is taken to the various supply points by six underground feeders formed of armored cables of three conductors. These feeders start from the storage-battery room and a set of junction-boxes fixed to the wall allows them to be connected with the cables coming from the switchboard. The main feeder

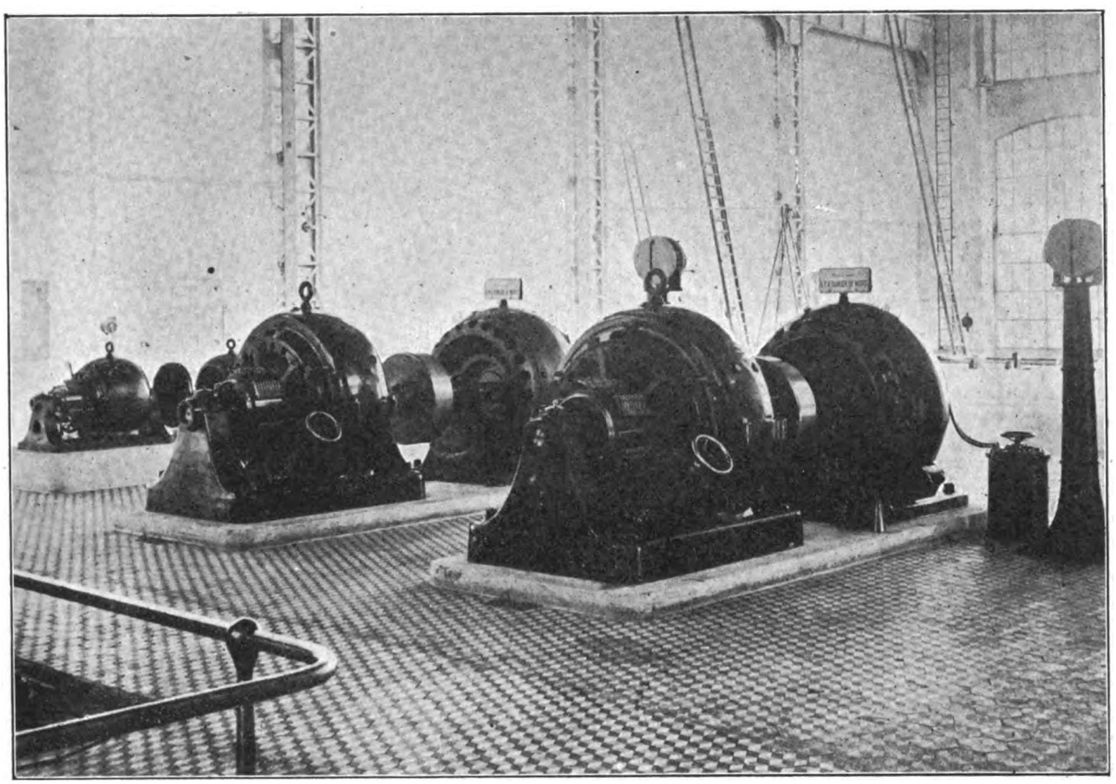


FIG. 4.—MACHINES FOR FURNISHING DIRECT CURRENT FOR EXCITERS, MOTOR-DRIVEN PUMPS AND STATION LIGHTING CIRCUITS.

be thrown out of the circuit for repairs. These bars, as well as all the wires, are painted in three colors, so that each of the phases may be distinguished at a glance. Owing to this very simple method, the connections and work upon the switchboard is made very much easier.

On the ground floor of the station and on each side of the motors of the turbine pumps, are placed two small switchboards for the direct-current circuits. One of these carries the panels of the machine, with the usual instruments and switches, while the second board has three panels, one of which is used to handle the storage-battery circuits, and the other two serve for the lighting and motor circuits of the station. These switchboards, as well as the boxes of the cables, and a permanent ground-wire is provided.

As regards the coal supply of the station, the situation of the plant on the river bank allows the coal to be brought very conveniently by barges. Upon an elevated platform on the bank is mounted a crane worked by electric motors, which is used for unloading the coal from the barges and dropping it into the small carts which are rolled upon a track into the coal yard. The carts are passed over the scales before entering the premises. In like manner the coal is weighed before going into the boiler room, and the firemen present a check for each load of coal which they receive, so that a careful account is kept as to the coal consumption

cables are then sent two by two in the same trench in three different directions to the suburban points of Ivry, Saint-Mandé and Saint-Maur. The lines, which are thus doubled, are laid out so that each cable is sufficient to carry the whole load in each case, thus providing for accidents. The feeder cables are kept charged both day and night. Junction-boxes placed at different points allow of isolating the sections for repairs, etc.

One of the main substations is located at Ivry. It takes the place of a central station which was formerly placed at this point and operated on the three-wire system at 220 volts. This distribution, which was required by the municipality, has been retained, and the central station replaced

Digitized by Google

by a substation for converting the three-phase current of the feeders. The plant in this case consists of three-phase motors working on 5,000 volts and coupled direct to 250-volt generators. The station contains two separate rooms, one for the machines and a second for the large storage battery which is used here. The cables bringing the current at 5,000 volts from the central station come to the switchboards, each carrying a main switch, a voltmeter and two ammeters. From these boards the current is distributed to the three-phase motors by cables which pass around the hall in conduits covered by iron gratings. Each motor is connected with this circuit by a line which passes first through fuses, starting switch and ammeter.

The converting groups in the substation (Fig. 5) are of the Alioth system. These are three groups, each composed of a non-synchronous, 5,000-volt motor of 150 horse-power connected to a 100-kilowatt generator delivering 250 volts. This latter machine carries a small boosting machine on the end of the shaft, which is used to charge the storage battery. In general, two of these groups are run upon the circuits, while the third group serves as a reserve. Besides these groups the station contains another direct-coupled set, known as "Triplex." It is composed of a non-synchronous motor of ninety horse-power whose shaft extends on either side so as to carry the armatures of two generators, which furnish 225 volts direct current and resemble the former machines, except that the boosters are not used in this case. Space has been left in the station for placing a second group of this kind. The current from the generators is sent to a direct-current switchboard, and on the bars of this board may be connected in parallel two batteries of accumulators having 350 ampere-hours' capacity each at five-hour discharge rate. After passing two meters the current goes to the starting board of the feeders and from thence to the overhead lines which branch from the station.

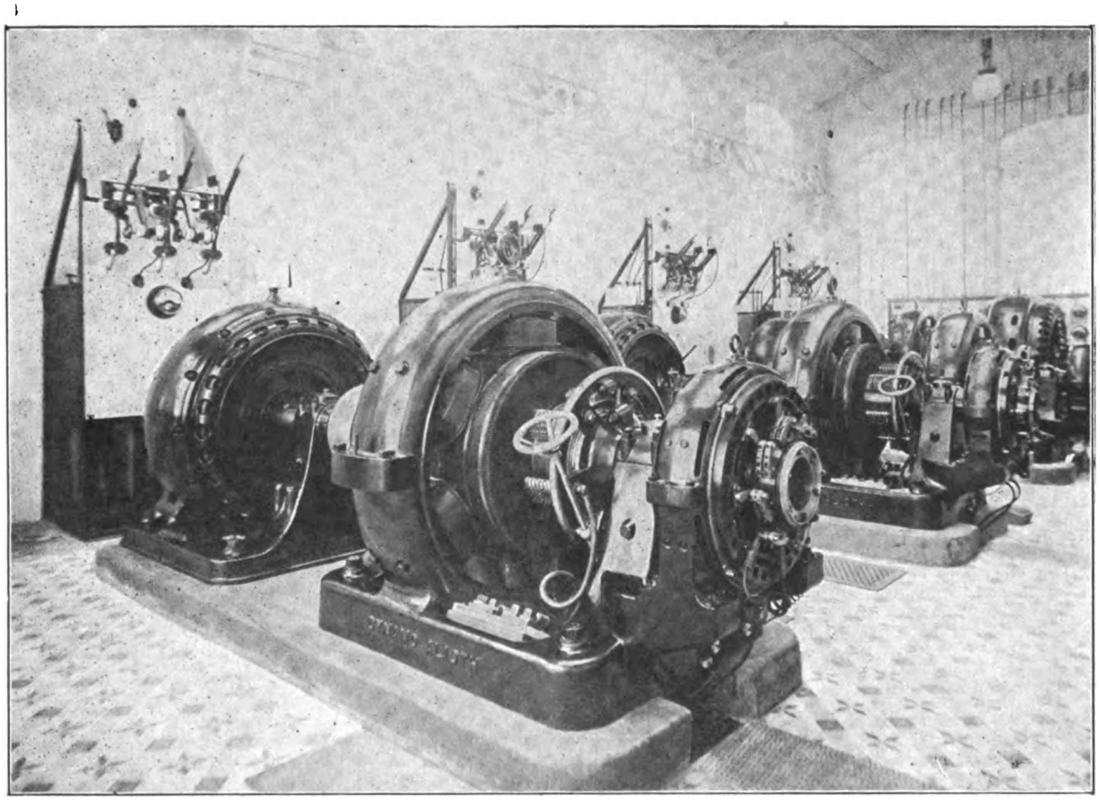


FIG. 5.—SUBSTATION AT IVRY, SHOWING DIRECT-CURRENT GENERATOR AND AUXILIARY MACHINES ON EXTENDED SHAFTS.

A second substation is located at Saint-Maur. This district was formerly supplied by single-phase current produced at a central station which delivered current at 3,000 volts. Transformers placed along the high-tension lines served to supply current to the subscribers at 110 volts. Both primary and secondary lines were overhead and in most cases mounted upon poles. It was decided to utilize the system of circuits without changing them, and to replace the central station by a substation which should contain step-down transformers to lower the tension from 5,000 to 3,000 volts. The present substation contains three Alioth three-phase transformers of 100 kilowatts each. It has been erected at a more central point than the old plant and the feeders have been brought into it.

As regards the new circuits which have been laid out in the suburbs, substations are not used in this case, but the distribution is carried out by three-phase current at 125 volts. Transformer posts have been placed at the proper points on the circuits. They are formed of ornamental kiosks (Fig. 6) built of iron and masonry. The two high-tension cables are brought into the interior. A low-tension switchboard serves as the starting point of the circuits leaving the kiosk. These circuits pass up along the wall of an adjoining building to an overhead line, and the latter then continues along the roofs upon a series of iron brackets, and but few poles are needed in this case.

In the foregoing description a general idea has been given of the important enterprise which has been carried out by the Compagnie Est-Lumière and the Société d' Applications Industrielles, upon the Alioth system. The new plant has made an excellent start and there is no doubt that it will be called upon to receive a considerable extension in the future. It has proved a boon to this part of the suburbs of Paris, which is well-populated and is of an industrial character, and at present there are a large number of subscribers. This is true not only as regards

Digitized by Google

lamps, but also for electric motors. Owing to its large plant, the Est-Lumière Company is able to supply current at a very low price, so that the use of electric motors is constantly on the increase, either for replacing petrol or gas motors, and even steam engines, or for substituting them for horses or hand labor; for instance, in the case of the irrigation farms, where the motors are coming into use for driving the water pumps. It is especially in the use of the three-phase motors where the advantages of the current are appreciated.

FIG. 6.—ORNAMENTAL KIOSKS CONTAINING TRANSFORMER POSTS.

The Circular Tour of the Institution of Electrical Engineers, of Great Britain.

The circular tour of the Institution of Electrical Engineers, of Great Britain, included a trip through Rugby, Birmingham, Manchester, Liverpool, Glasgow, Edinburgh, Newcastle and Leeds. The visiting associations included the Société Internationale des Electriciens, the Associazione Elettrotecnica Italiana, Elektrotechnischer Verein, the Verband Deutscher Elektrotechniker, the Schweizerischer Elektrotechnischer Verein and the American Institute of Electrical Engineers. The party left London on June 28, and at Rugby visited the manufacturing works of the Thomson-Houston Company and Messrs. Willans & Robinson. One party visited Stratford-on-Avon, and another party proceeded directly to Birmingham, where the works of Messrs. Belliss & Morcom and the Summer-Lane plant of the Birmingham Electric Corporation, the plant of the Wolseley Tool and Motor Company and the plant of the Metropolitan Amalgamated Carriage and Wagon Company were visited. Luncheon was served at noon at the Grand Hotel in Birmingham, and Sir Oliver Lodge addressed the visitors, extending a cordial welcome to the city. Professor Gisbert Kapp, Schuyler S. Wheeler and Guido Semenza also made brief addresses, which were acknowledged by J. Gavey, president of the Institution of Electrical Engineers, and the Lord Mayor of Birmingham. In the afternoon the works of the Birmingham Small Arms Company, the General Electric Company and the University of Edgbaston were visited. In the evening a reception was held at the Council House by the Lord Mayor of Birmingham.

On Friday, June 29, the Manchester local section entertained the visitors. In the morning the Lord Mayor of Manchester and the mayor of Salford, with the members of the local reception committee, entertained the visitors at the Town Hall. The Stuart street station of the Manchester Corporation was visited, and at noon luncheon was served at the Town Hall. The Lord Mayor of Manchester presided, and in reply to his remarks addresses were made by Schuyler S. Wheeler, Mr. Gavey, Mr. Howarth and the mayor of Salford. In the afternoon the works of the British Westinghouse Company at Trafford Park were visited. Leaving Trafford Park a steamer trip was made through the Manchester ship canal. In the evening there was a conversazione at the Manchester University, Dr. Alfred Hopkinson, vice-chancellor, receiving the visitors.

On Saturday, June 30, the Lord Mayor and Lady Mayoress received the visitors at the Lime street station in Liverpool. The Lister drive station was inspected, and a trip was made from Dingle to Seaforth on the Liverpool Overhead Railway, the party returning to Liverpool by way of the Lancashire & Yorkshire electric system. The tramways and electric light and power committee of the Liverpool Corporation tendered the visitors a luncheon at the Exchange Hotel, Sir Charles Petrie presiding. Professor T. Epstein and P. J. J. Marsalès made brief addresses. In the afternoon the Formby power-house of the Lancashire & Yorkshire Railroad was visited. The general manager, J. A. F. Aspinall, took personal charge of the inspection. In the evening a reception was held at Liverpool by the Lord Mayor and Lady Mayoress at the Town Hall.

On Sunday, July 1, the train was met at Windermere by coaches and a driving trip was made to Keswick, stopping at Grasmere for luncheon. From Keswick a trip was made to Glasgow. On the morning of Monday, July 2, the visitors drove to Pinkston and Port Dundas, where the power-house equipments were inspected. Lord Provost Bilsland presided at the luncheon given to the visitors at the City Chambers, and addresses were made by

Digitized by Google

Lord Kelvin, chairman of the local reception committee; Councillor Hugh Alexander and Bailie J. Willock. Lady Kelvin was present, and the assembly was graced by the attendance of many notables. In the afternoon the shipbuilding yards and engineering works were inspected, and in the evening Lord Kelvin, as chancellor of the university and chairman of the local section of the Institution of Electrical Engineers, with Lady Kelvin, received the kindred associations at a conversazione held in the university. Signor Guido Semenza, on behalf of the Associazione Elettrotecnica Italiana, presented two volumes of reproductions of the works of Leonardo da Vinci to Lord Kelvin. Professor Pagliani read an address from the University of Palermo.

On Tuesday morning, July 3, the Renfrew works of Messrs. Babcock & Wilcox were visited, the balance of the day being spent in cruising upon the Clyde in the turbine steamer Queen Alexandra, which was chartered by Messrs. Babcock & Wilcox. In the evening a conversazione was held at the Art Gallery.

On Wednesday, July 4, the city of Edinburgh was visited, the many historic places being inspected by members of the party. The Edinburgh Corporation tendered a luncheon to the visitors, the Right Honorable Lord Provost presiding.

On Thursday, July 5, the party visited Newcastle and because of the many events scheduled, three parties were made up. One party visited the Elswick works of Armstrong, Whitworth & Company, later joining the ladies' party, which had been inspecting the castle and the museum, and making a steamer trip to the shipyard of Messrs. Swan, Hunter & Wigham Richardson. The third group visited the works of J. H. Holmes & Company and C. A. Parsons & Company. The whole party assembled at the shipyard of Swan, Hunter & Wigham Richardson, and boarded the Mauritania, and luncheon was served at the Wallsend Drill Hall. H. L. Riseley, chairman of the local reception committee, presided. Herr E. Naglo made the response to Mr. Riseley's address. In the afternoon the Carville power station and the works of the Wallsend Slipway and Engineering Company were visited.

On Friday, July 6, the day was spent in Leeds. The electricity and tramways committee of the corporation received the visitors and served luncheon in the Town Hall. The party was welcomed by the Lord Mayor of Leeds, Mr. Gavey responding. Professor J. L. Farny, Robert Hammond, Sir John Ward, J. H. Patchell and Alderman Matheson made brief addresses. The tramway and lighting power stations and the works of Greenwood & Batley, Kitson & Company and Joshua Buckton & Company were inspected. In the evening a conversazione was held at the Leeds University.

On Saturday, July 7, the concluding day of the tour, Harrogate and Fountain's Abbey were visited, the trip including a thirty-mile coach drive. The return trip to London was made very pleasantly and safely, and before arriving at the King's Cross station the president of the Institution of Electrical Engineers and Mrs. Gavey bade a personal farewell to each member of the party.

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

ELECTRICITY AS AN AID IN LIFE SAVING.

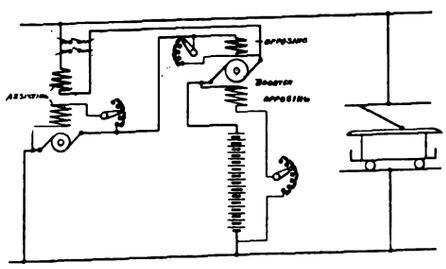
The paper which excited the greatest amount of interest at the Mining Institute meeting was one by Herr Meyer, a mining engineer of the Shamrock collieries in Westphalia, on "Rescue Apparatus" for use in mines after an explosion. After an explosion in a coal mine, the atmosphere of the mine is very bad. The oxygen has largely been displaced by carbonic acid gas and carbonic oxide, the proportion of oxygen in some cases being as low as six per cent, and the problem involved in rescuing men who may be left unconscious in the mine, and of reopening the mine, is a very difficult one. At the Shamrock collieries in Westphalia, where they are very subject to fires from spontaneous combustion, and to the explosions that sometimes follow, apparatus have been worked out, designed to enable the rescue party to explore the mine, notwithstanding the condition of the atmosphere. Other apparatus have been worked out by Fleuss, and by English inventors, but all are on very much the same lines. The explorer carries a supply of compressed oxygen, in one or two cylinders, on his back; and in addition, a vessel containing trays of caustic potash, the object of the latter being the regeneration of the air expired by the lungs. In addition, he carries what is termed a breathing bag on his breast. He breathes the same air over and over again, the carbonic acid and moisture imparted to it in the lungs being taken from it by one part of the apparatus, and a small supply of oxygen being added to the expired air, the oxygen being used in Herr Meyer's apparatus to carry the regenerated air into the lungs by a simple form of injector. Electricity comes in to assist, in a rather humble form. At the Shamrock collieries they have a portable telephone which is carried by the explorers, and by means of which they are kept in communication with those who are in places of safety. The Shamrock collieries apparatus was employed by the Shamrock rescue brigade, under the control of Herr Meyer, at the recent disaster at the Courrières mines in the Pas de Calais, and the portable telephone was of such great assistance, that when Herr Meyer's party returned to Westphalia the telephone apparatus was left at the French colliery. It appears to me that the use of telephonic apparatus might be carried very much farther than this. The great danger in cases of this kind, is the collapse of the explorer. The apparatus he carries is of considerable weight, and the mine roadways are often in a very bad condition after an explosion, so that the work of exploring is very fatiguing. In addition, the regeneration of the expired air from the lungs by the caustic potash, appears to be by no means perfect, and the result is that the expired air becomes, after a time, gradually charged with carbonic acid, and the explorer becomes weaker from the effects of his exertions, and of the vitiated air he is breathing, so that he may collapse at any moment. English mine managers who have used rescue apparatus, on somewhat similar lines, after explosions in English collieries, strongly recommend that three explorers should always go together, in case one or more of them may collapse, and they state that forty minutes is the greatest time an explorer is able to work. There are two important functions of the human body both of which it appears to me, the working of which might be transmitted to the main rescue party at the pit bottom, or wherever fresh air is extended to, *viz.*, the pulse and the rate of respiration. It should not be difficult to design a form of microphone to be placed on some convenient artery, and connected to the cable which the explorers must carry with them, if they have a portable telephone, and to have at the other end of the line, either a surgeon or a trained assistant who would be able to know by the sound in the telephone, the actual condition of the explorer to whom he was connected. A somewhat similar arrangement might also be connected to some part of the breathing apparatus, by which also the labored breathing which accompanies exhaustion, whether from exertion, or the presence of a large percentage of carbonic acid, would also be read at the pit bottom. By the aid of one or both of these apparatus, very much val-

Digitized by Google

uable time, and probably many valuable lives would be saved. It is unfortunately, no uncommon thing for explorers to lose their lives in the act of exploration. It also appears to me that the full benefit that might be obtained after explosions by the aid of electricity, has not been appreciated by mining engineers, in the matter of the restoration of the ventilation. After an explosion the ventilation is almost always very much interfered with. Falls are of very frequent occurrence, main roads and branch roads being often completely blocked by them, and when they are not completely blocked, the ventilating current is often very much throttled. As I have before pointed out in these notes, the ventilating air current in a coal mine follows very much the same laws as an electric current on a two-wire distribution system. The two main roads, the intake and the return, correspond to two main feeder cables, and the branch roads and others correspond to the branch connections of an electrical supply system, it being necessary for an air supply, to construct a bridge for the air from the intake to the return. After an explosion the air may be throttled in its passage through any one of these branches, by a fall of roof, or by other obstructions, and the carbonic acid and carbonic oxide, which have been produced by the explosion, are not able to get away, and hence exploitation in the district where it is most wanted, is most difficult. It appears to me that portable fans driven by electric motors, might be carried to one end of any branch, blocked or, partially blocked, and that a current of air might be forced into it, or through it, the noxious gases being thereby cleared out, and the work of the explorers and of the repairing parties very much lightened from the fact that they would be working in a pure atmosphere. In this country, fortunately, explosions are now very seldom, and therefore it would appear a little quixotic to keep the necessary apparatus in readiness. On the other hand, it would not be a great matter for the power companies which are being engineered in every colliery district, to have portable fans, motors for driving them, and flexible cables on reels kept ready to be sent to any colliery where an explosion has taken place. Failing this, the electrician at the colliery, if allowed to do so, should be able to rig up temporary arrangements for "boosting" the ventilation, from the apparatus at his disposal. Difficulties would of course arise underground, as to fixing the motor and the fan, but again a great deal may be done for temporary purposes with a few timbers, and there is always plenty of timber about a colliery.

Electrical Patents.

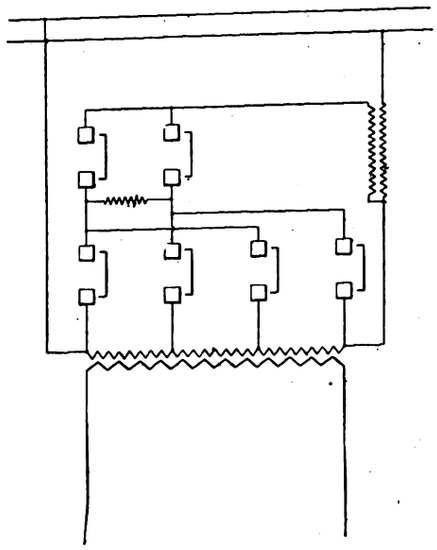
Albert S. Hubbard, Greenwich, Ct., and Edward Lyndon, New York, N. Y., have obtained a patent (826,429, July 17) for an improved self-regulating system of electrical distribution, which they have assigned to the Gould Storage Battery Company, New York, N. Y. The invention relates to regulating systems of electrical-current distribution comprising auxiliary devices, such as a storage battery and booster, inserted in the system to react in response to fluctuations of the load as represented by amperes and prevent the greater part of the same from reaching the generator. The invention consists in the combination of a generator, a work-circuit and a storage battery assisting the generator at periods when the generator load exceeds a predetermined value, an auxiliary generator whereby charge and discharge of the battery are assisted, connected thereto, a winding of comparatively coarse wire on the generator field, and cir-



SELF-REGULATING SYSTEM OF ELECTRICAL DISTRIBUTION.

cuit connections whereby the total current output to the work-circuit is passed through the coarse wire winding on the generator fields.

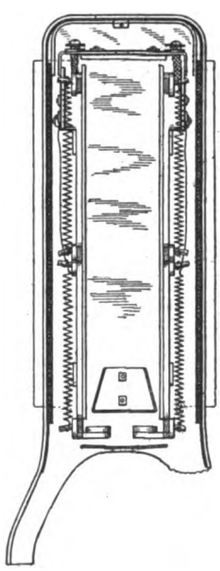
Harve R. Stuart, Wilkinsburg, Pa., has obtained a patent (825,986, July 17) for an improved voltage regulator, which he has assigned to the Westinghouse Electric and Manufacturing Company. The invention relates to apparatus for varying the voltage of alternating-current circuits; and it has for its object to provide a simple, compact and commercially efficient apparatus for raising and lowering alternating-current voltages that are so high or the attendant currents of which are so large that the regulators heretofore generally employed have been found inadequate or unsatisfactory for the service. The invention consists in the combination with an operating handle, a pinion actuated thereby and a gear wheel meshing with the pinion, of a shaft to which the gear wheel is rigidly secured, a quill loosely mounted on the shaft, cams on the quill, switches actuated by the cams, a second quill actuated by the shaft, a shaft actuated by a second quill, and having a threaded portion at one end, a stationary nut with which the threaded por-



VOLTAGE REGULATOR.

tion engages, cams mounted on the shaft, switches actuated by the cams, and tripping devices for the switches.

George J. Schneider, Detroit, Mich., has invented an improved electric cooker (825,938, July 17), which he has assigned to the American Electrical Heater Company. The invention relates to electric cookers, and is more particularly designed for use in broilers. The invention consists in the combination with a casing having parallel side walls, an opening in one end thereof, of a pair of gratings arranged upon opposite sides of the opening within the casing and heat-conductors arranged



ELECTRIC COOKER.

in the space between the gratings and the adjacent sides of the casing and exposed to radiate heat through the openings in the gratings.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

A New Type of Electric Valve Tube.

When platinum foil is connected with barium oxide, and this oxide electrode is made the cathode of a vacuum tube, and heated, the drop of potential at the cathode is much diminished. Joined to an accumulator battery of 110 volts, the tube does not indicate a drop of potential of more than nineteen volts, provided the current strength is not raised above two amperes per square centimetre. This drop is very constant at different current intensities. Thousands of volts may be reduced in this way to eighteen or twenty volts, but only when the oxide electrode is made the cathode. When oscillations of high frequency are sent through the tube, only the phase for which the oxide electrode is the cathode is allowed to pass. The valve tube is a pear-shaped glass vessel. Three anodes, consisting of steel rods, are arranged symmetrically about the cathode, which is a platinum strip four centimetres in length, one centimetre in width, and 0.03 centimetre in thickness, soldered to two stout copper wires. The wires pass through tubular inward projections in the glass, the inner ends of which are fitted with cylindrical platinum caps. Although it may be convenient to speak of the "cold" anode by distinction from the heated cathode, the anode really becomes intensely hot, as in this tube almost the whole current energy is transformed into heat at the anode. When triphase currents are to be rectified the three anodes of the tube are coupled with the three terminals of the transformer, and the oxide cathode is joined to the neutral wire. The valve tubes are recommended for use in combination with the Wehnelt electrolytic current interrupter.—*Abstracted from Engineering (London), July* 6.

On the Physical Properties of Fused Magnesium Oxide.

Messrs. H. M. Goodwin and R. D. Mailey have recently made some extensive tests on the physical properties of fused magnesium oxide. Their attention was first directed to the preparation of fused oxide of magnesium in an attempt to find a substance which, at temperatures up to at least 1,000 degrees centigrade, would serve as suitable containing vessels for fused salts in an investigation now in progress on their electrical conductivity—that is, a substance which would possess the properties of being chemically inert, a non-conductor of electricity, and having a sufficiently high melting point to retain its shape at the temperatures mentioned. The authors were particularly desirous of obtaining tubes or rods of such a substance. After experimenting with a number of silicates and metallic oxides, both in the natural crystalline form and artificially prepared, it was decided to try to make pure fused magnesium oxide. The first attempt was made in a graphite resistance furnace. A pure Acheson graphite rod eighteen inches long and three-quarters of an inch outside diameter was bored with a one-half-inch drill, and the ends fixed into large graphite block terminals for leading in and out the current. The furnace was mounted vertically, packed with coke to prevent excessive oxidation of the graphite tube, and the whole insulated with firebrick. The furnace was heated by current from a fifty-kilowatt transformer, the voltage of which could be carried by steps of ten volts from 160 volts to ten volts. From twenty to thirty kilowatts were used in the furnace to maintain the temperature required. Chemically pure magnesium oxide was fed in at the top of the furnace in the form of powder, and packed down by means of a graphite rod. In this way it could be melted, and rods of the fused oxide were obtained about one-quarter of an inch in diameter and two inches long. In no case could rods be formed as large as the interior diameter of the bored graphite rod, owing to an action between the oxide and either of the walls of the tube, and gases given off from or diffusing through the walls of the enclosing tube. As this method was not satisfactory for the production of the desired size of rods, it was thought that an arc furnace might be more effective. A hollow rectangular graphite boat ten by four by four centimetres was used as a receptacle for the fused oxide. Over the centre a powerful alternating-current arc was arranged, into which the oxide was fed. The whole was enclosed in graphite bricks, around which were built up fire bricks. In this way irregular masses of fused oxide were obtained. From these masses rods or pieces of the desired size were bored by means of carborundum. The large masses thus obtained, however, were not homogeneous: certain portions or layers were composed of very fine, compact crystals, and other portions of larger crystals. Some samples, however, were obtained so hard and compact that they were quite nonporous to water and to fused salts. Difficulty was experienced in getting pieces sufficiently free from minute bubbles or blow holes. Summarizing the results of these tests, the following essentials are noted: When pure and uncontaminated the oxide is pure white, very hard, with a surface resembling glazed porcelain. The substance takes on a good polish. Fragments of magnesium oxide which had not been previously fused were tested for melting points, and it was found that below 1,890 degrees centigrade the fragments did not fuse together or soften. Above 1,940 degrees centigrade they always fused together, indicating that the melting point is between 1,890 degrees centigrade and 1,940 degrees centigrade. In round numbers, 1,910 degrees centigrade may be taken as the approximate melting point of the oxide. The specific conductivity of the fused magnesium oxide at various temperatures was determined as follows:

Temperature.	Specific Conductivity.	Temperature.	Specific Conductivity.
700° C.		1,050° C.	0.34×10^{-6}
800	0.01×10^{-6}	1,100	1.00 "
900	0.10 "	1,150	2.60 "
1,000	0.20 "		

Concerning the chemical properties, the authors determined that the fused magnesium oxide possesses, in a remarkable degree, the ability to withstand chemical action of many neutral salts at high temperatures, and is therefore well adapted for use as vessels and apparatus for containing such salts when subjected to high temperatures.—*Abstracted from the Physical Review (Lancaster)*, July.

Electric Telpher for Conveying Coal.

The Associated Portland Cement Manufacturers, Limited, have equipped their Bevan works with a complete telpherage installation for conveying all the coal used by the works. The system has been constructed by Siemens Brothers & Company, Limited, London, England. The capacity of the plant is 400 tons per day. The coal is brought in in barges of 150 to 250 tons capacity each. The plant is worked day and night, the barges being changed at high tide. A complete steel structure has been built over the barge dock, extending back over storage hoppers. Upon this structure a line of monorail track has been laid, a single line being carried over the dock, thence back with a gradient of one in 5.5 until the necessary elevation

Digitized by Google

is secured; and on the level the track is continued and branched so as to form three lines over three rows of hoppers. Suitable switches are provided at the junction of the three lines of track. The telpher which runs upon this track consists of a steel frame truck with two wheels, each driven by a separate motor. Suspended below the truck, and arranged so that the whole machine is in balance, is a grab with hoisting drum motor and complete controlling gear. The grab has a capacity of one ton of coal. The maximum running speed of the telpher is 750 feet per minute. The average running speed is 650 feet per minute. The hoisting speed is sixty feet per minute. The total load hoisted, including the weight of grab, is two and one-half tons, and the total weight of the telpher, grab and load, is seven tons. The nominal capacity of the telpher is twenty-five tons of coal per hour, but its actual capacity is somewhat in excess of this. With a full barge one man driving the telpher is required for working the plant. As the coal in the barge gets low an additional man is stationed for trimming. The driving motors are totally enclosed and of the tramway type. They are series-wound and are spring-supported in a manner similar to that for tram motors. A powerful foot brake is provided, operating brake shows on both travel wheels. In average work the electric power required for operating the plant has been found to be one-third of a unit per ton of coal delivered into the hoppers. The labor amounts to two cents per ton, which includes the wages of the man driving the telpher, the man in the barge, and cleaning and sundries; so that the total cost for power and labor is about two and one-half cents per ton of coal.—*Abstracted from Engineering (London), July* 13.

A New Zinc-Lead Accumulator.

Although it is over 100 years since Ritter and Gautherot discovered the reversibility of electrolytic action, we are still waiting for the battery which shall put accumulator traction on a really sound commercial basis. The chemistry of the zinc-lead accumulator is somewhat complex, but, generally speaking, the action is that, in discharging, the zinc dissolves in the sulphuric acid, forming zinc sulphate. This is decomposed in recharging, the metallic zinc being deposited on the zinc plates. A stumbling block hitherto has been the difficulty of obtaining a good zinc deposit on recharging. In the new lead-zinc "Zedecco" battery, shortly to be placed on the English market, it is claimed that these difficulties have been surmounted. A thin plate of amalgamated commercial zinc is used for the negative, and for the positive a special type of Faure plate is used. This plate consists of a lead grid filled with a paste composed of litharge and a patent mixture, the proportions of which are not disclosed, such that, when formed, it produces a very porous plate apparently free from buckling. One of the features of the cell is that during the charging process air is bubbled up between the plates from the bottom of the charging boxes by means of perforated pipes connected to a compressed-air reservoir, thus keeping the liquid in constant motion and at the same time presenting streams of air to the charging surfaces of the plates, effecting a smooth deposit of zinc. It is also claimed that this means a higher oxide than PbO_2. The output claimed for the battery at the normal rate of discharge of fifty amperes is forty-eight to fifty watt-hours per kilogramme, and thirty-nine watt-hours per kilogramme at a discharge rate of 150 amperes. These figures correspond with about twenty-two and seventeen and one-half watt-hours per pound of cell respectively. Upon testing, one box of three cells discharged at eighty-nine amperes for two and one-half hours, with an average voltage of 2.42 volts per cell, and gave sixty-five amperes for one and one-half hours at an average voltage of 1.83 per cell, giving a total of 320 ampere-hours. The following data are given for the same cells upon recharging: weight of zinc plates, fourteen in number, on commencing charge, three pounds three ounces; charging volts varied from 2.8 to 2.64 volts per cell, averaging 2.71; charging amperes varied from fifty-five amperes down to fifteen amperes; time of charge, ten hours and twenty minutes; total charge, 424.61 ampere-hours at 2.71 volts, making 1,150 watt-hours; weight of the fourteen zinc plates at end of charge, four pounds two ounces, making a gain of fifteen ounces upon charge. The theoretical weight deposited would be about eighteen ounces. After the above charge the cells were discharged on a constant resistance with the following results: started at 2.58 volts per cell at fifty amperes, down to 1.8 volts per cell at thirty-five amperes; total ampere-hours discharged, 399; watt-hours, 860. After standing all night the cells recuperated and gave 2.5 volts on open circuit, and fifty amperes starting at 2.2 volts for a quarter of an hour. One cell which was short-circuited for over one minute gave 120 amperes at 1.4 volts, and then rose to 2.2 volts on open circuit. The weight of the complete cell was forty-two pounds. This gives for 860 watt-hours over twenty watt-hours per pound of cell, and about thirty-six watt-hours per pound of plates.—*Abstracted from the Electrical Review (London), July* 13.

Electric Traction on the Lancashire & Yorkshire Railway.

The Liverpool, Southport & Crossens line of the Lancashire & Yorkshire Railway Company was converted to electric traction in 1904, the line being one of the first of the main railways in England to be electrified. After two years' working the directors of the company, on the advice of their general manager, are extending the electrification and converting two different routes. It has been proved that electric traction is giving a far greater carrying capacity, a higher economy in operation, a speedier and more flexible service, a lessened depreciation of rolling stock, more effective use of rolling stock and permanent way, and greater facility in adapting the service to meet the demand. The growth of traffic and the successful working of the line have compelled the railway company to electrify all four roads between Bank Hall and Seaforth stations, and all of these are now available for dealing with the more congested traffic which exists between Hall Road and Liverpool. The additional length of track represented by this extension is to be eight miles. The enterprise of the railway company does not stop at this extension, and a tribute to the success of the electrification, as well as to the progressive character of the management, is furnished by the issuing of orders for the electrification of other neighboring lines of the system. The length of track when the contemplated extensions are made will foot up to about seventy-five miles operated by electric traction. In the electrification of the line a fourth rail was added to act as a continuous return, in order that the bonding of the running rails to each other might be avoided. Instead of this, the end of each running rail was cross-bonded to the fourth rail, which still gave the full advantage of the section of the running rails as a return. The experience gained in two years of work shows that the third and fourth rails have not given a large amount of trouble, which some advocates of overhead conductors for railways feared. For considerably over a year all necessary operations in connection with the effective maintenance of close upon fifty miles of permanent way have been carried out without hitch, without anything in the nature of a serious electrical shock or accident, and without undue increase in the cost of such work.—*Abstracted from the Electrical Engineer (London), July* 6.

Digitized by Google

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

ORGANIZATION AND CONDUCT OF A NEW-BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.

BY S. M. KENNEDY.[1]

There is probably no other kind of business in America to-day which is capable of as much development as is the selling of electric energy. At first glance this may appear to be a bold assertion, but the more the subject is considered the more the truth of the statement will become evident. There are countless opportunities for working fields only partially cultivated, for plowing and sowing fields now lying fallow, and for reaching out into the deserts and making them "blossom like the rose." It matters little what may be the relative size of the city in which a central station is being operated—whether it contain 5,000, 50,000 or 500,000 population, the opportunities are there in each case and almost begging to be looked after. However, opportunities are not in the habit of rushing at those who sit down and wait for them; they require to be sought. But many a man who is sincerely looking for Opportunity will be surprised to find that Opportunity has been looking for him, and anxious to meet him more than half way. Electrical opportunities are everywhere in any city, on the streets, in the home, in the office, in the factory, in the store, and in the workshop—on the surface, over head and under ground—wherever men and women live, labor, eat and sleep.

New Business—There is no standing still in the electrical business, and a central station is either going ahead or falling back. As a matter of fact, a really healthy electric company should be behind with its new work most of the time, should be rushed with orders and straining to keep up with them. It is not meant by this that there should be inefficient methods, or insufficient help, but that the pressure of constantly increasing demands for electric energy should be impatiently pushing forward the orders awaiting their turn for attention.

But this great pressure of work, these insistent demands for attention—what are they? Just the visible indications of opportunities which have been stirred up, and opportunities which have been met on the way in. And the central station will obtain the full advantage of these opportunities by means of its "new-business department."

Objects—The great problem which central station managers are trying to solve, is one of equalization. It is highly desirable to increase the sale of electric energy in every legitimate way, but some ways are more profitable to a company than others. In a growing city it is an easy matter to build up a "peak." But it takes efforts and brains to broaden the "peak," to build up a day load and to reduce the difference between the peak load and the minimum demand. These are prime reasons for the existence of a new-business department. It is to this department that the central station manager must look in order that he may obtain a proper load for every hour of each day, and every day of the year.

Foundations—In organizing such a department it is well to consider what are the requisite foundations upon which to build: in the first place there should be a corner-stone on which is graven the words: "Electricity for Everything, and Everything for Electricity." This should be adopted as the motto and slogan for all connected with the department. With such a corner-stone, the remainder of the foundation should consist of: (1) Energy—untiring, unswerving energy—the kind which never stops. (2) Vigilance—the watch-dog of progress—the sleepless element which takes advantage of every opportunity. (3) Alertness; quickness to see an opening for business, and readiness to act upon it. (4) Aggressiveness; so that old methods and conditions may be successfully combatted and changed to conform with modern ideas. (5) Persistence; in order that prospects may be converted into actualities. (6) Knowledge; which is the mother of good judgment. And (7) Enthusiasm; the quality which compels by force of belief—the combination which oils the mechanism of a business and cements the forces for a common cause. These are the principal elements which are required as a safe foundation for a new-business department, and with a proper admixture of each, the superstructure will grow of its own volition.

Staff—A new-business department is no longer considered an experiment or a fad—it is a necessity in the operation of a central station. The generator is the heart of the plant, but the new-business department is the lungs. A man can not get along without a heart, neither can a central station. A man can get along with only one lung, or part of a lung, but he will die if the part shrinks up too much—and so will a central station. For cities of 50,000 population and under, the staff of a new-business department proper, may consist of from one to twelve individuals, depending altogether on the size of the city, the local conditions, and the rate of speed with which certain objects are to be attained. There has been an inclination in some quarters to look upon this department as an extravagance, which tended toward excessive plant investment. But this theory is easily exploded. A properly organized and well-operated new-business department not only points the way to profitable extensions, but increases the value of present investments by developing paying business existing under a company's lines and selling energy during those hours when it would otherwise be wasted, or, at least, not fully utilized. Let the central station manager select a good man to put in charge of the new-business department, and let that man add to his assistants as he feels the necessity, and as circumstances warrant. An energetic man will soon stir up more business and more prospects in a city of 10,000 inhabitants than he can take care of himself, and he and those laboring with him will have pleasure in watching the growth of the new business added as the direct result of their efforts.

The Work—It is safe to say that no city on this continent, no street, no block, and no house can claim to be properly illuminated, or to have all the electricity-consuming devices which might be used with advantage. It is safe to say that in every city of any size there are hundreds of horse-power in steam and gasolene engines being operated at a greater cost than necessary, just because their owners

[1] General agent, Edison Electric Company, Los Angelos, Cal. Winner of the $300 prize offered by the Cooperative Electrical Development Association.

Digitized by Google

have wrong ideas about electric energy and are not aware of the great advantages to be derived from its use. It is safe to say that there are many electrical appliances which could be installed in each household now using electric light. In every community there are many thousands of dollars in revenue waiting to be picked up from the sale of current, the production of which would not increase the central station plant investment to the extent of one cent. As a matter of fact, the people really want to know all about the possible advantages of electricity, and this curiosity should be stimulated and satisfied by the central station, as it is entirely in line with the growth of its business. More light and more power can be sold to consumers, as well as non-consumers—but it must be done by hard work. Men with a knowledge of salesmanship and business methods are required to successfully spread the news of electrical possibilities, to swell the number of consumers, and increase the amount of individual consumption. This is the kind of work cut out and waiting for the new-business department.

New Method—But if it is discovered by a manager that so much valuable business is waiting attention, what must he de to gather it in? Well, there are four ideas which he must grasp before starting on his campaign, namely, that the public requires education, instruction, persuasion and demonstration. It is not usual for men or women to want something which they do not know exists. And after they have been taught that something does exist which would better their condition, they require to be instructed as to its advantages. In a city of 20,000 population, a company may have 3,000 consumers—all using light. Perhaps the manager contentedly leans back in his office chair, and, in answer to an enquiry, says: "Yes, business is good, we keep adding to our consumers right along, and must soon increase the capacity of our plant." And at the same time his load curve may probably resemble the spire of a church as much as anything else! Does he try to broaden his "peak"? Does he try to equalize, so that there may be a profitable day load? Maybe he is too busy to do more work himself. If such is the case, then he had better obtain a means of educating his public. His 3,000 customers could probably be increased to 4,000—but, let us stick to the 3,000. They are all using light. Splendid! What do they want first? More light! It is an axiom, in this business, that the more opportunities there are for using light, the more light will be used. Some of the residences are without porch lights, hall lights, portable lights, cellar lights, outhouse lights and outdoor lights. The stores want more inside lights—and more electric signs. The factories and workshops need more arc and reflector lamps—good light makes cheerful and efficient workmen, and good workmen deserve good light.

Electric Appliances—What next? Do those householders know of all the electric appliances which add so much to the comforts of life? Well, maybe they do know of some of them—but not from the central station office. And yet those housewives are ready to use electric toasters, chafing-dishes, irons, sewing-machine motors, plate-warmers, coffee pots, curling tongs, broilers and a dozen of other conveniences. But they must be told about them.

Anything else? Yes, just POWER—but spell that word with capitals, for it usually means day load, and that is what our friend, the manager, is looking for. That city of 20,000 is using lots of power in intermittent and constant operation. How much of it electric? Is the manager going to sit down until new factories start, and wait for the promoters to come to his office and enquire what can be done? If he does, he will probably have few enquiries. Is he going to wait until those existing power users who have steam and gasolene plants meet with accidents and then expect to have them ring him up for information? Well, maybe he'll have a few calls, but he'll have fewer orders.

What must be done to obtain these valuable kinds of business? Educate, instruct, demonstrate, persuade. If you want to sell more light, show your customers that they need more. If you want to derive the increased income from the use of electric appliances without increasing your investment, you must create a demand for the appliances. If you want power consumers to hold your plant down during the daylight hours, then show the power users in your city the advantages of electric energy. They must learn of the convenience, cleanliness and reliability of electric motor-driven power. They must be shown the saving in insurance, interest and depreciation. They must have all these things explained and demonstrated to them. They must become interested, then anxious, then hungry.

Electric Irons—The company with which the writer is connected operates in one city with a population of 225,000, and in seventeen other cities with populations varying from 4,000 to 25,000 and has upward of 30,000 electric consumers. About eighteen months ago it was decided to stimulate the sale of electric laundry irons for use in private dwellings, some hundreds having already been installed in various laundries on the system and found to be giving great satisfaction. Within twelve months there were installed in residences over 1,600 irons, which were all paid for by the consumers using them. Careful data were compiled and it was conservatively estimated that the average monthly income from each iron was sixty-five cents, or equivalent to eight dollars per year. It was also apparent that those who had the irons were highly pleased, and, in numerous instances, were enquiring for other appliances. But many did not have the irons that would gladly use them, who could not or would not spend the money to buy them. Now, here is what the company discovered: electric irons were good things; day load; lighting rates; no increased plant, line, transformer or meter investment; average income at least eight dollars per year; 1,600 of them installed! Why not 10,000? But the people won't buy them! Well, let's see! Every thousand irons out increases the annual income $8,000; 10,000 irons would mean $80,000! Just like finding it! What was to be done? Invest a little money. Take a little risk. Loan the irons to customers who will use them.

That is what our company has done. The first order placed was for 3,500 irons, and within twelve months from the time the plan was put into effect the company will have loaned not less than 7,500 irons, and there will probably be in use on our system altogether 10,000 electric irons in 1907. That is one way of getting new business and making it easy to obtain more.

Buying Old Plants—One more reference to the means adopted by the same company to obtain power business. It often happens that a power user may be interested in electricity, but he has his money tied up in a steam or gasolene engine and does not wish, or thinks he can not afford, to invest more. During the past two years our company has purchased such plants, in units averaging twenty horse-power each to an aggregate of over 1,000 horse-power. These engines have been resold and shipped to territories away from the company's lines, and their former owners are now invariably strong advocates of electric energy. But engines have only been purchased in this manner where there was no other way of obtaining the electric power business. Owing to the lower cost of motors, most of

Digitized by Google

these exchanges were made without loss to the company, although in some cases it was figured out that an initial loss must be met in order to obtain profitable and permanent power business.

Ways and Means—And now we come to the question of ways and means. How is the public to be educated, instructed and persuaded? What is it that the new-business department must do to begin with, and what must it continue to do? The answer is: advertise, solicit, exhibit, systematize, foster existing business. The success of the central station is first dependent upon good service, but most of the different problems in generation, transmission and distribution have been satisfactorily solved, and most managers know how to obtain an adequate amount of energy. But the limits to the sale of electricity have not yet been sighted, and the more these limits are sought, the greater distance they seem to be away.

The new-business department can not be divorced from the other departments of the company. It must of necessity keep in touch with the operating and construction ends, must be close to the accounting side, and in constant communication with the customers' department. The manager of the new-business department may not be an engineer, but he must have absorbed a considerable amount of technical knowledge. He may not be an accountant, but he must know how to figure. He may not be a meter reader, a collector or a trouble man, but he must know what are the difficulties in each position. And, above all, he must know the public. He must know its failings, its prejudices, its needs and its opinions.

Advertising—In the conduct of a new-business department the subject of advertising is ever present. It is one of the mainstays, and must receive careful attention. But let me take it for granted that the manager acknowledges the importance of advertising—the next question is, what are the best methods of publicity? Probably more than any one else, the man who advertises must put himself in the place of those whom he wishes to reach. With this idea before him, he will understand how to attract the attention of the public, where to place his advertisements, and, when the psychological moment arrives, to produce the best results. Now, advertising of any description must attain its object by a well-defined process. In the first place, it must attract attention, next promote enquiry, then awaken desire, and finally create a demand. Again it is asked, what is the best medium for doing all this and increasing the sale of electricity? For the reason that the public can not be all reached in the same way, it follows that all honest advertising is good. Some people never look at the advertisements in the daily papers, but will eagerly scan each advertising page in a magazine. Others never see an advertisement in a periodical, but yet their eyes catch the notice on a billboard, or the card in a street car. Again, there are others too absent-minded to note anything on billboard or in car, but put a circular or letter in their hands and it will be read from beginning to end. Consequently, if you wish to reach every class, use every medium of attracting their attention. You don't require to go after all at once—but go after them somehow.

Newspapers—Newspaper advertising pays in many ways, its returns being visible and invisible. It frequently happens that considerable space is taken in order to propitiate the press. The friendship of your local papers is important. Foster that friendship, but do not neglect the space you take just because you think it is there always, and the advertisement may be changed at the same time. That space is valuable to you in proportion to the circulation of the paper, just as the editor may be valuable to you for the same reason. If your advertisements are built right, if they attract attention and say something, they will help your business and increase your income. It is a good plan to tell one thing at a time, to change the copy frequently, so that it may not become stale, and to use a snappy, concise style which will gradually draw a regular following of readers, who will look for your advertisement in the paper just to see what you have to say. What you print will be read by consumers and non-consumers. Say something to each. The first-named should be using more current. Point out to them where they need more. The others need to begin. Show them where they will be better off. Create the desire. You do not require to be an advertising expert. Know your own business. Be thoroughly acquainted with the public needs. Talk in the advertisement as you would to a prospective customer sitting in your office. Attract attention—then be short, direct and crisp, and let your words show that you believe in what you say and they will carry conviction.

Regarding the many valuable media of advertising other than newspapers, the business manager must, of necessity, be governed by local conditions and his own experience as to the advantages of each class. It is desirable to vary the manner of publicity, but to keep at it all the time, remembering that constant drops of water will wear away the stone, and that indifference may gradually be changed to interest and antagonism to friendship.

Circulars, Etc.—The mailing of circulars separately or along with bills is a successful way of arousing interest, but the circulars require to be carefully prepared—printed on good paper and always artistic. Neat booklets or folders should be interchanged with the circulars, and each should draw attention to one subject only. Billboards are splendid for special announcements and catch the eyes of many who will not read the papers. He who runs may read a poster—and many read and remember. Street-car advertising is also valuable to impress an idea on the public. If a man is sitting in a car for ten or fifteen minutes and one of your advertisements is opposite to him, he will read it whether he wants to or not. And if what you say is catchy or important, he will not forget it.

"Follow-up" Letters—"Follow-up" letters are a dignified and desirable means of drawing the attention of selected people to a subject which should be of special interest, and are always productive of good results. These letters should have a personal touch to them, and should be neat and attractive in style and diction, avoiding altogether the appearance of a general circular. By this means the individuals you wish to reach are talked to without chance or haphazard.

Advertising on Bills—It has been found that one of the best ways of drawing attention to a subject with existing consumers is to use the backs of monthly bills. If you wish to advertise electric appliances useful in a home, put a snappy notice on the backs of the bills. If you wish to have merchants consider window lighting, electric signs or fans, talk to them briefly on the backs of their bills. Say something different each month. Somehow, every man and woman will look at an electric bill to see the amount. When they see the amount let them also notice a bold line reading "See Other Side." They'll turn the bill over and read your advertisement. That's what you want them to do. The new business manager should do his advertising well, thoroughly, intelligently and systematically. If he can not do it himself, or have some one on his staff who can, he had better pay an ad-smith to take the details of the whole matter off his shoulders. But let him advertise and do it right.

(To be concluded.)

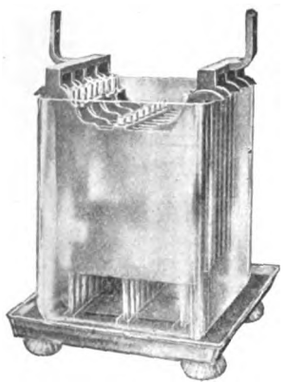
Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

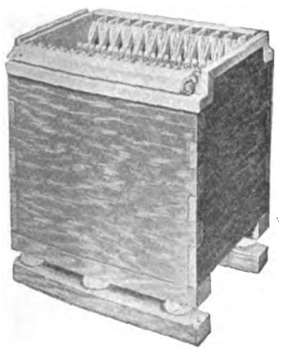
The Gould Telephone Storage Battery.

The very rapid increase in the application of storage batteries for telephone work is a just recognition of the economy and efficiency of this apparatus. The Gould Storage Battery Company, New



TYPE W, GOULD STORAGE BATTERY.

York city, has for a long time been at work designing and improving a special telephone battery which would meet all of the requirements of this particular service. The recent tendency of storage-battery invention has been toward the sub-



TYPE S, GOULD STORAGE BATTERY.

division of the plate, giving it increased surface for active material without increased weight. In the Gould plate the increased surface has been obtained without a sacrifice of mechanical strength. A sheet of chemically pure rolled lead is cut

CROSS-SECTION OF PLATE, SHOWING MANNER IN WHICH LEAD IS SPUN UP BETWEEN THE KNIVES.

to the exact size and shape of the plate and passed backward and forward between two shafts, upon which are mounted alternate thin steel discs and spacing washers. These discs gradually work further and further into the metal and displace it, spinning it up into the ribs between the knives. No lead is removed, the blank being merely changed in form. By varying the gauge of the disc and spacing washers, ribs and grooves of any desired thickness, depending upon the work the plate is required to perform, may be developed.

The advantages of this method of developing the contact surface are that the web of the metal is left as a central conductor, and current-distributing crossbars of solid metal are left between and around the rib sections.

The company claims that the mechanical strength of this design is ample for all needs, and that the electrical design is such as to secure perfectly equal distribution of current throughout the entire plate, preventing uneven wear and distortion.

The lead used in the Gould plate is free from antimony, and consequently there is no destructive secondary action. The spinning process produces a uniform and homogenous metal, which is an important and desirable feature for long life.

The grid or conducting frame is identical with the contact surface for active material, and there is no mechanical connection to become impaired by use. The active material (peroxide of lead) of the Gould plate is formed electrochemically out of the metal of the ribs composing the contact surface. The grooves become filled with closely compact but highly porous active material. When thus filled it is claimed that the contact is so intimate and the space is so narrow that the possibility of active material falling out is reduced to a minimum. The granular and porous structure of the active material secures a thorough circulation and diffusion of the acid electrolyte.

The Gould Storage Battery Company maintains a special telephone department, which undertakes the application of special types of Gould cells suitable for the peculiarity of each form of service.

An Improved Indicator for Enclosed Fuses.

The new line of National Electrical Code Standard 250-volt enclosed fuses, illustrated herewith, is equipped in all capacities with a positive mechanical indicating device just patented, the manufacturer guaranteeing every fuse equipped with this patent indicator to indicate clearly and unmistakably when it is blown and not before.

Fig. 1 shows the size from one to thirty amperes, not blown. The indicator

FIG. 1.—ONE TO THIRTY-AMPERE FUSE, NOT BLOWN.

for this capacity consists of a projectile shell at the end of the fuse tube and inside one of the end caps. This projectile cap is held down over a spiral spring, which is released when the disruption of the fuse and the shell inside is thrown out

FIG. 2.—ONE TO THIRTY-AMPERE FUSE, BLOWN.

longitudinally and closes both side and end holes of the outside shell, as shown in Fig. 2.

This construction provides an indicating fuse for either the spring clip form of contact or the 250-volt Edison screw-plug

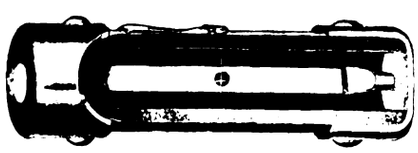


FIG. 3.—THIRTY-ONE TO SIXTY-AMPERE FUSE, NOT BLOWN.

casing, because it is easily seen either from the side or the end of the fuse whether or not the fuse has blown.

Fig. 3 shows the size from thirty-one to sixty amperes, not blown. The indi-

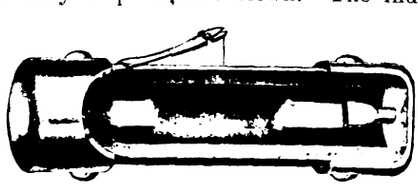


FIG. 4.—THIRTY-ONE TO SIXTY-AMPERE FUSE, BLOWN.

cator for fuses above thirty amperes and up to 600 amperes consists of a phosphor-bronze spring on the side of the enclosing case. This spring is held down by a fine phosphor-bronze wire passing through the case from the end of the compressed spring

Digitized by Google

and is fastened to a cut away portion of the fuse strip. This part of the strip is the weakest portion and being the first to melt on disruption, releases the indicator which springs upward into clear view and can be readily detected even along a row of fuses, as shown in Fig. 4.

These fuses, which are manufactured by the Horton-Morehouse Company, Detroit, Mich., have been thoroughly tested, approved and listed.

A New Line of Magneto Telephones.

The Automatic Electric Company, Van Buren and Morgan streets, Chicago, Ill., has placed on the market a line of magneto telephones, supplementing its automatic switchboards, telephones and auxiliary appliances. In the installation of its automatic systems it has been necessary for the company to develop a line of manual apparatus for making up wire chiefs', trouble and information clerks' desks and toll and farmer line switchboards. This

FIG. 1.—DRY-CELL TELEPHONE.

apparatus has been designed with great care, and since it has met with a large degree of success, the company has decided to place it upon the market as a standard line of apparatus. The company does not expect to make large manual switchboards, but will develop a line that will meet the demand from the rural districts and villages for small simple hand-operated boards. All of its standard bridging telephones are wired for divided-circuit ringing, and the apparatus is built along the lines of standard practice.

Fig. 1 shows a dry-cell telephone. These sets are furnished in quarter-sawed oak or walnut. The woodwork is carefully

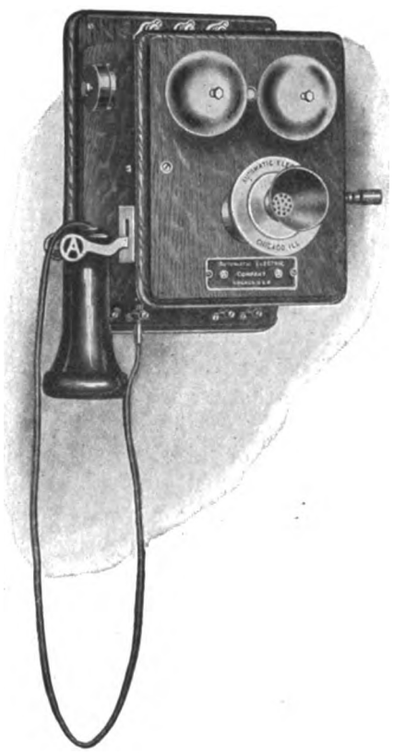


FIG. 2.—RESIDENCE OR HOTEL TYPE TELEPHONE.

made of well-seasoned stock. Each telephone is equipped with long-distance transmitter and hard-rubber shell, receiver, carbon block arrester, adjustable transmitter arm with two concealed cords, induction coil, hook switch with German silver springs having pure platinum contacts, two cells of dry battery, and a three or four-bar hand generator. These telephones are made for both bridge and series work.

Fig. 2 shows a residence or hotel type of telephone. The woodwork is designed to accommodate a three or four-bar hand generator. The binding posts are located on the backboard at the bottom of the instrument for attaching the battery leads. The equipment is the same as that described for the instrument shown in Fig. 1.

Fig. 3 is a view of the receiver. The cord terminals are inside of the rubber shell, and all strain is taken up by a supporting or straining cord which is a part of the braid, and is securely fastened inside the shell. Two styles of receivers are furnished, the difference being in the material used in the outside shell. The standard receiver is in two pieces, made of high-grade hard rubber. The other is made of composition rubber. In either style the shell is made very heavy, the thickness of the walls being not less than five-thirty-seconds inch at any point.

The magnets are made in two pieces from special bar magnet steel, firmly bolted together. The pole pieces are made of the best grade of Norway iron, carefully annealed and rigidly clamped between the magnets and the mounting bridge. The magnet spools are wound with the best quality of silk-insulated copper wire, thoroughly insulated from the spool heads and pole pieces. The spool heads are rigidly fastened to the pole pieces, and all parts are carefully made and gauged.

The mounting bridge, to which all of the interior parts of the receiver are fastened, is made of a special non-magnetic metal cast under high pressure in accurate dies. The front surface of the rim of this bridge is arranged to take the diaphragm, and as the location of all mounting holes in the bridge is determined from this front surface, the distance from the pole pieces to the dia-

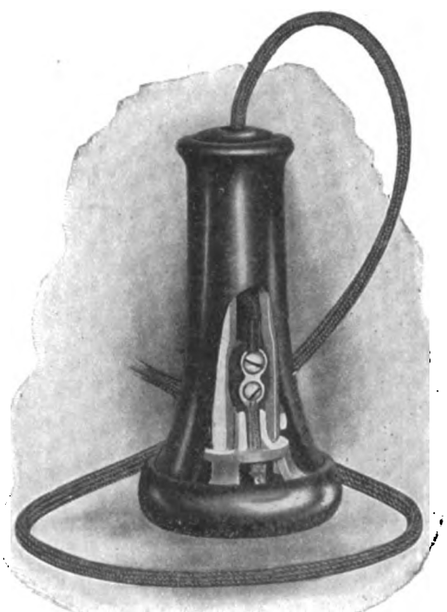


FIG. 3.—RECEIVER.

phragm must be the same at all times. The rear portion of the bridge is fitted to the top of the back shell, and the hard-rubber front or ear-cap is screwed down over the whole, clamping the diaphragm rigidly in place. The diaphragm is made from non-rusting ferro-type metal. The receiver terminals are fastened to insulating blocks attached to the lower end of the mounting bridge, and are so made that

Digitized by Google

the cord terminals can not become loosened. Each receiver is equipped with a thirty-six-inch green silk cord.

Fig. 4 is a rear view of the transmitter. The electrodes are made of a special grade of imported carbon, and are treated by a secret hardening process. The exposed surfaces are given a high polish, so that

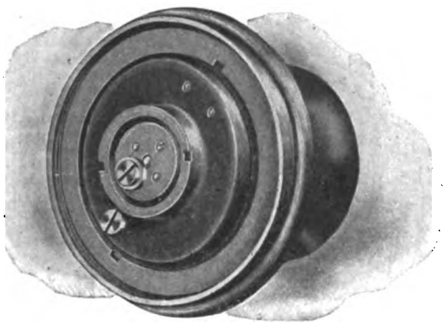


FIG. 4.—REAR VIEW OF TRANSMITTER.

they will not be affected if subjected to excessive heating. The opposite faces are copper-plated, so that they can be soldered to the metal parts. The carbon granules are made from selected materials, and are also specially treated. They are extremely hard, free from dust, and will not be injured by heating of the transmitter. The diaphragm is made of hard-rolled aluminum, and is permanently attached to the back circular bridge by a metal ring spun over the edges. At the centre the carbon retaining cup is fastened by means of a nut. This cup is made of brass and contains the front electrode and the carbon granules. The back electrode is fastened

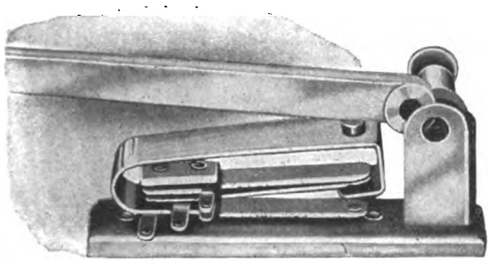


FIG. 5.—HOOK SWITCH, SHOWING METHOD OF DISMOUNTING.

to a brass cup, which is threaded to fit into the back bridge. Surrounding this electrode is a soft felt ring, against which the carbon retaining cup presses, thus holding the carbon granules in place, yet permitting the diaphragm and retaining cup to vibrate freely. The dampening spring is made of German silver, in one piece with two arms shaped to give the proper amount of pressure on the diaphragm. These arms are provided with small felt pads which eliminate the chances of metallic sound in transmission. This spring is fastened to the inside of the back bridge. The front of the transmitter case is made of heavy brass and is threaded on the inside arm, so that the assembled electrode containing case can be firmly held in place by a ring clamp arranged to screw down upon it. This clamp, as well as the back electrode cup, requires a special tool to remove it. The electrode case is completely insulated from the outside case.

Fig. 5 shows the hook switch. The hook lever is made of heavy half-hard sheet brass, so formed as to make a rigid shank. The ends of the hook are formed ring shape, of sufficient size to prevent their entering the hole in the receiver cap and thus damaging the diaphragm. The lever is held in place in the hub support by means of a spring plunger, which can be opened with the fingers and the lever removed or inserted, at will. The contact springs are of German silver, provided with pure platinum points. The springs are insulated from each other and from the frame with pure hard rubber, and they are provided with soldering terminals. The base, hub, hub support and spring plunger are made of steel, and all are exactly alike, so that all parts are interchangeable. Neither the hook lever nor base forms any part of the circuit. These parts are heavily nickel-plated, and the hook lever is highly polished.

Portable Desk Telephones.

The Dean Electric Company, Elyria, Ohio, has placed on the market a new line of portable desk telephones, illustrations of which are given herewith. Fig. 1 shows the desk stand for local or common battery service. The strength and thoroughness of construction of this desk stand are prime features for which the company claims more than ordinary merit. The concealed portion of the framework of the desk stand is made from heavy sheet steel pressed into shape. The parts are securely fastened together in such a manner as to never work loose and cause trouble, even with severe abuse. The upright is a seamless steel tube which is threaded at the bottom to engage in the heavy metal of the base. A heavy leather cushion is provided on the bottom of the stand, embedded in the steel framework, and so arranged as to completely prevent marring the finish of the desk or table upon which the stand may be placed. The upper portion of the stand upon which the transmitter is mounted is also made exceptionally strong. A knuckle joint gives ample movement to the transmitter, and is so designed as to completely conceal the two flexible circuit connecting cords leading to the latter. This knuckle-jointed portion is mounted at the top of a steel

FIG. 1.—DESK STAND FOR LOCAL OR COMMON BATTERY SERVICE.

hook switch supporting frame which extends downward within the desk stand upright and is held securely in place by a spring catch.

The hook switch of this desk stand makes use of platinum-pointed contact

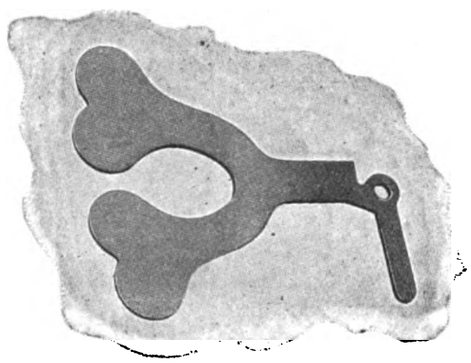


FIG. 2.—SHEET BRASS BLANK FROM WHICH ONE-PIECE HOOK IS MADE.

springs, which are located within the base of the stand and set edgewise, so that all of the contact points are in plain sight for inspection upon removing the base cover. The motion of the hook is transmitted to these springs by a simple intermediate lever, which, together with its cutout or main spring, is located on the removable

Digitized by Google

steel hook switch supporting frame. The lower end of this intermediate lever is

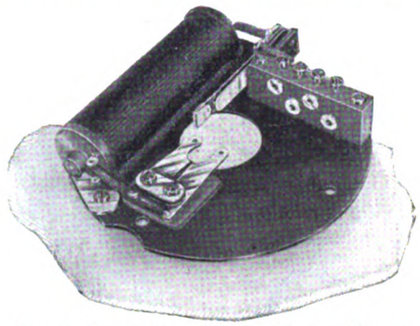


FIG. 3.—INTERCHANGEABLE CIRCUIT PLATE.

shaped so as to properly engage the contact springs when the hook switch supporting frame is inserted within the upright casing. The hook for supporting the receiver is made of one-piece construction, folded over through its entire length, including both prongs. Fig. 2 shows the blank from which this hook is formed.

A new and original Dean feature incorporated in these desk stands is the interchangeable circuit plate. This is shown in Fig. 3. All of the talking circuit apparatus, excepting the transmitter and receiver is mounted on a metal plate completely wired so as to form a unit. These units are interchangeable and are arranged for common battery and local battery circuits. The remainder of the desk stand, excepting the transmitter, is the same for both services. Thus if at any time it is desired to change the system, it is only necessary to replace the circuit plate with one containing the desired new circuit. The plates are complete in themselves and are held in place by three machine screws. The apparatus is securely mounted on the circuit plates by machine screws, no dependence being placed on threading into insulating material. The terminal racks are made for binding standard cord tips, the cords accompanying the stands being thus provided.

A distinguishing feature of this desk stand is the practical way in which all of the working parts are made accessible. The complete stand can be quickly opened for inspection. Fig. 4 shows the desk stand open. In making the inspection the base cover, which is held in place by a substantial lock, is first removed by inserting a screw-driver blade in a slot which shows through the circular opening, and turning it to the left. This completely exposes all of the circuit connections and apparatus, excepting the hook switch lever, the latter being readily removed by simply pressing the projecting release spring and withdrawing the hook switch supporting frame from the upright tube. (Fig. 5.)

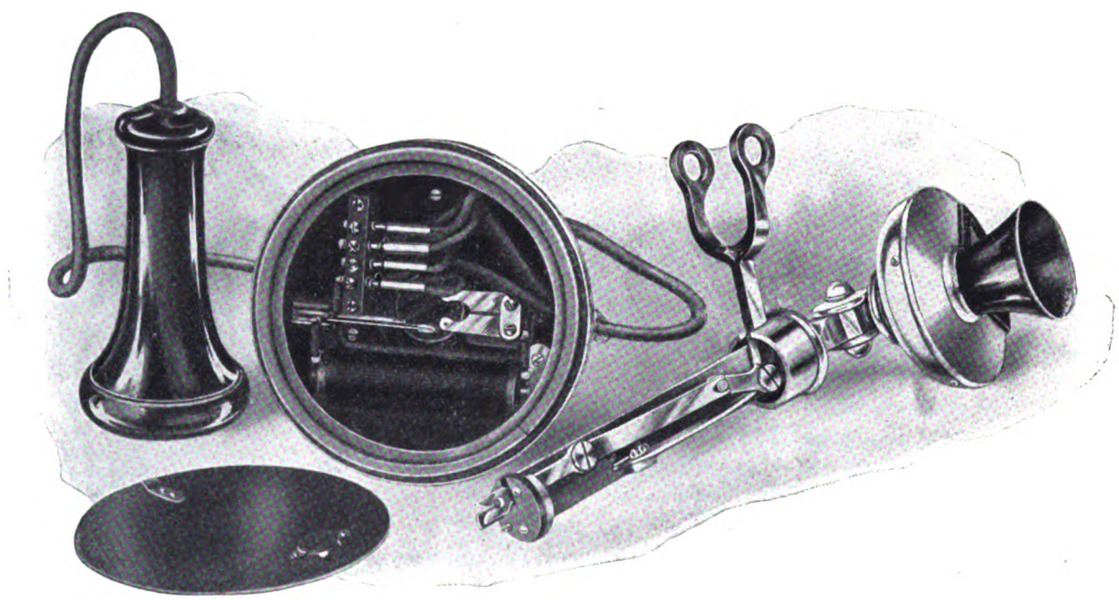


FIG. 4.—DESK STAND OPEN FOR INSPECTION.

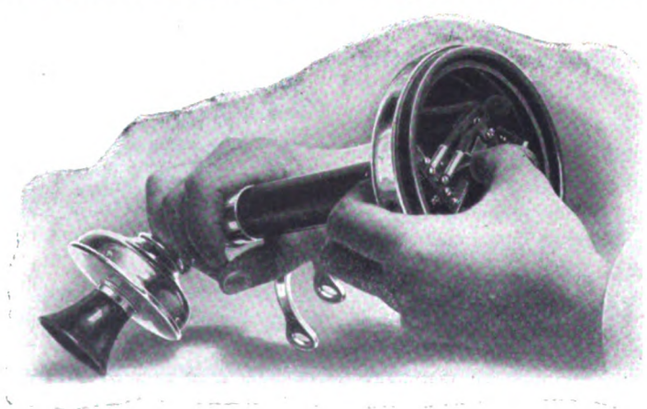


FIG. 5.—WITHDRAWING THE HOOK-LEVER MECHANISM FROM THE UPRIGHT TUBE.

The two cords used for carrying the transmitter circuit to the base of the stand have insulated terminals at the lower end of the hook switch supporting frame, arranged to engage the circuit connecting springs of the circuit plates.

The external design of the desk stand has been given careful thought. All crevices or sharp corners which invite dust and dirt or cause undue tarnishing have been done away with. The upright portion or handle of the stand is covered with a thick polished hard-rubber tube. The base cover enclosing the steel framework is made from thick brass and is finished in polished nickel plate. The transmitter hook switch lever and knuckle-jointed transmitter support are finished in polished nickel plate, while all of the interior part of the stand are protected from corrosion by a heavy plating of copper oxidized black and lacquered.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

DETROIT EDISON COMPANY TO ENLARGE—It is announced that preliminary plans are being drawn for the duplication of the plant of the Detroit (Mich.) Edison Company.

ROCHESTER-CORNING TRACTION—The Rochester-Corning-Elmira Traction Company has been incorporated at Albany, N. Y., with a capitalization of $4,000,000, to operate 120 miles of electric road. The directors include Max Schultz, C. O. Geer, Fred Eckstein and S. M. Levy.

SEDALIA (MO.) PUBLIC UTILITIES PURCHASED—Edward M. Deane & Company, Grand Rapids, Mich., it is announced, have purchased the gas, electric and traction properties in Sedalia, Mo., and will consolidate them under one management. The capitalization has not yet been determined upon, but bonds to the amount of $1,000,000 have been authorized.

CALIFORNIA TELEPHONE COMPANY—Articles of incorporation of the Home Telephone and Telegraph Company, with a capitalization of $10,000,000 stock and $10,000,000 bonds, were filed in the office of the county clerk at Los Angeles, Cal., on July 19. The company will take over and combine the Home Telephone plants in several of the southern California cities.

CALIFORNIA ELECTRIC COMPANY FILES MORTGAGE—A trust deed was filed in the office of the county recorder at Sacramento, Cal., on July 16, showing that the Northern Electric Company had mortgaged its property, tracks, cars, machinery, buildings, etc., to the Mercantile Trust Company, of San Francisco, for $6,000,000. The company now has a line in operation between Chico and Oroville, and is building toward Sacramento.

MERGER OF THE ST. LOUIS & SUBURBAN SYSTEM WITH THE UNITED RAILWAYS COMPANY—A total of $108,000,000 in stocks and bonds is involved in the merger of the St. Louis & Suburban system, St. Louis, Mo., with the United Railways Company. The United Railways Company is dominated by the North American Company, of Philadelphia and New York. It owns street railway and electric lighting companies in Philadelphia, Milwaukee, Detroit, St. Louis and other large cities.

CINCINNATI GAS DIRECTORS APPROVE LEASE—The board of directors of the Cincinnati Gas and Electric Company on July 18 unanimously approved the new lease and recommended its approval to the stockholders. Norman G. Kenan, president of the company, was authorized to call a special meeting of the stockholders, giving the usual three days' notice required by law. The stockholders' meeting will take place about the middle of August. This will give ample time after that meeting to arrange matters so that the Union Gas and Electric Company can take charge on September 14.

ELECTRIC LINE TO COST $20,000,000—W. D. Atwood, president of the Bank of Edinburg, Ark., has evolved a scheme for an electric line in southeastern Arkansas, which will make a circle of 400 miles, touching Little Rock, Hot Springs, Arkadelphia, Camden, Eldorado, Felsenthal, Crossett, Hamburg, Monticello, Cornersville, Star City, Pine Bluff, Jefferson Springs and Redfield. The road is to be known as the Atwood Electric Circular Car Line, and the probable cost is $20,000,000. The scheme includes the running of eighteen cars each way each day on the line, which is to be double-tracked for the entire 400 miles.

DETROIT HOME TELEPHONE COMPANY FILES A $6,000,000 MORTGAGE—The Home Telephone Company, of Detroit, Mich., has filed a $6,000,000 trust mortgage with the Commonwealth Trust Company, of St. Louis, Mo., to secure an issue of bonds of that amount for the enlargement of its plant. The bonds, which were authorized at a meeting of the stockholders held on June 23, are to be twenty-year first mortgage five per cent negotiable gold bonds bearing the date of July 2, 1906. The stockholders voted to issue $3,250,000 for immediate use in extending the system. The remainder is to be issued at a later date, and, of the latter, $100,000 is to be held by the trust company to protect the telephone company against any emergency. The mortgage is signed by C. M. Burton, as president of the Home Telephone Company.

NASHVILLE RAILWAY AND LIGHT COMPANY AUTHORIZES ISSUE OF BONDS—At a meeting of the stockholders of the Nashville Railway and Light Company, held on July 18 at Nashville, Tenn., it was decided to authorize the issuance of $15,000,000 in bonds, to take care of the improvements contemplated, and to retire other securities. After the bond issue had been authorized the stockholders took up the matter of going into a holding company, and a committee of five was appointed to investigate and report back at another meeting. The following committee was appointed: Colonel A. M. Shook, chairman; F. O. Watts, V. E. Schwab, Goulding Marr and W. L. Dudley. The holding proposition is to unite or consolidate all the stock of the Newman properties into a holding company, each shareholder in the Nashville, Birmingham, Memphis, Little Rock, New Orleans and Knoxville companies to receive so many shares or a certain proportion of stock in the holding company.

PLANNING A MONORAIL LINE—Plans are being prepared by the Baltimore & Ocean City Electric Railway Company, Baltimore, Md., for the building of a monorail line between Baltimore and Ocean City. It is proposed to ferry across the Chesapeake bay north of the Patapsco, so as to make the water route as short as possible. It is hoped to construct a road over which trains can make the trip of 113 miles in less than two hours. While the company has rights to enter the city, they are subject to the approval of the mayor and the city council, and no effort has been made to obtain such a franchise. It is believed, however, that the company proposes, if possible, to make some arrangement for entering the city through the United Railways. The American Monorail Company, which is behind the Ocean City charter, proposes to erect a sample track for exhibition purposes at the Jamestown Exposition, having obtained a concession for that purpose. The company will use the patents of Howard H. Tunis, of Baltimore, which provide for a railway with a single rail, on which trains may be run at a high speed.

NEW PUBLICATIONS.

PROCEEDINGS OF THE ENGINEERING ASSOCIATION OF THE SOUTH—The quarterly proceedings of the Engineering Association of the South for April, May and June, 1906, have been published. The contents include the minutes of the March and April meetings of the Nashville section; minutes of the May meeting of the Birmingham section; minutes of the meeting of tellers; minutes of the meeting held at Atlanta for organizing an Atlanta section; personal and other notes, and papers entitled "The Isthmian Canal," by E. C. Lewis; "Paint Tests," by Hunter McDonald; "Reconstruction of Eighth Street Tunnel, Kansas City, Mo., Metropolitan Railway," by W. M. Archibald, and "A Practical Determination of the Interval of Stadia Wires," by H. F. Wilson.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA—A membership list of the Engineers' Club of Western Pennsylvania has been published. This includes general information concerning the society's rooms and house and library privileges; a calendar for 1906-1907; a list of members; recapitulation; honorary members; life members; geographical distribution; deceased members; past and present officers; a historical summary; places where proceedings are on file; charter; by-laws of the society and of the chemical, mechanical and structural sections. The July issue of the proceedings of the society contains an article by H. C. Specht, entitled "Submarine Cables"; an article by J. R. Bibbins, entitled "Gas-Driven Electric Power System"; reports of the meeting held on July 19 and of the meeting of the board of direction on June 9 and a special meeting of the board on June 12, and reports from the chemical and mechanical sections, together with a memorial to Per Brynn.

Digitized by Google

ELECTRIC RAILWAYS.

SCOTTSBORO, ALA.—A survey is now being made for an electric road from Nashville to Chattanooga.

LAINGSBURG, MICH.—The Laingsburg village council has granted to Joseph Thick, of Detroit, a thirty-year franchise for operating an electric railway.

WILKESBARRE, PA.—The Danville & Sunbury trolley road was sold at auction recently at Danville, and was bid in by a representative of the stockholders. It was sold subject to a $60,000 mortgage.

TERRE HAUTE, IND.—That part of the new line of the Terre Haute & Sullivan Traction Company, between Shelburn and Sullivan, has been opened for regular traffic. Cars have been running between Terre Haute and Shelburn for several months.

HARTFORD, CT.—The Consolidated Railway Company is now ready to proceed with the work of overhead wiring for the proposed fast interurban electric service, which is to be established between Hartford and Rockville, and which will operate partly over steam tracks and partly over trolley tracks. The rails have been bonded and the poles set.

YOUNGSTOWN, OHIO—The Poland, Boardman & Canfield Railway Company has been organized. The officers are: president, H. H. Stambaugh; vice-president and general manager, S. J. Dill; secretary and treasurer, David Tod. The directors are: H. H. Stambaugh, S. J. Dill, John Stambaugh, David Tod, Richard Garlick, R. C. Steese and T. L. Robinson.

NEW ALBANY, IND.—J. H. Greeley, in charge of the real estate department of the Louisville & Indianapolis Traction Company, has closed a deal for land at Scottsburg on which a power-house will be built that will supply the electric current for running cars between Sellersburg and Seymour. It is stated that the power-house and equipment will cost $200,000. This will also include car barns and repair shops.

SOUTH BETHLEHEM, PA.—Letters-patent have been issued by the state department consolidating the following street railway companies under the name of the Allen Street Railway: Bethlehem & Bath, Bethlehem & Siegfrieds, Nazareth & Bath, Cement Belt, Alliance, Bath & Nazareth, Alliance & Bath, Township Line and Allen. All the above companies covered the territory between Nazareth and Alliance.

SPRINGFIELD, ILL.—The Joliet & Southern Traction Company, with headquarters at Aurora, has certified to the secretary of state an increase of capital stock from $10,000 to $1,000,000. This company was organized a year ago last spring to run a line from Joliet to Morris and Dwight. In this way it is expected that connection will be made. The company is controlled by the people who own the Joliet, Plainfield & Aurora line.

FORT COLLINS, COL.—The ordinance granting a franchise to the Denver & Interurban Street Railway, to build and operate an electric street railway system in Fort Collins, was passed at a special meeting of the city council. The amount in the forfeiture clause was raised from $10,000 to $20,000. The company is required to commence work in nine months, and a mile and a half of road must be in operation in eighteen months, with the construction of two miles each year thereafter until the line is completed.

ALBANY, N. Y.—The Suffolk Traction Company, Patchogue, L. I., capitalized at $1,200,000, has been incorporated at Albany to construct a street railroad, twenty-eight miles long, between Brookhaven and Babylon. The line will run through Brookhaven, Bellport, Patchogue, Blue Point, Bayport, Sayville and Islip. The directors are: Clinton L. Rossiter, D. H. Vallentine, Henry Seibert, W. M. F. Sheehan, D. L. Hughes, of Brooklyn; Charles A. Collins, of New York; W. H. Jaycox, M. G. Wiggins, G. G. Roe, of Patchogue, and Benjamin B. Wood, of Babylon.

ANDERSON, IND.—In consideration of the Anderson city council extending its local franchise to 1952 the Indiana Union Traction Company agrees to build and operate in the city, by July 7, 1907, its main car shops, to cost $125,000. The franchise contract also stipulates that the interurban electric lines shall be extended from Anderson *via* Middletown to New Castle, and also direct to Elwood by December, 1909. The proposed extension will parallel the Pennsylvania and eventually be a part of a direct route from Cincinnati to Chicago *via* Richmond, Anderson and Logansport.

DES MOINES, IOWA—The Inter-Urban Railway Company has amended its articles of incorporation, increasing the capital stock to $1,200,000. The increase is to provide for the larger investments, the promotion of the new line to Carlisle, and the completion of the line to Perry. The company now has in operation a line to Colfax and one to Woodward. The Woodward line will soon be completed to Perry. In addition to these, the Des Moines City Railway Company, made up of the same men practically as the Inter-Urban company, is building a line to Marquisville, and contemplating other city extensions.

IOWA CITY, IOWA—Iowa City's new interurban railway company has amended its articles of incorporation and elected officers for the ensuing year. The name of the road was changed from the proposed title to the Iowa City, Montezuma & Des Moines Railway. The line is to be an electric road, connecting Iowa City and Montezuma. The capital stock (preferred) is $10,000, and the board of directors is empowered to increase this at will, as exigencies demand. The initial list of officers is as follows: president George W. Ball, Iowa City; vice-president, J. W. Carr, Montezuma; secretary, Willard J. Welch, Iowa City; treasurer, Charles R. Clark, Montezuma.

KANSAS CITY, MO.—At the annual meeting of the stockholders of the Kansas City Railway and Light Company the yearly statement of the corporation for the year ended May 31 was submitted. This report showed that the gross revenue for the year increased $704,034, while the increase in net was $342,755, as compared with the previous year. The surplus showed an increase of $193,176. After paying the dividend on the preferred stock there remained four and three-fifths per cent for the common stock. At the election of directors Bernard Corrigan, E. S. Swinney, C. W. Armour, J. J. Hein, L. E. James, H. C. Flower, J. T. Downing, H. C. Ward, Edward George, S. R. Knott, J. O. Armour, Samuel McRoberts, C. L. Blair and K. K. McLaren were chosen.

NEW MANUFACTURING COMPANIES.

CAMDEN, N. J.—The Philadelphia Electric Equipment Company has been incorporated by John A. McPeak, William F. Eidell and F. R. Hansell. The capital stock is $25,000.

ALBANY, N. Y.—The Gold Car Heating and Lighting Company, of New York city, has been incorporated at the secretary of state's office, with a capital of $3,000,000. The directors are: Edward E. Gold, Richard V. Voges, John C. Dixon, Henry J. Horn, Lucius E. Varney, Ambrose L. O'Shay, of New York, and Edward J. Ronan, of Brooklyn.

PROVIDENCE, R. I.—Articles of incorporation have been filed at the office of the secretary of state by the Woonsocket Supply Company. Arthur C. Milot, Frank E. Holden and Fred A. Gardner are named as incorporators. The company is to engage in the hardware and electrical goods business in Woonsocket, and is capitalized at $10,000.

OBITUARY NOTICES.

MR. D. C. DEWAR, manager of the Montreal exchange of the Bell Telephone Company, died suddenly in Toronto, Ontario, on July 12. Mr. Dewar had been suffering from heart trouble for some time, and was resting, upon the advice of his physicians.

MR. CHARLES C. MILLER, for many years connected with the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., and later treasurer of the Peerless Rubber Company, New York city, died on July 17 at Long Branch, N. J. Mr. Miller was born in Pittsburg fifty-five years ago.

MR. JAMES BRADY, for a long time manager of the Brady Manufacturing Company, Brooklyn, N. Y., died on July 24 at his summer home at Lake Sunapee, N. H., in his sixty-ninth year. During the Civil War Mr. Brady was government inspector of ordnance. He was the inventor of several successful mechanical and electrical contrivances.

Digitized by Google

PERSONAL MENTION.

MR. JOHN S. COLEMAN has been elected by the board of water commissioners of Dunkirk, N. Y., superintendent of the Dunkirk water and electric light plant.

MR. HARRY M. HOPE, who has been electrical engineer for the North Shore Electric Company, Chicago, Ill., has become manager of the switchboard department of the J. Lang Electric Company, Chicago, Ill.

MR. SIDNEY SMITH, until recently connected with the legal department of the Interborough Rapid Transit Company, has become associated with the firm of Charles N. Morgan & Sons, New York city, which has an extensive clientele among electric light and railway companies.

MR. W. S. BARSTOW has returned from Portland, Ore., after a four weeks' trip. He reports that there is in contemplation the building of several miles of railroad extensions in connection with the Oregon Railway Company, for which his company is now building and equipping about sixty miles of road. It is expected that part of the main line between Portland and Salem will be in operation on September 1, and that cars will be operated between the two cities by July 1, 1907.

MR. WILLIAM B. GRAHAM, formerly superintendent of the Passaic district of the Public Service Corporation of New Jersey, has been made superintendent of the merged Essex and Passaic districts. Mr. Andrew Smith, who has been district superintendent for Essex county, becomes superintendent of the Bloomfield division. Mr. J. E. Spencer, who was superintendent of the Bloomfield division, now becomes superintendent of the Bergen street and Clifton avenue lines. Mr. James McCabe, assistant superintendent of the Plank road line, is promoted to the superintendency of the Turnpike division, succeeding Mr. Arthur Pratt, who now becomes superintendent of the Roseville division. Mr. George Stone is named as division superintendent of the Passaic division. Mr. Charles H. Coe becomes superintendent of the Kearney, Mount Prospect and Mulberry street lines.

MR. W. F. HESSEL, Chicago, Ill., has assumed the position of general sales manager of the Stuart-Howland Company, Boston, Mass. Mr. Hessel has been associated with some of the largest companies of the country, and has earned a wide experience and broad acquaintance with those interested in the electrical field. His early experience in the practical operation of central stations has been particularly useful as applied to the advancement of the modern electrical supply business, with which he has been identified for the past ten years. During the last four years Mr. Hessel has been identified with electrical industries in the Middle West, as sales manager of the Western Electric Company, manager of the Standard Electric Company, Cincinnati, Ohio; sales manager of Pass & Seymour, Incorporated; and prior to that time he was associated with Eastern interests. He has many Eastern friends who will be pleased to learn that he returned to again take a place among them.

ELECTRICAL SECURITIES.

The past week witnessed a decided growth and expansion in financial and speculative activity, the Russian crisis having but a temporary effect, even with the foreign market unsettlement. There has been a good general advance, and it is a matter of significance that there was one million-share day during the week, the second for the month of July and the first day of such proportions since July 2. It is held in many quarters that the revival of energy in the steel trade, the promising crop outlook and the return of many prominent interests to the market will create a new enthusiasm among outside investors, so that the present boom will be carried along well through the summer.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JULY 28.

New York:	*Closing.*
Allis-Chalmers common	17¾
Allis-Chalmers preferred	47½
Brooklyn Rapid Transit	77½
Consolidated Gas	138½
General Electric	167
Interborough-Metropolitan common	38¼
Interborough-Metropolitan preferred	78¼
Kings County Electric	165
Mackay Companies (Postal Telegraph and Cables) common	74
Mackay Companies (Postal Telegraph and Cables) preferred	72
Manhattan Elevated	149
Metropolitan Street Railway	103
New York & New Jersey Telephone	129
Western Union	92
Westinghouse Manufacturing Company	152

The Westinghouse Electric and Manufacturing Company has issued a statement of its operations for the six years ended March 31, 1906. The company reports a surplus after dividends on that date of $11,540,653. This is the first statement of earnings ever issued by the company.

Boston:	*Closing.*
American Telephone and Telegraph	138½
Edison Electric Illuminating	235
Massachusetts Electric	68
New England Telephone	131¾
Western Telephone and Telegraph preferred.	88

The directors of the New England Telephone and Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable August 15.

The Massachusetts Electric Companies' statement for the quarter ended June 30 shows as follows: gross, $1,860,142; operating expenses, $1,195,231; net, $664,910; interest and taxes, $425,231, leaving a surplus of $239,678. Notwithstanding the fact that July, 1905, was an abnormally large month in point of gross earnings, it is estimated that July gross earnings of the Massachusetts Electric system this year will increase $35,000 over last year. The largest earnings in the history of the company were reported on July 14. Gross earnings for that day exceeded $40,000.

Stockholders of the Edison company, of Boston, will be given the privilege this fall of subscribing for new stock. It is expected that the increase will be at least 10 per cent. The last issue was made in 1904 when the capital was increased 10 per cent, the new shares being offered at $200 a share. The company is carrying a large floating debt, the result of large purchases of real estate in the past year and this debt will be increased upon the completion of the new building on Boylston street for the exhibition and operating departments. At present a large portion of the operating force is at the Atlantic avenue plant. In the past four years the company has increased its capital from $7,850,000 to $11,488,100.

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	71
Electric Storage Battery preferred	71
Philadelphia Electric	8
Philadelphia Rapid Transit	30½
United Gas Improvement	84

The gross earnings of the Philadelphia Rapid Transit Company for the fiscal year ending June 30, 1906, are estimated at $17,440,000. This would show an increase of $1,252,000 over last year.

Chicago:	*Closing.*
Chicago Telephone	119
Chicago Edison Light	135
Metropolitan Elevated preferred	68
National Carbon common	80
National Carbon preferred	121
Union Traction common	4
Union Traction preferred	14

The directors of the National Carbon Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable August 15. Books close August 4 and reopen August 16.

President Hetzler, of the Chicago Metropolitan Elevated, says the proposed scheme of consolidation has not been presented to the stockholders, and that it would take months to work it out after the stockholders had approved. Mr. Hetzler favors the general outline of the consolidation scheme as proposed.

Digitized by Google

ELECTRIC LIGHTING.

CHATTANOOGA, TENN.—A new electric light plant will be established at Harriman.

EL CAMPO, TEX.—Work has been begun on a new electric light plant and waterworks system.

BEVERLY, MASS.—The Beverly Gas and Electric Company will increase its capital stock by $200,000, for the purpose of enlarging its plant.

DESHLER, OHIO—Work has been begun on Deshler's new electric light plant. Under the terms of the franchise the plant must be in running order by September 1.

NORRISTOWN, PA.—A report has been made of the cost of operating the Norristown municipal electric light plant, which shows a total expense of $12,800 or $59.51 per arc lamp for the past year.

WASHINGTON, D. C.—The Potomac Electric Power Company has purchased additional ground on Washington street northwest, to add to its plant in that locality. Building operations will begin shortly.

MORRISTOWN, N. J.—At a special election Rockaway declared for municipal ownership. The propostion voted upon was the issuing of bonds not exceeding $30,000 for the purchase of the local electric lighting plant from its private owners.

WENATCHEE, WASH.—Through the agency of Jay P. Graves, Boston capitalists have purchased the water power of the Chelan river for $40,000, and plans are now being formulated for the construction of an electric line from Spokane to Chelan.

CLEVELAND, OHIO—A syndicate of prominent Cleveland men has completed plans for a new electric illuminating plant to be erected in Newburg. Through its attorney, Eugene Quigley, of Hobday & Quigley, the syndicate has applied for a franchise for street and commercial lighting.

POUGHKEEPSIE, N. Y.—The Light, Heat and Power Company has made application to the state commissioner of gas and electricity for permission to issue $150,000 in six per cent twenty-year bonds. The bonds are to be issued to secure working capital, as the company expects to enlarge its plant.

OGDENSBURG, N. Y.—The New York & Ontario Power Company has received a franchise from the common council of Ogdensburg to erect poles and wires through the city streets for the transmission of electricity for light, power and heat. The towns of Lisbon and Waddington have granted rights of way, and it is the intention of the company to build a trolley road from Ogdensburg to Massena.

CLEVELAND, OHIO—A mortgage on the plant of the Rocky River Water, Light and Power Company has been given to the United Banking and Savings Company. It is for $20,000, and includes two pieces of property, pumps, boilers, a filtration plant, the mains already laid and those that are to be laid in Rocky River streets, the company's franchise, granted June 3, 1904, and practically all other possessions of the mortgagor.

LYONS, N. Y.—The Wayne County Electric Company, the principal stockholders of which are residents of Syracuse, at its annual meeting elected the following officers: president, Dwight P. Chamberlain; vice-president, Charles A. Lux; secretary, Benton S. Rude; treasurer, William H. Akenhead; superintendent, Robert W. Kiple; directors, John Dunn, Jr., F. C. Eddy, C. D. Beebe, H. H. Crowell, Charles A. Lux, Dwight P. Chamberlin and James W. Putnam.

PITTSBURG, PA.—Work has been started on the foundations for what will be the nucleus of the lighting plant of the Duquesne Light Company. A tract of land, 200 feet square, was purchased by Robert C. Hall, principal stockholder of the Duquesne company, some time ago and permits have been taken out for the erection of 2,000 poles throughout the East End. It is figured that the present plant will cost $250,000, and will furnish light for about 1,000 homes. The new plant will be located near the East Liberty depot.

PHILADELPHIA, PA.—The Philadelphia Suburban Electric Company, with general offices in the Land Title Building, Philadelphia, has purchased the electric lighting property at Clifton Heights, Pa. The Philadelphia Suburban Electric Company had previously purchased the plants at Morton and Lansdowne, and now controls the entire electric lighting and power situation in Delaware county. Plans are being prepared for a new station, and as soon as the estimates are in work will begin and will be pushed forward as rapidly as possible, so as to have the new plant in operation before cold weather.

DETROIT, MICH.—According to Secretary Bowler's annual report made at a meeting of the public lighting commission, the cost of maintenance of arc lights was reduced from $34.99 the year previous to $33.18 per lamp for the fiscal year just closed. There were 237 arc lights installed during the year, bringing the total up to 3,080. The cost of operating the arc plant for the year was $102,179.60, and for the incandescent plant, $24,792.03. The city's investment in the lighting plant to June 30 last, less three per cent depreciation, is $902,641.25.

ANNISTON, ALA.—The Asbury Electric Company has been incorporated with a capital of $10,000, to furnish electric power from a plant to be established at lock No. 2 on the Coosa river, near what is known as the Ten Island shoals. The concern has about seventy acres of land at this point, and purposes to erect a plant and utilize the water power to generate electricity. The local men interested are: W. F. Johnston and D. C. Blackwell. The officers of the concern are as follows: president, Brigham Curtis; vice-president, W. F. Johnston; secretary and treasurer, Millard C. Heemston.

NEWARK, OHIO—The Licking Light and Power Company at its annual meeting elected the following directors: B. G. Dawes, of Marietta; George F. Goodnow, of Chicago; J. K. Hamill, E. C. Wright, F. P. Kennedy, G. S. Schinnick and M. M. Gillett, the latter five residing in Newark. The directors then organized by electing Mr. Gillett, president; Mr. Wright, vice-president; Mr. Hamill, treasurer, and Mr. Schinnick, secretary. The financial statement showed the company to be in a most prosperous and satisfactory condition. The new power plant being erected on the site of the old one is being pushed to completion and will be finished about November 1.

KENOSHA, WIS.—The common council of Kenosha has accepted an estimate of the construction cost and the annual cost of operating a municipal lighting plant. Immediate action toward the erection of a plant is to be taken. The estimated cost of lighting the city by municipal plant is $40.37 per lamp per year, although it is figured that with deduction of expenses on moonlight nights, and basing the cost of operation on 310 nights per year, Kenosha can make its own current for about $37 per lamp per annum, whereas now it pays $78 per lamp per year. The total estimated cost of construction is $41,328.30, and the total estimated cost of operation, $12,110.40.

GRAND RAPIDS, MICH.—The Grand Rapids Edison Company is about to make extensive additions to its underground cable system, and much of the overhead wiring will be placed underground. This is in conformity with the provisions of the city ordinances, and the work will be prosecuted as rapidly as possible until all the wires in the prescribed district are placed under ground. The company is also having plans prepared for the remodeling of the old Lowell water and light plant on the Flat river. The dam is to be rebuilt, and this will increase the capacity about 200 per cent. The additional current will be brought to Grand Rapids. The powerhouse will be modernized. Work is to be completed during the fall.

TROY, N. Y.—The Mechanicville Electric Light and Gas Company at its annual meeting elected the following directors: James A. Greenway, Edwin Farrow and M. J. Farrow. The directors met and elected Edwin Farrow, president and treasurer; James A. Greenway, vice-president, and M. J. Farrow, secretary. The Halfmoon Light, Heat and Power Company at its annual meeting elected these directors for the ensuing year: J. C. Duncan, E. H. Strang, W. L. Howland, H. O. Bailey, A. J. Harvey, Stephen Lee, J. W. Gibson, W. C. Talmadge, W. R. Palmer, George Hudson and G. F. Best. The directors met and elected J. C. Duncan, president; E. H. Strang, vice-president; H. O. Bailey, secretary; William L. Howland, treasurer and general manager.

Digitized by Google

NEW INCORPORATIONS.

PEKIN, ILL.—Minier Mutual Telephone Company. Increased from $15,000 to $25,000.

HARRISBURG, PA.—The Enterline-Halifax Telephone and Telegraph Company, Enterline. $5,000.

AUSTIN, TEX.—Consumers' Light and Heating Company, Fort Worth. Increase of capital stock from $100,000 to $200,000.

MADISON, WIS.—The Belmont & Pleasant View Telephone Company, Lafayette county. Increase of capital stock from $5,000 to $10,000.

SPRINGFIELD, ILL.—The Alton, Jacksonville & Peoria Railway Company, Alton. Increase of capital stock from $10,000 to $300,000.

OKLAHOMA, OKLA.—Newkirk, Tonkawa & Southern Electric Railway Company. To build an interurban line from Newkirk to Oklahoma City. $1,500,000.

SPRINGFIELD, ILL.—New Athens & Hecker Telephone Association, New Athens. $600. Incorporators: J. A. Barthel, Henry Schaeffer and Fred Schanz.

AUGUSTA, ME.—Cape Shore Railway, South Portland. $36,000. Directors: L. M. Leighton, J. True, N. True, C. B. Dalton, Portland; E. C. Reynolds, South Portland.

ST. PAUL, MINN.—Cass County Mutual Telephone Company, Byron. $10,000. Incorporators: F. W. Deline, J. O. Jesme, of Leader, and F. H. Clayton, of Esterly.

JEFFERSON CITY, MO.—Appleton City & Rockville Telephone Company, Appleton City. $25,000. Incorporators: E. A. Hook, J. S. Painter, W. I. Marriott, R. C. Mendenhall and others.

SPOKANE, WASH.—The Spokane County Electric Company. To furnish electric light to Rockford, Fairfield, Latah and perhaps other towns in the southern part of Spokane county. $10,000.

JOPLIN, MO.—Missouri & Southern Railway and Power Company, Joplin. $2,000, all paid. Incorporators: R. C. Rawlings and L. Rosenthal, of Chanute, Kan.; George J. Grayston and R. N. Graham.

PIERRE, S. D.—Sunrose Telephone Company, to be located in Hartford township, Minnehaha county. $5,000. Incorporators: John P. Frederickson, William J. Forney and Clarence Forman, all of Hartford.

SOUTH BETHLEHEM, PA.—South Bethlehem Street Railway Company; to build a line from South Bethlehem to the Allentown-Coopersburg turnpike; $42,000. South Bethlehem & Saucon Street Railway Company; $30,000.

ALBANY, N. Y.—The Putnam & Westchester Traction Company. To build an electric road between Peekskill, Westchester county, and Oregon, Putnam county. $75,000. Directors: J. S. Ladd and A. L. Ehardt, of Peekskill, and Walter A. Perry, of Putnam Valley.

ALBANY, N. Y.—The Tuscarora Traction Company, Addison, Steuben county. To operate an electric road, eighteen and one-half miles long, from Addison to Jasper. $500,000. Directors: Thomas E. Harden, of Addison; John M. Connelly and George R. Brown, of Elmira.

AUGUSTA, ME.—Pensacola Electric Company. For the purpose of constructing, operating and maintaining railways operated by electricity, steam or other power. $1,300,000. Officers: president, Charles M. Drummond, of Portland; treasurer, John C. Rice, of Boston, Mass.

HARTFORD, CT.—Manila Suburban Railways Company. $500,000. Officers: president, Arthur L. Shipman; vice-president, John S. Fitzsimmons; treasurer, T. F. Wickham, of New York; secretary, Edward S. Bruce, of New York; directors, Arthur L. Shipman, Edward B. Bruce and John S. Fitzsimmons.

AUSTIN, TEX.—Hillsboro Telephone Company, Hillsboro. To construct and operate telephone lines and exchanges in Hill, Navarro, Ellis, Johnson, Tarrant, Dallas, Kaufman, Somerville, Hood and Parker counties. $200,000. Incorporators: N. H. Davenport, J. B. Earle and J. E. Boynton, of Waco.

TELEPHONE AND TELEGRAPH.

SCHENECTADY, N. Y.—A telephone line has been completed from Burtonville to Delanson.

WAVERLY, TENN.—A telephone line is in course of construction between Plant and Dry creek, a distance of about ten miles.

HAMILTON, OHIO—A force of linemen is now at work extending the lines of the Central Union Telephone Company to Monroe.

YANKTON, S. D.—The Northwestern Telephone Company will spend $40,000 in improving the Yankton service and remodeling the plant.

OAKLAND, CAL.—The Sunset Telegraph and Telephone Company has commenced work on its new building in East Oakland, to be used as a telephone station for that portion of the city.

PORTLAND, ME.—The new Peaks Island exchange of the New England Telephone and Telegraph Company has been placed in service.

WHEELING, W. VA.—The Bell Telephone Company has secured the right of way for a line from Wellsburg to Independence, a distance of twelve miles.

RICHMOND, VA.—The Lois Mutual Telephone Company has been incorporated, with J. M. Price, president; J. E. Stively, vice-president, both of Bealeton, Va., and George E. Bain, of Lois, secretary-treasurer.

OROFINO, IDA.—The work of installing a telephone exchange will be commenced at once by Sampson Snyder, Jr., who recently acquired the interests of the Pacific States company from Kendrick to Pierce City.

WINONA, MINN.—To accommodate the increasing amount of toll business the Winona Telephone Company has added another section to its switchboard. The service is being still further improved by the building of a copper toll line between Winona and Rushford.

BEATRICE, NEB.—The Nebraska Telephone Company has connected up its lines with the Independent lines at Filley. This will place Beatrice in direct communication with seventy telephones on the Filley line, thirty on the Dane lines and 100 on the German lines in Hanover township, thus covering the field completely in northeast Gage county.

PHILADELPHIA, PA.—The Bell Telephone Company has purchased property on Diamond street, having an area 80 by 170 feet. On the site an exchange building, to be known as the Diamond Central Exchange, will be erected. The building will be of brick and terra cotta, three stories high, 62.10 by 100 feet, and will cost about $100,000.

PHILADELPHIA, PA.—The Bell Telephone Company, of Philadelphia, and the Delaware & Atlantic Telegraph and Telephone companies announce a net gain of 3,537 telephones for the month of June, or 32,595 telephones since the first of the year, making a total of 157,385, against 97,283 one year ago. The estimated business for 1906 is 100,000 net gain. The gain for last June was 2,703 telephones.

DEPOSIT, N. Y.—A local telephone company has been organized by Dr. B. E. Radeker, A. Seymour Wickwire, Leonard D. Howell, F. D. Wilcox, C. P. Smith and Dee C. Freeman, of Deposit; E. A. Bronson, of Sherman, Pa.; Durward B. Seymour, of Cannonsville; W. J. Garvey, of Elmira; S. C. Ormsbee, of Syracuse, and W. C. Sexsmith, of Binghamton. The company will have an authorized capital stock of $12,000, although only $10,000 of stock will be issued at present, divided into shares of $10 each.

FARGO, N. D.—Announcement has been made of the consolidation of most of the important independent telephone companies in North Dakota, and the organization of the North Dakota Independent Telephone Company with headquarters in Fargo. The company begins business with about 1,000 miles of toll lines, and is proceeding to build standard copper lines to connect all parts of the state, and in the near future expects to have connections with every city, town and village in North Dakota. The new company will connect at Fargo with the lines of the Tri-State company, which has an extensive system in Minneapolis and a comprehensive system of copper toll lines connecting all the larger towns in Minnesota.

Digitized by Google

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1052 describes and illustrates the Allis-Chalmers type B motors and generators.

THE WESTINGHOUSE COMPANIES, Pittsburg, Pa., have issued a handsome illustrated catalogue in Spanish entitled "Industrias y Productos de Westinghouse."

THE GREEN FUEL ECONOMIZER COMPANY, Matteawan, N. Y., is calling attention, through a neat mailing card, to the Green air heater for drying operations.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., in bulletin No. 33 describes and illustrates panel cutouts for rotary switches, and panel cutouts with knife switches.

DODGE & DAY, Philadelphia, Pa., have established new offices in the Drexel Building, Philadelphia, where some important changes have been made in methods and organization.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, Chicago, Ill., will be pleased to send its booklet No. 18 descriptive of "Union" enclosed fuses, blocks and fittings.

THE CHANDLER & TAYLOR COMPANY, Indianapolis, Ind., has ready for distribution a series of handsome catalogues descriptive of its high-speed engines and tubular and vertical boiler equipments.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, in bulletin No. 221 describes and illustrates engine-type, direct-connected generators. The bulletin will be sent to any one interested, upon request.

THE OKONITE COMPANY, LIMITED, New York city, has prepared a valuable folder giving specifications for thirty per cent rubber insulating compound. This folder will be sent to any one interested, upon request.

THE R. HAAS ELECTRIC AND MANUFACTURING COMPANY, Springfield, Ill., will be pleased to send its catalogue illustrating and describing its portable type "Ideal" vibratory motor, which runs on sixty-cycle alternating current.

THE HORTON-MOREHOUSE COMPANY, Detroit, Mich., has ready for distribution a folder describing the "Arkless" fuse. This is an indicating fuse which, the company claims, is possessed of a number of special features of merit.

THE S. MORGAN SMITH COMPANY, York, Pa., is the manufacturer of the McCormick wheels described in the article by C. J. Hopkins regarding the development at Spier Falls, N. Y., in the issue of the ELECTRICAL REVIEW for July 21.

THE BARRIETT ELECTRICAL MANUFACTURING COMPANY, Cincinnati, Ohio, is making rapid strides. President C. H. Haddrell announces that his company will shortly extend its line of apparatus so as to include a complete listing of direct-current and alternating-current motors up to thirty horse-power.

THE ELECTRIC SERVICE SUPPLIES COMPANY, Chicago, Ill., has opened offices at No. 922 Missouri Trust Building, St. Louis, Mo., in charge of Ernest Boehme. A full line of samples will be carried at this office, including "Keystone" insulation, overhead line material, "Garton-Daniels" lightning arresters and other specialties the company is handling.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., in bulletin No. 611 describes and illustrates the "G. I." snap switch. Circular No. 784 is devoted to the "G. I." incandescent lamps, which are furnished for all circuits and conditions. Circular No. 781 is devoted to "G. I." type J primary fuse box or transformer cutouts. Any of this literature may be secured, upon request.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing to the trade a bulletin and circular descriptive of the Stanley-G. I. type "K" arc lamp. The good qualities and merits of this lamp are set forth in an interesting and convincing manner, and the company states that it is carrying a large stock and is in a position to quote attractive prices. Prospective buyers of arc lamps will be furnished with copies of this bulletin and circular, upon request.

WILLIAM A. BONNELL, 203 Broadway, New York city, will be pleased to send to any one interested descriptive matter concerning the Bonnell coupling for flexible armored conductors, "Circular Loom," "Flexduct" tubing, and "Attix" patent wire and cables. This device is a combination coupling and bushing for connecting armored conductors to standard outlet, switch or junction boxes.

THE BLAKE SIGNAL AND MANUFACTURING COMPANY, 246 Summer street, Boston, Mass., announces that 40,000 of the various sizes of the Blake insulated staples were used in the recently completed handsome Public Service Building of the Milwaukee Electric Railway and Light Company, Milwaukee, Wis., for the installation of its telephones. This is an indication of the high esteem in which Blake insulated staples are held for interior telephone wiring.

THE AITON MACHINE COMPANY, New York city, is placing on the market a high-speed twelve-spool strander designed to operate at 1,000 revolutions per minute. This is intended for use in the manufacture of hollow clothes-line and other light stranding work where high speed and large output are demanded. The first machine is going to the Malin Company, of Cleveland, Ohio, which, it is understood, has placed orders with the Aiton Machine Company for several additional ones.

THE NEWTON MACHINE TOOL WORKS, INCORPORATED, Philadelphia, Pa., announces that officers have been elected as follows: president, Harry W. Champion; treasurer, William M. Graham; secretary, Ellis J. Hannum. The election of new officers is occasioned by the death of Charles C. Newton, founder and president of the company, with whom the above-named officers had been closely associated in executive positions for many years. No changes in the conduct of the business will be made.

THE BURKE ELECTRIC COMPANY, Erie, Pa., is now occupying the recently constructed addition to its factory. This company is operating its entire plant with an unusually large complement of men, and is having conspicuous success with its line of machines. The increase in the plant is largely to allow a greater production of alternating-current motors, which the company makes in constant and variable-speed types. At the same time the shops devoted to the building of direct-current machines are very busy.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: St. James, Minn.; Stites, Ida.; Palouse, Wash.; Weatherford, Tex.; Seattle, Wash.; Rochester, N. Y.; Syracuse, N. Y.; Minneapolis, Minn.; Carbury, N. D.; Webster, N. Y.; Sodus, N. Y.; Mount Vernon, Wash.; Eminence, Ky.; Plain City, Ohio; Columbus, Ohio; Caldwell, Ida.; Lamont, Va.; Rome City, Ind.; Delaware, Ohio, and Lyndonville, N. Y.

THE BALL ENGINE COMPANY, Erie, Pa., will soon move into the large new building which has been under construction for some months. The building is of substantial stone construction, and has been planned for the manufacture of engines and turbines. The latter will soon be ready for the market. The shops are of the most modern design and will have an elaborate and up-to-date equipment in the way of machine tools and special apparatus for the heaviest classes of machine building. The offices are to be in the same building, but somewhat apart from the shops. The location of the new building is at Peach and Cranberry streets.

THE PLATT IRON WORKS COMPANY, Dayton, Ohio, whose New York city office has for a long time been located on Liberty street, has been forced by the growth of its business to take larger office quarters at 100 Broadway, New York city. A large wareroom, with a complete line of all patterns of pumps, compressors, feedwater heaters and condensing apparatus, has also been established at 81 West street, where repairs are carried in stock for prompt shipment. The New York office of the company is in charge of R. E. Fox, Jr., who for a considerable time managed the Atlanta (Ga.) office of the Stillwell-Bierce & Smith-Vaile Company before that company's business was acquired by the Platt Iron Works Company.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 6. NEW YORK, SATURDAY, AUGUST 11, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. L. W. MARSHALL, Manager
BOSTON OFFICE: Delta Bldg., 10 Post Office Square, M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad St., London, E. C., HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.
Copyright, 1906, by Electrical Review Publishing Co.
Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

CONTENTS.

EDITORIAL:
An Electrical Method of Measuring the Elastic Limit of a Metal.. 193
Electromotive Force 193
Telephones in Railway Work..... 194
The Agents of Transportation..... 195
The Design of Blast-Furnace Gas Engines in Belgium, by H. Hubert.... 196
Kjellin Electric Steel Furnace, by E. C. Ibbotson..... 198
Edgar C. Bradley Joins the Staff of the American Telephone and Telegraph Company 199
The Hydroelectric Plant at Lucerne, Switzerland, by Franz Koester.... 200
Annual Meeting of the British Association for the Advancement of Science 204
Harmonic Party-Line Systems, by W. W. Dean..... 204
The Report of the Westinghouse Electric and Manufacturing Company.. 207
Values of Ties of Different Materials..... 209
Wireless Apparatus to Prevent Collisions at Sea..... 209
The Electric-Car Equipment of the Long Island Railroad, by W. N. Smith 210
Live Steam-Heated Feed-Water—Its Effect on the Output and Efficiency of Steam Boilers, by G. Wilkinson..... 218
American Navy Safety Appliances at Milan..... 219
Telharmonic System in New York..... 219
Electrical Notes from Europe, by C. L. Durand..... 220
The Indianapolis, New Castle & Toledo Electric Railway..... 222
ELECTRICAL PATENTS 223
BOOK REVIEW 223
Electrical Accidents 223
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE..... 224
METHODS OF GETTING NEW BUSINESS..... 225
INDUSTRIAL SECTION:
Large Allis-Chalmers Induction Motors for the Washoe Smelter of the Anaconda Copper Company..... 228
A Novel Crank Mechanism for Internal-Combustion Single-Acting Engines 229
Automatic Feeder Regulators..... 230
Electrically Operated Refrigerating Plant in the Gallatin Hotel, Uniontown, Pa. 232
The "Universal" Electric Light Holder..... 232
CURRENT ELECTRICAL NEWS..... 233

AN ELECTRICAL METHOD OF MEASURING THE ELASTIC LIMIT OF A METAL.

To determine the elastic limit of a metal in the ordinary way—that is to say, by observing the elongation of a sample and the corresponding stress—is difficult. If the testing machine be fitted with an automatic recorder, the curve obtained rarely shows a sharp point where the change takes place—that is, where the strain ceases to be proportional to the stress. The point can only be determined approximately by careful interpolation. Where the record is obtained from point readings it is even more difficult to get an exact determination of the elastic limit. This difficulty has led M. Guillery to cast about for more accurate means of determining this point, and he has availed himself of the change in electrical resistance which takes place in the sample during the test. This method consists in observing this change by means of a suitable galvanometer. This instrument is of the double-coil type. A current is passed through the sample under test, and by means of a shunt circuit in parallel with the sample a compensation is effected, so that the deflections of the galvanometer are not due to the resistance of the test piece itself, but to the changes in its resistance. Since these changes must depend upon the length and cross-section of the sample, any sudden change in the latter will be accompanied by a sudden change in the galvanometer deflection. An actual test of this method bears out the theoretical considerations. Plotting a galvanometer record, there is a sharp change in the curvature, corresponding to the point where the elastic limit is reached. It is further shown that by proper calibration of the galvanometer the numerical values of the various points on this curve can be determined.

This is a very pretty application of electrical measuring instruments. Not only should it be easy to apply, as there is no delicate mechanical rigging to be adjusted, but the method itself seems to possess considerable sensibility. The resistance of the sample increases both with the increase in the length of the sample and with its decrease in cross-section, making it probably a function of some power of the change in length, and therefore such change can be more easily measured than the change in length itself. It seems possible, however, that the resistance may be effected by a change in the physical state of the sample, if not, indeed, by chemical changes. These features need to be studied further, but the method may lead to important developments, and forms another interesting extension of electrical means to measuring other quantities.

ELECTROMOTIVE FORCE.

It takes a long time for those who have not been able to give up some period of their lives to close study of science to distinguish between cause and effect; and even among those whose business it is to draw this distinction, more or less confusion is frequently brought about by their dwelling upon the effect and approaching the subject from a study of this, rather than attacking the problem from the other direction. Of course, in some cases this rear attack is necessary, but after the subject has been fairly well mastered better progress may be made generally by looking at it from the other side.

The desirability of taking up the subject in this way is not always realized, and instructors are prone to treat it chronologically rather than logically. They, for example, talk about

Digitized by Google

an experiment with currents, directing the student's attention to them, and only after he has more or less familiarized himself with phenomena accompanying an electrical flow do they suggest to him the idea of electromotive force—of that which causes the current to flow. He has already grasped the idea of a difference of potential, and the new term at first seems unnecessary. How many of us have not been in this condition, when we first took up the study of electricity, and complained that the distinction which it was sought to draw was too fine; that the current flowed because there was a difference of potential, and that it was not necessary to go back of this idea. Of course, further reflection or still further study demonstrated how impossible it would be to talk or think clearly on electrical matters if no such distinction were made. The mere introduction of a new term does not carry us any nearer to the ultimate explanation of things, but it helps to a clearer understanding and easier exchange of ideas.

This difficulty in appreciating what is meant by electromotive force—that is to say, the cause of an electric flow—is frequently met with in discussions of a more or less popular kind in which the term seldom appears. Probably, as a general rule, no harm is done, particularly if the omission be not too glaring; but, on the other hand, the idea of this force is often essential to the proper understanding of the subject. This is true in discussions of behavior of electrical machinery of all kinds, and particularly so when the apparatus being considered is a motor. We may talk about the performance of a dynamo fairly satisfactorily if we state merely that the driving around of the armature causes a current to flow; but when it comes to an examination of the performance of a motor we soon get into trouble if we do not explain clearly that the very motion of the armature of the motor sets up a force which opposes the flow of current through it.

No work can be done unless we overcome some force. In the dynamo we may say that the current flowing through the armature resists its rotation. But what resists the flow of current through a motor's armature, and what controls this rate of flow? These are questions which meet one at the very outstart, and until some satisfactory explanation is adopted no intelligent progress can be made. If the student will bear in mind Faraday's laws governing the action of a magnetic field on a conducting body—that is to say, that relative motion will set up an electromotive force, a force which tends to cause a current to flow; and Lenz's law, which is really a corollary of the law of the conservation of energy, that the reaction of an effect opposes the cause, he should have little trouble. When a current is allowed to flow through a dynamo armature, the magnetic forces set up by it oppose the mechanical motion; so, in a motor, if the armature be allowed to revolve when a current passes through it, this motion will set up an electromotive force which will oppose the flow of current—the so-called counter-electromotive force. A dynamo is a source of current, hence the electromotive force set up in it acts with the current. A motor is a consumer of electrical energy, therefore the electromotive force set up in it must oppose the current flow. These relations seem simple enough, yet almost every day one meets with evidence that they are not understood.

TELEPHONES IN RAILWAY WORK.

It was not many years ago that the availability of the speaking telephone as an adjunct to the Morse telegraph system in the despatching departments of great railroad systems was looked upon with considerable skepticism. The trained operator and ever-careful despatcher held that there was too much danger in a misunderstanding of the spoken words, and that, in the hurry and enthusiasm of a direct conversation, mistakes might be made which could only result in disaster. The practice of transcribing into long hand and recording permanently upon data sheets telegraphic communications seemed to indicate an almost infallible system—one which was surely very much more secure than that which depended upon the retention in one's mind of the spoken message. The telegraph, it was held, reduced matters to a nicety, and whatever message there was to be transmitted, conciseness and directness were essential characteristics.

To-day, however, the telephone is a recognized factor of considerable importance on more than one large system of steam railroads. While it is not entering very largely into the despatching department, it is almost universally used for intercommunication between railroad officials, freight agents, division superintendents, and between the public and all of these different departments. It is a matter of fact, also, that in many emergencies the telegraph system is almost wholly cut out and the communication established over telephone lines. In a recent issue of the *Railway Age,* the telephone equipment of the Burlington system is described. The Burlington system is operated under two grand divisions—the lines east of the Missouri, with headquarters at Chicago, and the lines west of the Missouri, with headquarters at Omaha. Each grand division is controlled by a general manager, reporting to the vice-president. The grand divisions are each further separated into semi-grand divisions under the control of division superintendents. There are four private branch exchanges in Chicago connected with exchanges at Aurora, Galesburg, Burlington and West Burlington. For the most part the lines are full copper metallic circuits, the copper wire weighing 210 pounds to the mile. This copper circuit is quadruplexed—that is to say, in addition to the telephone circuit it also furnishes a "quad" telegraph circuit. Besides the copper circuit there is, between Chicago and Aurora, an iron circuit which carries a standard composite equipment giving a single telegraph circuit for each wire of the pair, and a telephone circuit over the pair of wires, making three available circuits from a single pair of wires.

The officials of the traffic department are in regular communication with the local men of the department with regard to securing business, and information of this kind can be obtained by conversation over the telephone, where, by telegraph, considerable correspondence would be necessary and much delay experienced. The question of supplies is an important one, and

Digitized by Google

in the handling of merchandise orders this can be done to much greater advantage by telephone than by telegraph.

The operating department makes use of the circuits, especially in that the Chicago despatcher can arrange freight service with division points. In this class of service the railroad can not arbitrarily run regular trains, but must arrange the service according to the business in sight. Trainmasters and despatchers regularly twice a day discuss these questions and arrange their business accordingly. It is stated that by the use of the telephone on this division the road saved running ten train crews over a considerable distance in one month. This meant quite a saving in cash.

Many other uses of the telephone for railroad service could be mentioned. The addition of the telephone circuit along the right of way makes available the use of a portable telephone set carried upon the train. In many instances the conductor has been able, by hooking in, to get in communication with the despatcher's office and run around an obstruction, when, if the telegraph alone were available, he would have had to wait for orders from the nearest point at which a telegraph office was located. Again, in case of accident, the telephone may be used with distinct advantage, in that details can be properly attended to which, with telegraphic communication, would involve a very much greater length of time and the ever-present possibility of unfavorable consequences.

THE AGENTS OF TRANSPORTATION.

Human progress has always depended upon an exchange of ideas or things. First, language, spoken and then, written, developed the mind, and then the exchange of material possessions improved man's physical condition. No man can improve his mind by mere contemplation, nor can he make much progress materially without intercourse with others; nor can any community make more than a little growth if it shuts itself in and refuses to have dealings with its neighbors. One would not expect great wealth to develop in the Scotch village, the people of which are said to live by taking in each other's washing. Throughout all history the great civilizing and developing agent has been commerce, both in ideas and in things.

This idea has been slowly recognized. Those nations first to grasp it always forged rapidly to the front. At first commerce was more or less adventitious. The greater burden of it was carried on by water. Travel by land was too painful and uncertain. Even until what may be called recent times we were wont to depend upon water for transporting goods. If the place to be reached were not on the sea or on a navigable river, a canal was dug. Roads in those days were not constructed for such purposes, and thus sites possessing great material advantages for making certain articles were unavailable. There was no way of disposing of the products, even though they could be made easily; and the mere fact that a certain locality possesses unsurpassed advantages for making some article is of little value if there be not some way of disposing of it; for, as said before, no community can rise high from simple internal trading; it must take advantage of its superior facilities, for which others pay, and it must also be ready to grasp the advantages possessed by other communities, for which advantages it must pay. To meet this need various methods of transportation have been devised, but, until the introduction of the railroad no very great progress—that is to say, as compared with present-day conditions—was made. In fact, to-day it is safe to say that the welfare of a nation depends upon its commerce, and commerce depends upon the means of transportation.

But of late years a large commerce has grown up in things not material. The railroads have given us a method of transporting matter. Now we have developed a need for transporting energy. Perhaps the development may have been brought about in the reverse order, and the offering of the means for transporting energy has made available large resources hitherto unattacked. However the matter may be viewed, the condition is the same, and an essential of industry to-day is cheap energy.

Now, in the field of manufacturing energy, or, rather, of converting energy into salable form, certain localities possess great advantages, but to dispose of their wares they need a means of transportation. Until recently this was done painfully, and over short distances only, by means of ropes or some other crude method. Even to-day our main dependence may be considered a makeshift. We transport our fuel at great cost in order to obtain the necessary power at the point where it is needed. During the last ten years a means of transporting energy has been developed which may fairly be compared with the development of the railroad. Electrical transmission makes easy the production of power at one point and its delivery at the point where it is to be used. It is rapidly becoming to commerce in energy what the railroads are to commerce in material; and just as the welfare of a country is dependent upon its commerce, so its industries are dependent upon the production and distribution of power. These two agents of transportation—the railroads and electrical transmission—are therefore two of the most important fields to be carefully developed in every community. At the present day, measured by the standard of capital invested or of work done, the railroads are, of course, much the more important; but electrical transmission, in some form or other, touches us individually more closely, and, indeed, the railroads of the future may become absolutely dependent upon it. The one is the means for transporting matter; the latter the means for transporting energy. Both ultimately will be equally important.

The central station manager who devotes some thought and work these summer days to cleaning up and repairing his machinery will find the time and labor well spent. There has been a great improvement in the appearance of large lighting stations during the past few years, but this excellent cleanliness and care has not been so fully extended to the smaller stations. Every manager should take especial pride in making his place attractive and comfortable, by concealing all scraps, by having well scoured all bright metals and in maintaining a general inspection of all physical parts of the plant under his care.

Digitized by Google

THE DESIGN OF BLAST-FURNACE GAS ENGINES IN BELGIUM.[1]

BY H. HUBERT.

The first attempts at direct utilization of blast-furnace gas in engines were made in 1895. For a considerable time the gas had been burnt in Cowper stoves for heating the blast for the furnace, and under the boilers which supplied steam to the blowing engines, and others serving the furnaces. It was natural, therefore, that the idea of directly employing it in gas engines should have occurred simultaneously to several engineers, notably to Lürmann and to Lencauchez, who had pointed out the blast-furnace as a powerful gas producer. Nevertheless, nowhere had any attempt been made to apply it to this purpose up to the end of 1894, when Thwaite proposed it to James Riley, of the Glasgow Iron and Steel Company.

About the same time investigations were being made in Belgium and in Germany, independently of Thwaite's experiments, which were not generally known on the Continent.

The industrial world, which up to that time had hardly favored the idea, had thus been gradually prepared to receive it. The gas engine, long restricted to small sizes and dependent upon the use of an expensive fuel obtainable only in large centres, now began to make headway.

At the Paris Exhibition of 1889, two engines of 100 horse-power were shown, and excited much interest amongst engineers. One had four cylinders, and was made at the celebrated works of the Deutz Company, and the other was a single-cylinder engine, exhibited by two French designers, Messrs. Delamare-Debouteville and Malandin.

In the meanwhile the design of gas producers had made important progress, completely freeing the new engine from its dependence on the gas works, enabling it to be installed anywhere, and to realize to the full extent its economic value by supplying it with a cheaper fuel.

In 1892 Delamare installed at the Moulins Leblanc works, at Pantin, a four-cycle, single-acting, single-cylinder engine, using producer gas, and developing 220 brake-horse-power, with a consumption of about one pound of coal per brake-horse-power per hour. Despite the difficulties met with in this bold attempt, it showed the possibility of economically producing high power with poor gas.

The time had now arrived for engineers to pay attention to the use of gas from blast-furnaces, which, although not of great heating value, was less costly, and was the more suitable on account of the progress which had been made in the design and working of blast-furnaces, the proportionally lower consumption of coke, and, as a result, the marked reduction in the relative quantity of combustible gases, which only sufficed, with difficulty, to heat the blast and to produce the steam required about the furnaces. Finally, the progress of the science of heat had brought to light the causes of the low thermal efficiency of the steam engine, and notably of the loss resulting from the employment of boilers.

It is not therefore surprising that the idea of dispensing with the boiler, and burning the blast-furnace gases directly in the engine, occurred nearly simultaneously in three countries, where metallurgical industry had made great progress.

To Bailly and Kraft, of the Cockerill Company, belongs the honor of being the first in the field in Belgium. The patent taken out by the Cockerill Company for this new application was dated May 15, 1895, and the first trials were made at the end of that year. They were made with a "Simplex" engine of eight horse-power, in which it had only been sought to reduce the clearance space, in order to increase the compression and to facilitate the ignition of the mixture. The gas cleaning was very imperfect, and was carried out simply by passing it through two scrubbers four metres in height.

This engine displayed perfect elasticity and adapted itself to the variations of composition, pressure and temperature of the gases, giving an efficiency of 77 per cent.

The authors, in an article published in the *Annales des Mines de Belgique* at the commencement of 1897, described the results of the first trials, and the conditions necessary for the direct use of blast-furnace gases, showing that a plant producing 100 tons of pig per day was able to furnish about 18,000 cubic metres of gas per hour with a calorific value of 1,000 calories. Taking into consideration that half this volume is available, and allowing for an efficiency of only twenty per cent in the engines, the authors showed that it would be possible to obtain from these gases about 3,000 horse-power.

The small trial engine consumed about five cubic metres per brake-horse-power, which reduces the preceding figures to 1,800 horse-power; but they foresaw at the time that this consumption would be ere long greatly reduced, and that blowing engines driven by gas would be built. They also foresaw that, by disposing of the great surplus motive power, the blast-furnace would ultimately become a centre for the production of energy for works surrounding, the boilers of which it would gradually supersede.

This remarkable progress was described by E. P. Martin, president of the Iron and Steel Institute, in his presidential address of 1897.

At the meeting of the institute on May 3, 1898, M. A. Greiner discussed the results published up to that time, which included the author's paper of February, 1897; a note by Galbraith and Rowden on November 18, 1897; one by Lencauchez on November 8, 1897, and another by Lürmann on February 27, 1898.

Mr. Greiner combated the objections which had been specially raised against this new method of employing gas by German metallurgists at the Düsseldorf meeting, and gave reasons for his belief that the consumption would be reduced below four cubic metres per brake-horse-power per hour, and that the blast-furnaces would be able, by superseding the steam boiler as an intermediary in the production of motive power, to place at the disposal of the engineer twenty horse-power per ton of pig produced daily.

Experience soon verified these forecasts. The Cockerill Company have constructed, with the collaboration of Mr. Delamare, a four-cycle, single-cylinder engine of the "Simplex" type, which in the twenty-four-hour trials, at which the author had the honor to collaborate with Professor A. Witz, gave one brake-horse-power for an average consumption of 3,329 cubic metres, of a gas possessing a calorific power of 981 calories—say, 3,266 calories. (This figure has since been reduced to 3,162.)

The principal dimensions of this engine are as follows:

Diameter of cylinder.....	0.800 metre
Stroke of piston.....	1 metre
Revolutions per minute....	105
Indicated horse-power.....	213
Brake horse-power.....	182

The construction of this engine is worthy of note. The cylinder proper is cast with a breech carrying at its lower portion the exhaust valve, and at the back a cylindrical prolongation, in which the admission valve is placed. This breech or cylinder head has its own water jacket and is provided toward the front with flanges bolted to the cylinder jacket, which was a part of the cylinder bayonet casing.

The shaft is not cranked, and carries a heavy flywheel. The piston is made in one piece and is not chilled. The pressure does not exceed seven kilogrammes (100 pounds). The sparking is effected by Delamare's system, in which a succession of sparks, produced by a Ruhmkorff coil,

[1] Paper read before the Iron and Steel Institute, July 24, 1906.

Digitized by Google

is emitted from a slide-valve on the back of the cylinder when its opening comes opposite to an orifice bored in the back. The movement of the sliding valve and similarly of the other valves is made by a crank and by cams keyed on to an auxiliary shaft parallel to the cylinder and revolving at half the speed of the main shaft. The governing is effected by the hit-and-miss arrangement by means of Delamare's air governor.

Starting is effected by turning the flywheel by a handwheel and by admitting a charge of carbureted air the explosion of which starts the engine.

The success of this engine, which worked perfectly without the gas being cleaned as effectively as is now done, and is still running after being eight years in service at Cockerill's, encouraged them to build a much more powerful type of engine, capable of directly operating a blowing apparatus of 600 horse-power, and consequently of liberating the blast-furnace from its dependence upon the boiler.

Though the enterprise was considered rash, they still went on with the attempt, which was logically justified, seeing that in modern steam-driven blast-furnace installations the gas produced is only just sufficient for the requirements of the furnaces. To procure gas in excess it was necessary to commence by replacing the existing engines by the more economical gas engines, for by such means only would gas be available. It is necessary to commence with gas-driven blowing apparatus. A motor of this description attracted much attention at the Paris Universal Exhibition of 1900. Another, coupled with its blowing apparatus, in the blast-furnace department of the Cockerill Company, and started up on November 20, 1899, was submitted to a series of trials on March 20 and 21, 1900.

The features of this remarkable engine were as follows: regulation by the method of hit-and-miss—that is to say, suppression of an admission of gas complete.

By Brake Tests—		
Diameter of cylinder	1.300	metres
Stroke of piston	1.400	"
Revolutions per minute	94.4	
Indicated horse-power	786	*
Effective brake-h-p.	575	*
Consumption per indicated h.-p.-hour	2.556 cubic metres, or 2,515 calories.	
Consumption per brake-h.-p.-hour	3.495 cubic metres, or 3,440 calories.	
Tests with the Blowing Apparatus—		
Number of revolutions per minute	93	
Indicated h.-p.	886.5	†
Effective brake-h.-p.	725	†
Consumption per indicated h.-p.-hour	2.334 cubic metres, or 2,343 calories.	
Consumption per brake-h.-p.-hour	2.853 cubic metres, or 2,864 calories.	

* With 89 per cent admission and 11 per cent hit-and-miss by the governor.
† Full charge without hit-and-miss

The method of construction of the 200-horse-power motor had generally been retained, saving that the main bearings were separated from the cylinder casing, and were connected by four strong screwed steel stay-bolts, giving easy access to the piston. The shaft was cranked and rested on three bearings to support the flywheel, which weighed thirty-three tons. The piston-rod traversed the back cover in a stuffing box.

The admission valves were retained below like those of the exhaust. The admission of gas was carried out by separate valves placed in a valve box, separated from the cylinder by a third valve, called the mixture valve. The methods of working the valves and those of the ignition slide valve were retained. The regulation was carried out by hit-and-miss. The pressure attained nine kilogrammes per square centimetre (128 pounds). The circulation of water extended to the head and to the piston rod itself, to which the water penetrated by means of flexible pipes, which adapted themselves to its movement. The exhaust valve was also cooled. This was done with the object of preventing the ignition of the mixture by the dust, which, combining with the products of the decomposed oils on the piston or in the recesses of the explosion chamber, might form concretions retaining a temperature high enough to ignite the gases.

The arrangement of all the valves at the under side of the cylinder was such as to facilitate the sweeping out of the dust and decomposed oil, and to allow these large engines to work equally as well as the 200-horse-power engines without having recourse to a more perfect gas-cleaning process. This hope was ill-founded. It became necessary to interpose between the blast-furnace and the large engines of this class apparatus capable of reducing the dust held in suspension by the gas to 0.02 gramme per cubic metre. The means now used in Belgium are centrifugal fans with water injection and Theisen, Brian and Zschokke apparatus. The latter are not, strictly speaking, purifiers; they are, rather, coolers.

As they are not the invention of Belgian engineers, and as they will be made the subject of another paper, it is not necessary to deal further with them.

As is well known, the novel idea of the Cockerill Company was vigorously discussed by engineers, who saw therein an economic mistake, and maintained that it was better to divide the power between two or four cylinders. The designers, nevertheless, knew perfectly well that they could obtain in this way, for a 600-horse-power engine, a more regular and perhaps more economical engine. They had already, however, studied the two-cylinder tandem types of 600 and 1,200-horse-power. One of Cockerill's licensees—Brietfeld-Danek, of Prague—had, since 1901, constructed a four-cylinder double-tandem engine of 600 horse-power, giving remarkable even running; but Messrs. Cockerill wished to demonstrate that it was practically possible to develop 600 horse-power by means of a single cylinder alone, single-acting and of four cycles, and consequently to construct engines developing up to 2,500 horse-power without exceeding four cylinders. In addition to this they were, moreover, anxious also to improve the governing, by applying to these large engines the principle of variable admission in lieu of the hit-and-miss governing, which required the use of heavy flywheels, and was not well suited for producing alternating electric currents, and needlessly strained the engine when it had to run continuously with reduced loads.

From 1901 they realized, with M. Delamare, that it was essential to obtain a variable-admission motor, an air governor, or else a centrifugal force, causing the double air and gas valves to open from the commencement of the suction stroke, but determining the closure earlier in the stroke as the power to be developed becomes lower.

In this manner the mixture admitted possessed the composition most favorable for complete combustion, but the volume admitted to the cylinder varied, and with it the pressure.

The ingenious mechanism which realized this mode of operation, which has been described elsewhere by the author,* was applied to a single-cylinder motor of 200 horse-power of the same dimensions as that of 1898.

The trials to which it was submitted in November and December, 1901, established beyond doubt a consumption varying between 3.318 and 3.455 cubic metres per brake-horse-power per hour for full load, the calorific value being 914 to 1,017 calories. The expenditure in calories per horse-power varied between 3,172 and 3,434, and has been on an average nearly 3,298—practically the same as that of 1898. At half-load it was on an average 4,320 calories, and at quarter-load 7,406 calories.

About the same time (1902) the Cockerill Company produced another engine, designed to give greater regularity with

* *Revue Universelle des Mines*, 1902, vol. lix.

Digitized by Google

smaller dimensions—*viz.*: the double-acting engine.

It was well known that the first industrial gas engine—that of Lenoir—was double-acting, but the success of the Otto four-cycle and single-acting engine had, for a long time, relegated to the background all other types of engines. Nevertheless, M. Letombe, at the Brussels Exhibition, showed a four-cycle and double-acting engine.

The Körting Company exhibited at Düsseldorf a powerful two-cycle double-acting engine which attracted much attention. The long-standing prejudice against the adoption of this system was thus broken down.

The direct driving of the blowing apparatus from the piston rod of the engine had accustomed Cockerill's engineers to the adoption of a stuffing box at the back end of the cylinder. They were therefore naturally disposed to adopt double action, which enabled them to considerably reduce the size of the cylinder, and consequently approach large powers more easily, thus ensuring more steady running with a lighter flywheel.

They retained, firstly, the general arrangement of the single-acting motor, which up to that time they had constructed, notably the disposition of the inlet and exhaust valves underneath the cylinder. However, from that time they introduced an important modification. The cylinder liner with its jacket constituted a part independent of the two cylinder heads. Each of these carried a stuffing box, through which the water-cooled piston rod worked, and an extension downward of the combustion chamber, in which were installed the valve, which simultaneously admits air and gas, and actuates the exhaust valve. The actuating mechanism of the valves was also modified, without departing from the system of variation of the admission, consisting of cutting off the air and gas supply simultaneously. This system had the advantage of preserving the composition of mixture most favorable to complete combustion, but it had the inconvenience of diminishing to some extent the compression as the charge decreased. This diminution reduced the economic efficiency of the engine in the case of light loads; and also when it happened that the gas was very poor it spoilt the ignition and caused misfires, which altogether upset regularity and economy.

This trouble becomes very marked in motors driving dynamos, which very often work with reduced loads, and where economy is a greater consideration than in blowing engines. Therefore, no time was lost in introducing another system of variation, consisting of air admission to the cylinder during the whole piston stroke, and only allowing the gas to enter during the last portion of the stroke by the governor varying the moment at which this admission commences. In this way invariable compression is secured.

It is true that when the mixture is modified it becomes poorer and poorer; but it should be noted that gas is introduced at the back end of a cylinder already partially filled by a volume of air which follows the piston. Although it is impossible absolutely to rely upon retaining the exact stratification characteristic of the Otto cycle, there persists, nevertheless, an undoubted statification of mixture, the richest strata remaining at the back end of the cylinder, close to the ignitor.

The sparks then impinge on the explosive mixture, which, being strongly compressed, ensures that the ignition is readily transmitted to the whole volume. It will be seen that the gas-admission valve must be able to open independently of that giving air admission.

In engines of this system the two valves are superposed, the air arriving by a casing which surrounds the gas passage, and the valve spindle passing through the gas valve, which is hollow. The placing of the valves in an ante-chamber of the combustion chamber, leading to a tubular combustion chamber, evidently assists the stratification of which mention has been made, and consequently, the ignition of weak charges, but it resulted in cylinder heads of unsymmetrical form, which created difficulties at Cockerill's works, as it had already done elsewhere.

The unequal contraction of the metal of the various parts of the cylinder head caused great stress, which, added to the already high stresses, due to the explosion and to the heating, have occasionally brought about the fracture of the cylinder heads, even when they have been replaced by steel castings.

This circumstance decided the makers of large engines to revert to the symmetric arrangement of the valves, which is customary in steam engines where the inlet valve is placed on the top of the cylinder, and that of the exhaust underneath, and thus to obtain an arrangement which lends itself well to expansion, and which, moreover, facilitates access to the valves.

This arrangement has been obtained in different ways by manufacturers, notably at the works at Deutz and Nürnberg and at Seraing. At the Cockerill Company's works the covers are no longer attached to the central body by studs screwed into it, but joined by tie-bolts bolted to flanges on these covers.

These bolts are thus subjected to tension, and, similarly, the body of the cylinder is subjected to a compression stress of the kind which best suits such metal. This arrangement is patented. The frame is formed of two box girders carrying the cylinder. These girders are joined by tie-bolts to others that contain the slides and carry the crank-shaft bearing. The piston is composed of two halves with double walls, each half permitting water circulation, the two halves being bolted together with an india-rubber joint.

The water cooling is effected at a pressure of three and one-half to five kilogrammes (fifty pounds to seventy pounds) per square centimetre, to avoid water-hammering in the piston and its rod. The water, furnished to the latter by a duct fixed at one end, passes through the rod and the two halves of the piston, and goes out at the back by another duct.

The ignition is effected by means of one or two high-tension magnetos, through fixed sparking-plugs. These magnetos do away with the necessity for a source of electricity external to the motor. The compression has been successively increased up to fourteen kilogrammes per square centimetre. The starting is effected by means of air, compressed to ten atmospheres (143 pounds) by a special compressor, and retained in a reservoir in sufficient quantity to enable the engine to revolve several times.

KJELLIN ELECTRIC STEEL FURNACE.[1]

BY E. C. IBBOTSON.

This process was reported upon by the Canadian commission in 1904, and much detailed information was also given in a paper by Chief Engineer V. Engelhardt, published in "Stahl und Eisen."[2] Believing that some of the latest particulars of the process will be of interest, the author submits the following data:

At Gysinge, in Sweden, during the year ending May 31, 1906, from a fixed furnace giving one ton (2,240 pounds) of steel per tap, there were produced 950 tons of tool steel and special steel ingots. In carbon and iron tool steels all the usual tempers were made. The bulk of this steel was made from charges composed of about

[1] Paper read before the Iron and Steel Institute, July, 1906.
[2] Vol. xxv, 1905, Nos. 3, 4 and 5.

Digitized by Google

eighty per cent of Swedish white pig iron and twenty per cent of steel scrap. The percentage of carbon was regulated by the addition of briquettes. Other charges were made from Swedish white iron and steel scrap.

The average time taken per charge for the year, when adding briquettes, was seven and one-eighth hours, and the electric energy consumed was 1,128 units (kilowatt-hours) per ton. The average time per charge for white iron and scrap charges was five and one-half hours and the electric energy consumed was 886 units per ton. These consumptions include all time and energy lost from various causes, such as bad water supply, ice, etc.

It is quite ordinary practice to complete the charges with briquettes in six and one-half hours, and without briquettes in five hours, as shown by the following typical charges: white pig iron, 1,457 pounds; steel scrap, 439 pounds; briquettes, 220 pounds; ferro-silicon (fifty per cent of silicon), seventeen pounds; ferro-manganese (eighty per cent of manganese), fifteen pounds; aluminum, one ounce.

The times, strength of current and units consumed for this charge were as follows:

Time.	Current.		
	Kilowatts.	Units.	
5.30	125	.....	Charging two-thirds of the pig iron.
6.00	145	67.50	
6.30	160	76.25	
7.00	170	82.50	Charging the remaining one-third of the pig and the scrap.
7.30	170	85.00	
8.00	165	83.75	Clear melted.
8.30	165	82.50	Briquettes added.
9.00	165	82.50	
9.30	165	82.50	Briquettes added.
10.00	165	82.50	
10.30	165	82.50	Briquettes added.
11.00	165	82.50	
11.30	165	82.50	
12.00	130	73.75	Ferro-silicon and ferro-manganese added. Tapped.
6¼ hours.	...	1,046.25	

The chemical composition of the materials charged and of the resulting steel were as follows:

WHITE IRON (HERRANG).

	Per Cent.
Total carbon	4.00
Silicon	0.15
Manganese	0.18
Sulphur	0.010
Phosphorus	0.012

BRIQUETTES.

	Per Cent.
Iron	59.0
Sulphur	0.010
Phosphorus	0.006
Silica	11.00
Lime (CaO)	2.50
Alumina	0.50

STEEL INGOTS.

	Per Cent.
Carbon	0.40 to 2.00
Silicon	0.12
Manganese	0.34
Sulphur	0.012
Phosphorus	0.014

The lining of this furnace during the year was magnesite. When using briquettes the lining lasts, on an average, five weeks, and when charges are worked without briquettes the average life of the lining is seven weeks.

Various tests have been made of the steels produced in this furnace, and many have been given in previous reports. During the year satisfactory results obtained in works practice have been reported, particularly in connection with the following steels: stamping dies, punches, cold chisels, screwing dies and taps, cutlery, drills and turning tools. The following special steels have also been produced: Tungsten steel (including permanent magnet steel), chromium steel, nickel steel, nickel-chromium steel, self-hardening steel and high-speed tool steel. High-speed tool steel, tested to one of the latest government specifications, gave satisfactory results, while twenty-five per cent unannealed two-inch nickel steel bar, one-half-inch diameter, gave a yield point of 30.68 tons per square inch, a maximum stress of 50.44 tons per square inch, an elongation of forty-four per cent, and a reduction of area of sixty per cent.

Electrical tests carried out have shown that No. 6 gauge rods had a specific resistance of thirty-six microhms per cubic inch; No. 16 gauge wire a specific resistance of 33.5 microhms per cubic inch.

Edgar C. Bradley Joins the Staff of the American Telephone and Telegraph Company.

Edgar C. Bradley has resigned as second vice-president of the Postal Telegraph-Cable Company to accept a leading executive position on the staff of Frederick P. Fish, president of the American Telephone and Telegraph Company.

Mr. Bradley was born at Portland, Mich., November 16, 1855. At the age of fifteen, he entered the service of the Michigan Central Railroad Company as telegraph operator. He became connected with the Pennsylvania Railroad Company in 1877, and in 1888 was appointed superintendent of telegraph of the entire Pennsylvania system west of Pittsburg. Four years later he became assistant general manager of the Postal Telegraph-Cable Company with headquarters at New York city, rising later to the position of vice-president. He has had general charge of the lines and physical property of the company, supervision of requisitions for supplies and various other details connected with this great network of lines of communication.

EDGAR C. BRADLEY.

For the next three months Mr. Bradley will make his headquarters at San Francisco, where he will assist in the rehabilitation of that part of the telephone system destroyed by the recent earthquake and conflagration. Mr. Bradley is one of the ablest telegraph men of the day, and his genius has been responsible for a great deal of the development which has come about in this industry. His affiliation with the American Telephone and Telegraph Company will surely be productive of much forward work, and his enterprise can be counted upon to make him of professional value to his new field of endeavor.

Digitized by Google

The Hydroelectric Plant at Lucerne, Switzerland.

By Franz Koester.

THE city of Lucerne, the capital of the canton by the same name, the city most frequented by tourists in Switzerland, has lately installed its own power plant to supply light and power to the city itself, as well as to the Stausstad-Engelberg Railway, water power from the Erlenbach by Engelberg having been utilized, a company being formed in 1903 in which the city of Lucerne holds ninety per cent of the stock.

As the river gives a water supply of some 1,000 litres per second (thirty-five cubic feet), and as the head is 1,023 feet, some 8,000 to 10,000 horse-power is available; this, however, is figured on the operation of the plant for twelve hours per day; but, taking into consideration the number of small mountain streams which may easily be turned into the river, a still greater horse-power is easily obtainable should occasion demand.

A short distance from where the spring emerges from the mountain a channel 259 feet in length diverts its course to a natural reservoir which has a capacity of 2,471,000 cubic feet.

The water of this spring is always at the same temperature and particularly free from sand. The flow is greater in summer than in winter, but the needs of the plant are met exactly, as in the summer season there are greater demands made on the plant, due to the increase in traveling. From the natural reservoir a tunnel leads to a concrete collecting basin twenty-three feet square. The tunnel, which is 8,480 feet long, has a cross-sectional area of forty-five square feet and runs on a slope of 1.2 feet per 1,000. The concrete collecting basin is designed to accommodate four penstocks, only two of them being at present in place, and is well provided with sluice-gates, screens and overflow. The penstocks have a diameter of 3.28 feet, are 2,025 feet long, and are made of riveted steel plates in sections twenty-six feet long. They are anchored by heavy concrete blocks at five points, as may be seen in the accompanying illustration, expansion being allowed to take place in an upward direction, the lower end being anchored and the upper end provided with an expansion joint.

At the side of the power-house, before the penstocks branch to the water-wheels, they are each provided with a butterfly valve, and two safety valves are placed on the end of each penstock, by which also the entire penstocks may be drained, the water flowing in the tail-race to river Aa.

The main generating room is 177 feet long, 43.6 feet wide and thirty-nine feet high and is directly in front of the switching house, separated from it by heavy pi-

LUCERNE HYDROELECTRIC PLANT. COLLECTING BASIN, PENSTOCKS AND POWER PLANT.

lasters upon which travel a thirteen-ton electrically operated crane. Behind the switching house is the transformer annex, another small annex being devoted to the storage-battery room and offices.

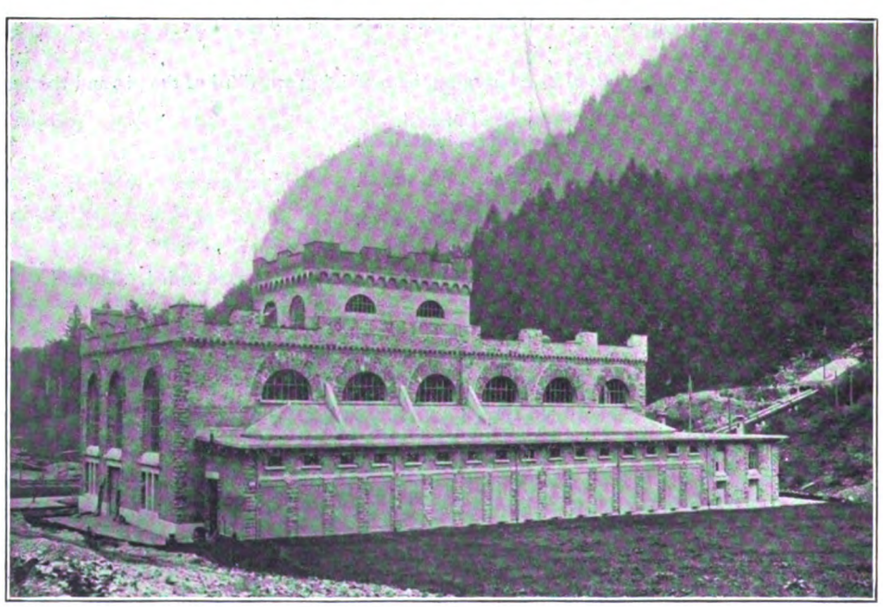
The architectural features of the inside of the building are pleasing, while those of the outside harmonize well with the surrounding country. The building, of rough-faced stone, reminds one of the old Swiss strongholds and castles, although it does not lose its identity as a power plant. Large arched windows are provided, furnishing plenty of light for the generating and switching rooms.

The plant is designed to accommodate six 2,000-horse-power Pelton wheels, direct-connected to the generators. There are, however, only four main units installed. These Pelton wheels, operating under a head of 1,023 feet, make 300 revolutions per minute, and are well equipped with automatic and hand-regulating apparatus and hydraulic servomotors.

The plant supplies light and power to Lucerne, which is distant seventeen miles, and Engelberg, nine miles, besides supplying some 200 kilowatts to some fifteen villages at canton Uid and Obwalden. One generator of 600-horse-power capacity is held in reserve that it may be thrown in parallel with the generators of the Stausstad-Engelberg Railway power-house when needed.

There are two distinct bus-bar systems—one a single-phase system, for the lighting of Lucerne; the other bus-bar supplying all other light and power. There is an additional plant in the Thorenberg which in the future is to become a reserve for the single-phase system of lighting at Lucerne, the light and power for the smaller towns and villages being taken off the three-phase lines, as the variations in the load are not great enough to seriously interfere.

There are four single-phase—three-phase generators of 2,000 horse-power each, which may be thrown either on the



LUCERNE HYDROELECTRIC PLANT. POWER-HOUSE, SHOWING TRANSFORMER ANNEX.

Digitized by Google

lighting or power system, the connections for these being separated from those of the 600-horse-power railway generator referred to above, with the exception of the exciting system, which is common to all. The exciters consist of two 100-kilowatt generators, only one of them being used at a time, this generator also supplying the current for the lighting of the power-house, working the signal system, and for the small motors which operate the high-tension switches. A storage battery is placed in the exciting circuit. The bus-bar circuits are constructed as complete ring systems.

The generators are of the Oerlikon revolving-field type, 6,000 volts, fifty cycles, making 300 revolutions per minute, and are capable of generating 1,850 kilovolt-amperes on three-phase and 1,380 kilovolt-amperes on single-phase. The generator frame is made in four parts, the segments being fastened together by cast-steel rings. The coils are placed in mica tubes and fastened in the slots by fibre wedges. The poles, of which there are twenty, consist of four laminations each, and are securely fastened to four steel rings which are shrunk on to the spider. The four laminations of the poles are so arranged that the edge of one overlaps the other. The magnet coils consist of copper strips bent on edge.

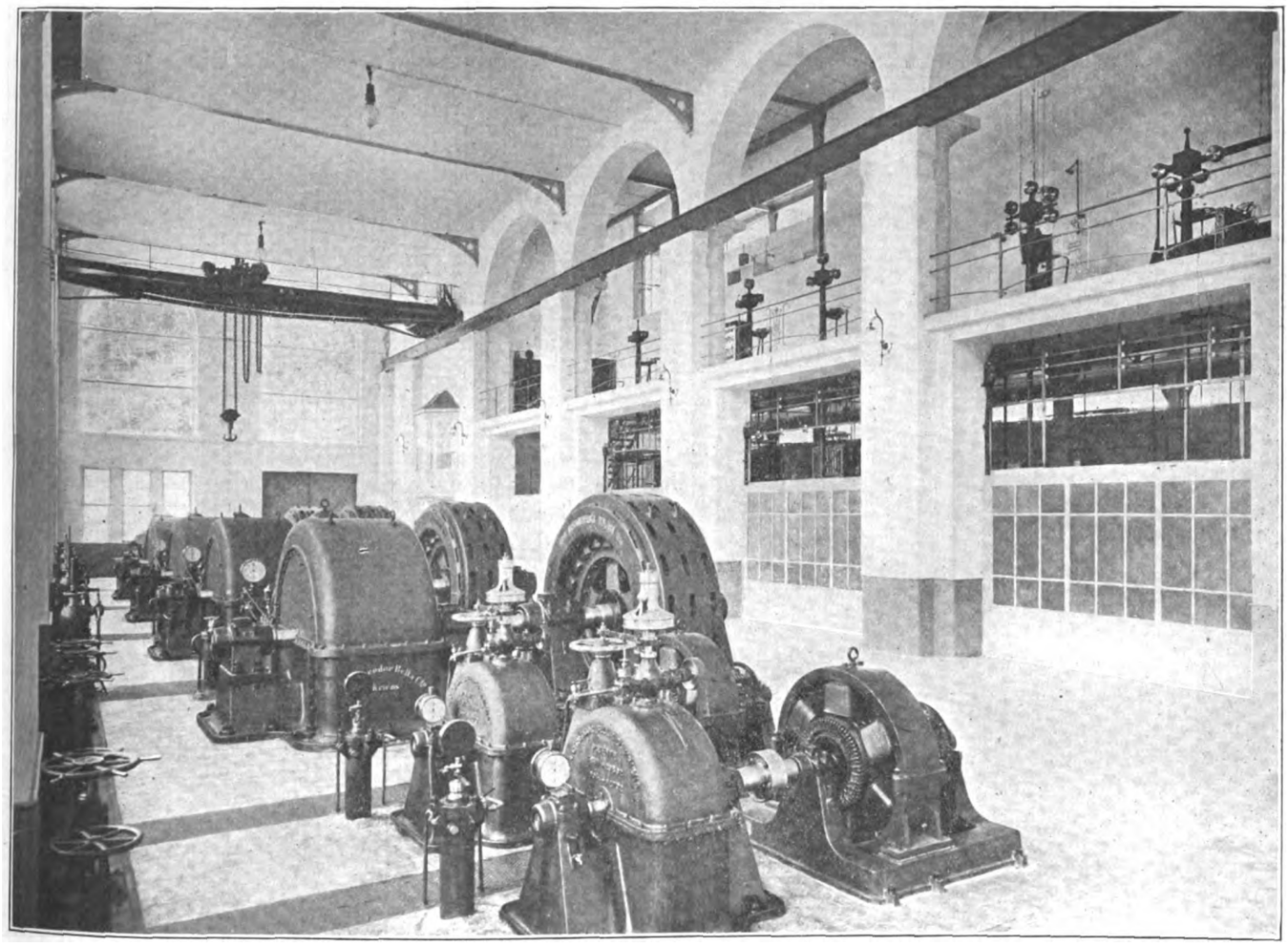
As a 600-horse-power, three-phase reserve generator for the Stausstad-Engelberg Railway works in parallel with the railway power-house, a frequency of thirty-two and one-half was chosen, the generator being coupled directly to the turbine shaft by means of a flexible coupling and making 480 revolutions per minute, giving a voltage of 780 and 540 kilovolt-amperes.

The exciters have a capacity of 100 kilowatts and have a normal voltage of 100, while the maximum voltage is 150. They are six-pole, shunt-wound machines.

The storage battery consists of fifty-six elements, with a capacity of 1,000 ampere-hours or 1,500 amperes for a quarter of an hour, and are arranged in three rows, provided with a double cell switch so they may be operated at a distance. A small direct-current motor is used for operating the switch when charging and discharging the battery.

The main transformer station is an annex to the power plant, special attention being paid to its design, not only as regards its architectural features but also considering its lighting and ventilation. The transformers are single-phase, water-cooled oil transformers, each being placed in a separate fireproof compartment, the intervening wall being of heavy masonry; a rolling door protects the entrance to each compartment. The transformers are placed on slide-rails to facilitate ease of handling in case of accident, and a small track runs directly in front of the entrance to the several compartments.

The aisle between the switching and transformer compartments contains on the wall nearest the transformer compartment the pipes of the water-cooling system. This water supply is provided with an automatic alarm system, so that, should there not be an adequate water supply for normal conditions, it is at once known. There are sixteen transformer compartments, ten of which hold transformers,



LUCERNE HYDROELECTRIC PLANT. INTERIOR OF GENERATING ROOM. SWITCH GALLERY AT RIGHT. EXCITERS IN FOREGROUND.

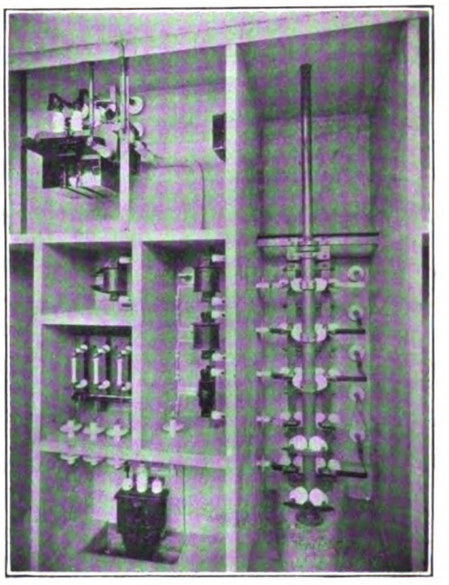
Digitized by Google

each having a capacity of 700 kilovolt-amperes, having a 6,000-volt primary with a secondary voltage of 27,000, at a frequency of fifty cycles.

apart. The entire switching arrangement is constructed on the isolated system, each accessory being placed in a separate fireproof compartment of reenforced concrete.

from which the whole generating room is overseen; the third floor being in the tower, the floor being flush with the generating room, contains the switches of all

LUCERNE HYDROELECTRIC PLANT. TRANSFORMER COMPARTMENTS.



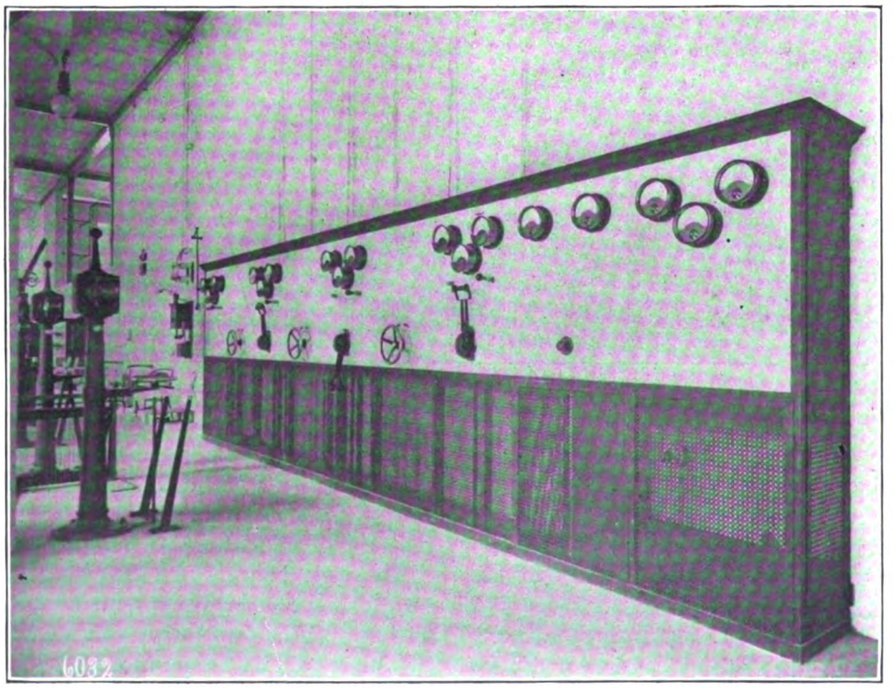
LUCERNE HYDROELECTRIC PLANT. REAR VIEW GENERATOR SWITCH PANEL.

The care shown in the design of the transformer room was even exceeded in the design of the switching room, a feature which in nearly all power-houses is

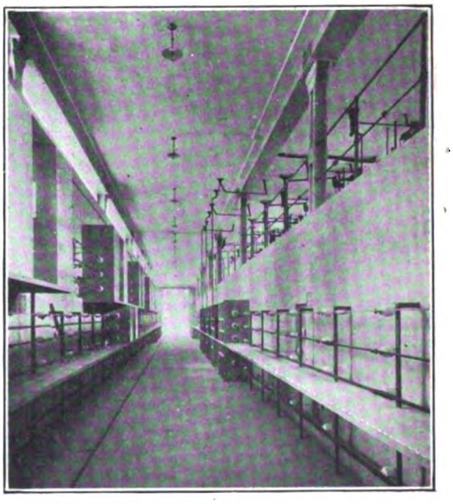
The switching house has three floors, the first containing the switching apparatus of the generators and exciters, the 6,000-volt bus-bar system and the primary

outgoing wires and the lightning arresters. The first and second floors are each divided by two division walls, thus giving three distinct compartments on each floor.

The connections between the generators and switchboards are carried along the



LUCERNE HYDROELECTRIC PLANT. OUTGOING FEEDER PANEL.



LUCERNE HYDROELECTRIC PLANT. 6,000-VOLT BUS-BAR ROOM.

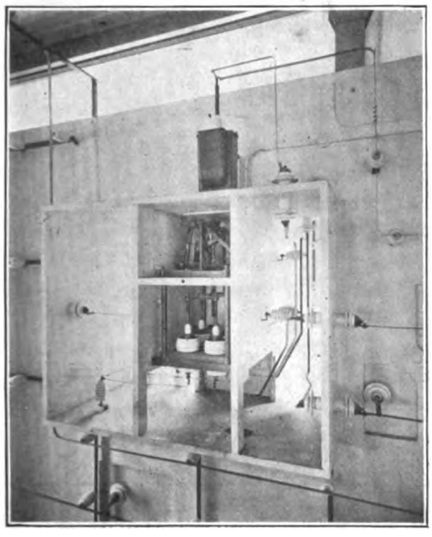
of secondary importance, but which in this instance occupies nearly as much space as the generating room, care being taken that low and high-tension wires are kept far

switches for the transformers; the second floor contains the secondary switches of the transformers, the 27,000-volt bus-bar system, and is the main operating gallery

ceiling of an arched concrete tunnel beneath the floor line. The first compartment, toward the generating room, of the first floor contains the switching apparatus for the exciter units, generators and the storage battery. The first panel of the board is devoted to the use of the generator for the Engelberg street railway, and carries an automatic oil-switch, a blowout fuse, and the necessary apparatus

Digitized by Google

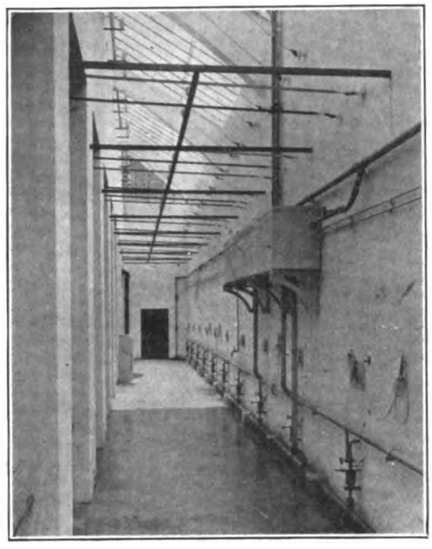
for synchronizing the generator with the Engelberg station. The four adjacent panels are for the 2,000-horse-power generators and their equipment. Each panel contains an automatic oil-switch, or tension transformer and four other transformers, one for the ammeter, one for the wattmeter, and two for the blowout coils of the maximum switch. There is also a double-throw switch by which the generators may be thrown either on the lighting or power bus-bars. Additional compartments are provided for the exciter generators and the battery, as well as for a double-throw switch for charging and discharging the latter. The apartment directly above the one just described is devoted to the switching apparatus of the shunt-wound regulators of the exciters and the exciter rheostats. The centre apartment of the first floor is devoted to the



LUCERNE HYDROELECTRIC PLANT. MAXIMUM OIL-SWITCH FOR 27,000-VOLT CURRENT.

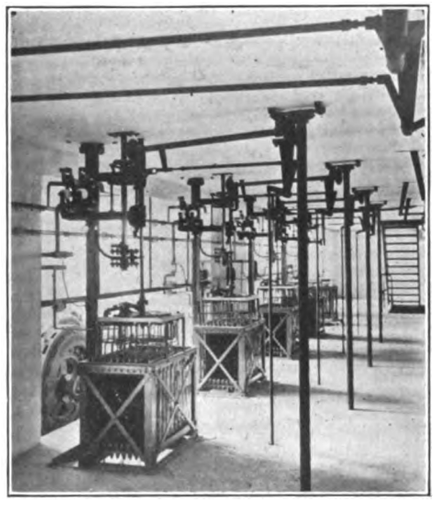
6,000-volt bus-bar system, from where feeders run either to the transformers or to the Engelberg street-railway system, both bus-bar systems being installed for the total capacity of the plant and equipped with sectionalizing and disconnecting switches. Between the feeders of each generator there is a sectionalizing switch, while a disconnect switch is on each side of the generator feeders. The primary switches of the transformer plant are operated from the third apartment of the first floor, directly above them being the secondary transformer switches, so arranged that they may be operated either from the first or second floor, the levers being connected by a small wire. The primary and secondary switches are equipped with time relays and optical and acoustic signal systems. For each transformer there are a signal lamp, time relay and ammeter arranged on a panel by the side of the main switch lever.

In the third floor is located the 27,000-volt, bus-bar systems, provided with the necessary switches, similar to those of the 6,000-volt system. There are altogether



LUCERNE HYDROELECTRIC PLANT. PASSAGE BETWEEN SWITCHROOMS AND TRANSFORMER COMPARTMENTS.

nine outgoing feeder systems, two of which are for lighting the city of Lucerne, three for power for Lucerne and three for light and power for Unterwalden, each of the three three-phase systems being so arranged as to draw current either from the power or lighting bus-bar system.



LUCERNE HYDROELECTRIC PLANT. RHEOSTATS FOR EXCITERS.

The lightning arresters are of the Siemens horn type, arranged in series and provided with water rheostats and inductive rheostatic coils. For sudden overloading, due to electrical discharge, each terminal of the lightning arrester is provided with the so-called water-spray apparatus, absorbing the excessive current and conducting it to the earth; the water that is used for this purpose is taken from a spring and is also used for cooling the transformers.

In spite of the exaggerated appearance of the switching system, it has been found to be very simple in operation, everything being operated from the apartment of the second story.

A striking feature of this installation are the columns well known in Swiss practice, being nearly exclusively installed by the Oerlikon Company. Each column supports a wattmeter, an ammeter and a voltmeter, provided with two scales, one for the generator voltage, the other for the phase voltage used in connecting the generators in parallel, while accompany-

LUCERNE HYDROELECTRIC PLANT. CONTROL COLUMNS, SWITCH GALLERY.

ing each column there is a hand-wheel and two levers throwing the generators on the bus-bar systems and operating the carbon switches of the exciters and the rheostats. The interlocking system of the switching arrangement makes it difficult for the operator to make a mistake, as one switch can not be thrown until the one upon which it is dependent has been operated; in addition to this each generator column is equipped with a red and a white incandescent lamp and an electric bell to give signals for throwing in and out the generators. The storage-battery column is equipped with two ammeters and a voltmeter provided with a double-throw switch for measuring the voltage of the bus-bars and the charging and discharging voltage of the battery, the two levers operating an

Digitized by Google

automatic cutout switch and the switch for the battery.

The exciter column is provided with an ammeter and a voltmeter, the hand-wheel governing the shunt-wound regulator and the two levers being used to control the circuit to the generator for which the exciter is to be used. From this operating gallery the sectionalizing switch in the bus-bars is also controlled, and there is a small switchboard controlling all outgoing wires, the first panel of which contains the instruments of the generator supplying Engelberg. The next three panels are for light and power, and the last two panels bearing the static voltmeters for testing the grounded bus-bars of the 27,000-volt system and the condensers and graphite rheostats. There is still another small switchboard, which is only used for controlling the lighting of the powerhouse, consisting of eight arc lamps and numerous incandescent lamps.

The mechanical equipment of the plant was installed by Th. Bell & Company, of Kriens, Switzerland, while the entire electrical equipment was designed and furnished by the Oerlikon Company, of Baden, Switzerland.

Annual Meeting of the British Association for the Advancement of Science.

The annual meeting of the British Association for the Advancement of Science began in York, England, on August 1, under the presidency of Edwin Ray Lancaster. In his inaugural address the president outlined the advancement of science during the last quarter of a century, which, he said, "will stand out forever as that in which new chemical elements possessing astounding properties have been made known with extraordinary rapidity and sureness of demonstration." Mr. Lancaster devoted much of his address to a review of the increased knowledge concerning radium and gave Ernest Rutherford, of McGill University, Montreal, much of the credit for investigation in this direction.

While speaking of astronomy, Mr. Lancaster made reference to the method of Professor Pickering, of Harvard University, of charting the sky rapidly, and his records of the sky as a whole. "This wonderful new method," continued the president, "is a mode of keeping a record of present movements and changes which promises much for the future of astronomy."

The president made acknowledgment of the assistance rendered by wealthy Americans to scientific research in providing great telescopes and equipment, as well as other helpful gifts for other branches of science. "In the United States this is not infrequent," said the speaker, "while in this country it is rare."

It was announced that Sir David Gill had been nominated for the presidency of the association for 1907.

HARMONIC PARTY-LINE SYSTEMS.[1]

BY WILLIAM W. DEAN.

The name Harmonic Party-Line System has been given to a system of selective bells for telephone party lines which has come into very general use in the last four years among the independent telephone companies of this country. Referring to Kempster B. Miller's book, "American Telephone Practice," you find the following passage which I consider the most lucid explanation of the principle involved in this class of systems which I have ever seen. He says:

"These systems, with one exception, make use of the fact that every pendulum or every vibrating reed has a natural period of vibration, and that it can be made to take up this vibration by the action of a succession of impulses of force occurring in the same frequency as that in which the reed or pendulum vibrates. A familiar example of this is found in one person pushing another in a swing. The swing has its natural period of vibration depending on the length of the ropes, and a gentle push applied at proper intervals by the person on the ground will cause the swing to vibrate with considerable amplitude. If the pushes are applied at intervals not corresponding to the natural period of vibration of the swing, many of them tend to retard rather than help its vibrations, so that a useless bumping results, producing but little motion."

The first harmonic selective party-line system was that invented by J. B. Currier and patented by him in 1881, and used for several years by the New England Bell Telephone Company. In this system the electromagnets with their armatures, which in this case contained the bell tapper, were arranged in series in the line the same as in the Edison harmonic telegraph. Currier produced his pulsating currents by means of pendulums of different lengths, which pendulums were provided with contacts for interrupting the ringing current.

The next improvement invented in this line was the system of J. A. Lighthipe's, patented in 1895, which was used to a limited extent by the Bell Telephone Company on the Pacific coast. Lighthipe's system is almost identical with the harmonic selective party-line systems in use to-day. He was the first one to introduce the condenser in series with the bell across the line to prevent the central office current from flowing through the magnet coils.

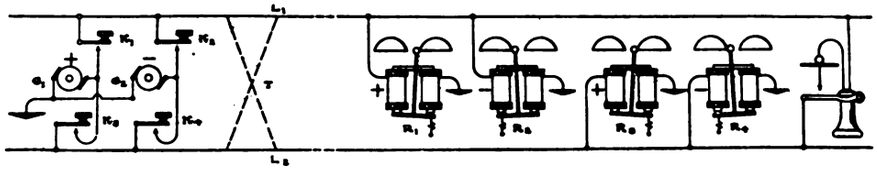


FIG. 1.—GROUNDED HARMONIC SYSTEM.

It is very easy to see and understand why early harmonic systems were not an entire success. Two things are necessary for the successful operation of systems of this class: the current impressed on the ringing mechanism must be of constant frequency and of approximately uniform potential. When we look back on early telephonic conditions, we see that these things were not available. How could we expect to deliver a current of constant frequency and potentials to our bells when we had bad lines, no storage batteries, no ringing machines, and if we had had this apparatus we could not have had the splendid sources of electric power at present available to operate them with. What has really made possible the use of harmonic party-line systems has been the introduction in the last few years of modern engineering methods into the telephone business.

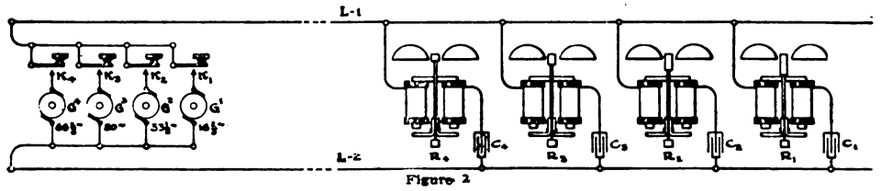


FIG. 2.—METALLIC CIRCUIT HARMONIC SYSTEM.

Early telephone experts never expected that the time would come when each telephone subscriber would be provided with an individual metallic circuit, consequently a large amount of work was done by them along the lines of developing selective party-line systems. I myself remember that in St. Louis, in the early

[1] Abstract of a paper read before the Pittsburg section of the American Institute of Electrical Engineers, March 13, 1906.

Digitized by Google

eighties, a system which employed the "step-by-step" mechanism was used, and as high as sixteen parties were rung selectively on one line; this was known as the "Bliss" system.

If a committee of telephone engineers were asked to decide the question as to what things were most desirable in a party-line system, their report would be as follows: No earth connections, no relays, no adjustable springs or weights, no step-by-step mechanisms, and that the ringing of the bells should not be appreciably affected by the capacity or resistance of the line. The only way that such a specification could be satisfied would be to have bells whose operation depends upon mechanical tuning.

In order to bring out clearly the advantages of a system using clean metallic circuits as compared with those using earth connections, it will be necessary to describe briefly the latter.

Referring to Fig. 1, we have represented a subscriber's telephone line consisting of wires L-1 and L-2. Connected to earth from the L-1 line are the bells R-1 and R-2; connected to earth from the L-2 line are the bells R-3 and R-4; bells R-1 and R-3 are responsive to pulsating currents of positive sign, and bells R-2 and R-4 to pulsating currents of negative sign. Generator G-1 furnishes pulsating current of positive sign and generator G-2 pulsating current of negative sign. The switches K-1, K-2, K-3 and K-4 are provided at the central office for connecting current of the proper kind to line.

When we consider a system such as that illustrated in Fig. 1, we find that the following objections are present: on account of the presence of earth connections at the substations, the lines are susceptible to bad inductive disturbances, due to electric railway, alternating power and lighting circuits and telegraph. It is apparent that, in order that subscribers be rung selectively, each bell be connected to the proper side of line. In other words, the operator, when she wishes to ring stations 1 and 2, projects either positive or negative pulsating current on to the L-1 half of the metallic circuit, and when she wishes to call station 3 or 4 she connects plus or minus current to the L-2 side of the line.

Now, if a line be transposed, say, at T, to prevent inductive troubles, or if the wire chief at the central office happens to get a jumper reversed in the process of making a cross-connection on the distributing frames, the currents sent out would go to the wrong side of the line, and a wrong subscriber be called, thus causing endless trouble. This class of faults is constantly occurring to my knowledge.

In installing telephones in a system such as Fig. 1, the installer is always obliged to locate accurately the proper side of the line before connecting it to the telephone, which operation entails expense and chances for mistakes. When an operator in this system rings a subscriber, say, No. 4, with the minus pulsating current, and during the process of ringing the subscriber removes his receiver from the telephone hook, part of the current is carried over to the other half of the line and the bell connected to it which responds to like current (No. 2) will consequently give a false ring.

Now we come to the description of a modern harmonic selective system. Referring to Fig. 2, L-1 and L-2 represent the two sides of a metallic circuit telephone line. R-1, R-2, R-3 and R-4 are mechanically tuned telephone bells, each having connected in series with it a one-microfarad condenser across the line. G-1, G-2, G-3 and G-4 are generators designed to ring them. K-1, K-2, K-3 and K-4 are switches used by the operator for connecting the currents of proper frequency to line. It is evident that no transposition of the line at any point or of the terminals of the instruments can effect the operation of this kind of a system, and inasmuch as each bell responds to an entirely different current, no "cross-rings" can be produced by the removal of the receiver during the process of ringing. It is also evident that when telephones are being installed they can be connected to the line without care or reference to polarity, in the same manner that incandescent lamps are connected to a lighting circuit.

Two of the first problems that present themselves in designing a harmonic party-line system are the selection of currents of proper frequencies and voltages and the method of producing the same. Elisha Gray found during his experiments with harmonic telegraph, that frequencies which were related in a ratio of one, three, five, seven and nine produced the least interference. It is evident that to produce currents whose frequencies are related in the above manner, it would be necessary, if one driving motor were used, to use belted or geared transmission which is not desirable. It was found that currents whose frequencies were related in a ratio of one, two, three and four were sufficiently non-interfering for commercial purposes. Currents or frequencies of 2,000 4,000, 6,000 and 8,000 were finally adopted and were generated by a set which consisted of a motor direct-connected to two, four, six and eight-pole generators, the whole outfit running at a speed of 1,000 revolutions per minute. It was found by experiment that high-frequency bells required more power to operate them than the low-frequency ones, and consequently it was found necessary to step up the voltages of the generators as the frequency increased. The voltages which were finally found to be the best were for sixteen and two-thirds cycles, sixty volts; for thirty-three and one-third cycles, 100 volts; for fifty cycles, 135 volts; and for sixty-six and two-thirds cycles, 180 volts. These harmonic ringing sets are provided with a governor, by means of which the speed of the motor is kept constant regardless of the variations of voltage in the power circuit.

We now come to the design of the harmonic bell itself. The following points are essential to a successful harmonic ringer: its armature must be in perfect tune with the current designed to operate it; it must remain in tune, after once leaving the factory, indefinitely; it must be interchangeable with the ordinary single-party telephone ringer, for the reason that a great many of the operating companies find it necessary to change over their old to the new system; it is desirable that the general appearance of the ringer after being installed be the same as that of the ordinary single-party ringer, it being sometimes desirable that the telephone users be in ignorance of whether other subscribers are using party or single-line service.

It is a well-known fact that a device in tune with the energizing force is many times more efficient than one which is not. In working with these absolutely tuned bells I have found that they can be constructed to give any desired degree of sensitiveness.

While the motor-generator ringing machines previously described serve their purpose, they necessarily limit the use of the harmonic system of ringing to such exchanges as can obtain the necessary electric current for their operation. These machines are furthermore expensive in first cost, also in operation and maintenance, when compared to the cost of a telephone switchboard and the cost of current required to operate it. Thus many small exchanges have been prevented from installing the harmonic system, and a big

Digitized by Google

demand created for a simple and inexpensive method of producing the harmonic currents without the necessity of special power circuits and without a big current consumption. The harmonic converter is a result of this demand. It is made up of four separate units, each consisting of a pole-changing vibrator, a transformer adapted to the frequency of its associated vibrator and designed to give the proper voltage in its secondary winding for the operation of the harmonic ringers previously described, and a condenser also suitably proportioned to the electrical conditions of the circuits. These units are shown with their connecting wiring in Fig. 3. It will be seen that the vibrators V-1, V-2, V-3 and V-4 have electromagnets T operating armatures P similar to the action of an ordinary electric house bell. Upon these armatures are mounted two springs, m and n, which are connected to the terminals of a source of direct-cur-

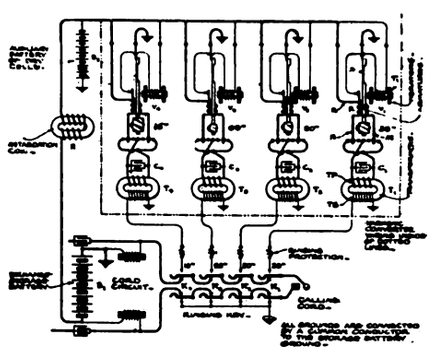


FIG. 3.—CONNECTION OF HARMONIC VIBRATOR.

rent supply. Four contacts are arranged, two on either side of the springs, so that when the armature is drawn up the current will be allowed to flow through the primary winding T P of the transformer, and when the armature swings back these latter contacts are cleared and the other two contacts are made, causing current to flow in opposite direction through the same primary winding. The condenser C, which is placed across the primary winding of the transformer, takes up the discharges from the coil and prevents sparking at the vibrator contacts. It also assists in rendering the alternating effect in the primary winding more uniform and efficient. One of the secondary terminals on each of the transformers is connected to a common conductor, and together with conductors from the other four free terminals, serve to carry the four frequency-ringing currents to the switchboard.

Unlike the direct-connected motor-driven multifrequency generator, the separate units of the harmonic converter allow the use of the most desirable frequencies for non-interference in ringing. An incidental advantage in the use of separate units for each frequency is that each vibrator will continue to operate perfectly, even though one or more of the other converters or associated apparatus are disabled.

The vibrator or pole-changing mechanism of the harmonic converter is made with massive parts rigidly put together, so that the continual vibration of the armature will not work them loose. The armature itself is made from one piece of tempered steel cut away at its upper part so as to form a thin spring portion as shown at X in Fig. 3. This construction obviates the use of rivets, and gives a solid portion of the metal at its top which can be rigidly held in the vibrator frame. The reduced portion of the armature is made rather long, so as to give a free and easy armature movement and an indefinite life to the spring. At the lower end of the armature is attached an adjusting weight which is used to get the final tuning of the mechanism to the proper frequency. These weights can be raised and lowered during the process of tuning, and securely clamped in place at the proper position. The main difference in the rate of vibration of the armature is obtained, however, by making its reduced or spring portion of different thicknesses, the highest frequency having the thicker spring. Vibrators constructed on these lines do not vary perceptibly from a uniform rate of vibration, even with great changes in the voltage of the operating circuit. The only noticeable effect is the variation in the amplitude of movement, but this has not been found a serious obstacle when operating within the limits of the voltages usually met with in practice, a change of thirty to forty per cent in the case of storage batteries. A governing mechanism is therefore unnecessary, as the proper frequency is always maintained.

The transformers used in the harmonic converter are built after the pattern of those used in electric lighting, with a very efficiently closed magnet circuit. The amount of iron as well as the design of the windings are varied to suit the frequency and voltage required at the secondary terminals, the lowest frequency having the greatest amount of iron and the smallest voltage.

The first experiments on the harmonic converter were directed towards reducing the number of contact points in the vibrators, and the most promising scheme developed was the use of a double primary transformer with a vibrator having two contacts, arranged one on either side of the armature, and so connected as to cause current to flow, first in one primary coil of the transformer and then in the other coil but in an opposite direction. Thus an alternating current was produced in the secondary winding. Condensers were placed across each of the primary windings of the transformers to reduce sparking at the contacts and assist in the circuit action. It was found, however, that the use of two primaries greatly reduces the efficiency of the transformers, giving less output and a greater no-load or exciting current than when one primary is used. Also the breaking of the current at one vibrator contact, which necessarily has a comparatively small amount of movement, limits the output of the machine as well as restricts its use to low-voltage primary circuits.

A multiple break and a complete reversal of the current in the vibrator, as shown in the perfected harmonic converter, were thus found necessary to correct these evils. The breaking of the current at the two contact points simultaneously not only reduces the voltage at each break to one-half that of the primary source, but doubles the distance of contact opening in the circuit, thereby allowing the harmonic converter to be operated from the higher voltage primary power circuits.

It has been found in practice that the various frequencies used in the harmonic system of party-line ringing, when produced by properly designed alternating-current generators, give no noise in the talking circuits or inductive disturbances in the lines when ringing. This is probably due to the character of the alternating current, which has a curve approaching that of a true sine wave. The use of a transformer and condenser in a harmonic converter tends to smooth out the current curves produced by the pole-changing vibrators so that the quiet effect of the sine waves is obtained.

Another and more important problem presented itself when operating the harmonic converter from a storage battery of a common battery exchange, as the rapidly recurring changes in potential, due to the action of the vibrators, is sufficiently strong to make the entire talking system noisy. When the exchange battery is of large size and the taps for the harmonic converter are taken directly off its bus-bars, this noise is only slightly perceptible. But any disturbances of

Digitized by Google

this nature are not to be tolerated in a modern exchange installation, so that efficient means had to be produced to entirely overcome this defect. The use of a retardation coil of sufficient impedance to kill the noise in the talking circuits cuts down the efficiency of the harmonic converter to such an extent that its output is not great enough to ring the bells of the party-line system. However, a device was produced as shown in the diagram, Fig. 3, which allows the use of a very high impedance coil and still retains the full efficiency of the harmonic converter. This retardation coil is placed in the supply or feed wire between the main exchange battery B-1 and the harmonic converter, and between them is bridged or floated an auxiliary battery B-2. Like poles of this battery and the main exchange battery are connected to the same wires, so that the auxiliary battery is kept constantly charged, and in fact, called upon for no discharge except when the electromotive force, due to the main battery, is choked down and prevented from providing a peak current, the deficiency being then momentarily supplied for each wave by the auxiliary battery. In fact, the auxiliary battery may be called an equalizer, since it really takes up and absorbs the noisy back surgings, which would otherwise produce a disturbance in the entire common battery system. This auxiliary source of current supply can be a small storage battery, or even electrolytic cells, but in practice ordinary dry cells have served the purpose.

The power consumption and actual results obtained in practice from harmonic converters with fifty-five-watt transformers will serve as an example of the possibilities of this piece of apparatus. With a twenty-two-volt source of current, it requires less than 0.58 watt to operate the four vibrators, while with the primaries of the transformers connected, this consumption is increased to about six and one-half watts. The latter figure represents the total no-load power required when the harmonic converter is connected for regular exchange service. This machine will furnish power to ring simultaneously over fifty fully loaded lines of four bells each, and while an excessive load, it yet remains in the safe limits of operating. Such a machine will do easily all of the ringing of an exchange of 6,400 lines.

When no direct-current source of power is available, primary batteries can be successfully used for operating the harmonic converter. In the case of small exchanges, dry cells are used to a large extent. In any event, it is desirable to have the primaries of the four transformers normally disconnected from the vibrators so that the no-load current will be at a minimum. This is done by means of a magnetically operated switch or relay, which is in turn operated by contacts on the ringing keys. As previously stated, the total no-load power consumed is then less than 0.58 watt—the energy required for keeping the vibrators in motion. With small exchanges this no-load current can be eliminated by allowing the vibrators to remain at rest excepting when actually required for ringing. In this case, the relay switch just mentioned is made to complete the power circuit to the vibrators and set them in motion each time a ringing key is operated. The armatures of the vibrators are brought into full motion with practically no time-loss and with no effect whatever on any but the ringer which it is desired to actuate.

All of these methods of operating the harmonic converter have been in actual use in a large number of exchanges for a sufficient length of time to conclusively prove the extreme reliability and great economy of this method of producing harmonic ringing currents.

The Report of the Westinghouse Electric and Manufacturing Company.

The report of the board of directors to the stockholders of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., for the six years ending March 31, 1906, was presented at the meeting held on July 25.

The company's foreign interests are included in the following enterprises:

The British Westinghouse Electric and Manufacturing Company, Limited, London, England.

Société Anonyme Westinghouse, Paris, covering France, Spain, Portugal, Italy, Belgium, Switzerland and Holland and their dependencies.

Westinghouse Electricitäts Actiengesellschaft, Berlin, for Germany.

Westinghouse Electric Company, Limited, London, of which all shares are owned by the company and has all territory not covered by the companies named.

The Société Westinghouse Electrique de Russie has been organized (under French laws) to purchase an electrical works in Russia, and these have been developed by the Society Anonyme Westinghouse, of St. Petersburg (the Russian Brake Company) to undertake extensive work in Russia.

During the period from March 31, 1900, to March 31, 1906, the East Pittsburg works were twice increased in size and capacity; in 1901-2 by extensions yielding 653,711 square feet of additional floor space. The six-story general office building was also erected in 1901, realizing a further large area of floor space in the works as additional manufacturing space.

In 1904-5 these works were again enlarged by the building known as the east machine shop, with floor area of 694,943 square feet; also 45,980 square feet additional area, all commanded with powerful electric cranes, in a building connecting this shop with other works buildings. These additions gave the East Pittsburg works nearly four times the original floor space.

The Cleveland (Walker) works were changed in 1904 into an iron foundry, admirably equipped, and since then used for the more important foundry work.

The rapid growth of the business is now quite fully occupying the facilities of both the Cleveland and Allegheny foundries.

The Newark works were completely rebuilt since 1902, and additions were made providing a total floor space of 185,000 square feet.

All these additions to the works in East Pittsburg, Cleveland and Newark are now fully equipped with machinery and are prepared to care for the large business now being done, as well as for a reasonable growth. Especial attention has been given to provide adequate facilities for taking care of the rapidly growing and important business in turbo-generators, as well as the building of electric locomotives of all sizes and types, both for special and regular railroad service.

Following is the total number of employés, exclusive of the selling organization, at the close of each of the past six fiscal years: 1901, 7,971; 1902, 9,305; 1903, 11,269; 1904, 10,622; 1905, 11,894; 1906, 14,705.

During the past year a line of railway between East Pittsburg and Trafford City was completely equipped by this company with the latest type of catenary suspension trolley line for high-tension alternating-current transmission, and is being used in testing single-phase electric locomotives manufactured. This railway is also fitted with the third-rail and adequate substations for testing locomotives using direct current, thus affording complete facilities for thoroughly testing under service conditions this important and

Digitized by Google

rapidly increasing part of the product of the works.

To provide for the rapidly increasing business of the Sawyer-Man Electric Company, demanding larger quarters, a plot of ground was recently purchased in Watsessing, N. J., on which entirely fireproof buildings containing 206,700 square feet of floor space are being erected. These buildings will be equipped with the most modern appliances for the manufacture of incandescent lamps. A large addition to the main factory of the Bryant and Perkins companies, in Bridgeport, Ct., is rapidly nearing completion.

The single-phase system developed by B. G. Lamme, chief engineer of the company, has for more than a year been in successful operation on a number of important interurban roads. It has been adopted by the New York, New Haven & Hartford Railroad for the operation of trains on its main line from New York city to Stamford, Ct. This contract is now in process of execution. Two other important railroads have placed contracts, namely: the Grand Trunk Railway, of Canada, for the electrification of the Sarnia tunnel, and the Spokane & Inland Railway, of the state of Washington, for the complete operation of its lines by this system.

The following data show the sales of the company for the fiscal years 1900-1901 to 1905-1906, both inclusive: April 1, 1900, to March 31, 1901, $12,516,071.86; April 1, 1901, to March 31, 1902, $17,927,339.43; April 1, 1902, to March 31, 1903, $19,571,294.91; April 1, 1903, to March 31, 1904, $18,569,614.21; April 1, 1904, to March 31, 1905, $16,570,717.13; April 1, 1905, to March 31, 1906, $24,939,602.35.

For the first five months of the present calendar year the sales have averaged above $2,850,000 per month, which, if maintained, as from present indications we may reasonably expect, will make a total for the year of above $34,000,000.

The above statement of sales does not include the sales of the subsidiary companies, the Bryant and Perkins companies, the Sawyer-Man Electric Company and the R. D. Nuttall Company, which for the fiscal year 1905-1906 amounted to about $3,500,000. All of these subsidiary companies show large increases for the current fiscal year.

It is of interest to note the growth of the sales department in connection with the foregoing table, as follows: number of employés—April 1, 1900, 124; April 1, 1901, 150; April 1, 1902, 192; April 1, 1903, 243; April 1, 1904, 294; April 1, 1905, 391; April 1, 1906, 429.

The sales of railway motors during the past year have increased fifty-one per cent over any previous year in the company's history. The sales of electropneumatic unit-switch system of multiple control have continued large, showing an increase of upwards of sixty per cent over any previous year.

The central station business, including long-distance transmission plants, has been characterized by the more general use of steam-turbine directly-driven generators. The business in turbine-driven generators has been very large and is constantly on the increase.

The industrial and power department, which directs the sales of apparatus for industrial application, including machine shops, mills, mining motors and generators for resale, has shown an increase during the year 1905-1906 of forty-six per cent over the best previous year, and for the early months of the current fiscal year the sales have been on a basis very largely in excess of last year's increase.

GENERAL BALANCE SHEET, MARCH 31, 1906.

ASSETS:		
PROPERTY AND PLANTS:		
Factory plants at East Pittsburg and Allegheny, Pa., and Newark, N. J., including real estate, buildings, machinery and equipment	$10,630,177.14	
Other real estate, including property in Garrison place, Pittsburg, under agreement for sale at $500,000. Book value, $415,795	448,177.73	
		$11,078,354.87
QUICK ASSETS:		
Cash	$6,938,899.88	
Subscriptions to five per cent Convertible Sinking Fund Bonds, due in April, May and June, 1906	2,031,817.00	
Accounts and Bills Receivable	7,414,600.58	
Interest and Dividends Accrued, not due	93,102.46	
Raw Materials and Supplies at purchase prices and Finished Parts and Completed Apparatus and Work in Progress, at factory costs	10,836,994.06	
Completed Apparatus on Consignment at District Sales Offices and other places, for resale, at factory costs	1,046,498.82	
		28,361,912.80
INVESTMENTS:		
Stocks and Bonds of Subsidiary American Companies—Manufacturing Companies of which over ninety-five per cent of the entire Capital Stock issued and all Bonds are owned by this company. Par Value, $7,210,900.00	5,191,146.93	
Stocks and Bonds of Foreign Companies—operating manufacturing plants in Canada, England, France and Russia and selling companies with valuable patent rights in Germany, China, Japan and other foreign countries. Par Value (pounds, francs, marks and roubles) approximately $13,750,678.95	10,661,541.79	
Stocks and Bonds of Lackawanna & Wyoming Valley Rapid Transit Company	6,300,000.00	
Miscellaneous Securities	434,501.36	
		22,587,190.08
OTHER ASSETS:		
Charters, Franchises, Patents, Office Furniture and Fixtures at Factory Plants and District Sales Offices, Insurance and Taxes paid in advance, etc		7,034,537.22
Total Assets		$69,061,994.97
LIABILITIES:		
CAPITAL STOCK:		
Preferred	$3,998,700.00	
Assenting	20,996,350.00	
Non-Assenting	3,650.00	
		$24,998,700.00
FUNDED DEBT:		
Convertible Sinking Fund five per cent Gold Bonds	$15,000,000.00	
Debenture Certificates	2,500,000.00	
		17,500,000.00
COLLATERAL NOTES:		6,000,000.00
CURRENT LIABILITIES:		
Bills Payable to be retired at maturity	$7,157,000.00	
Debenture Certificates—to be retired July 1, 1906	100,000.00	
Accounts Payable	1,482,819.55	
Interest Accrued, not due	282,833.34	
		9,022,652.89
*PROFIT AND LOSS—SURPLUS:		11,540,642.08
Total Liabilities		$69,061,994.97

NOTE—This company has a contingent liability, as guarantor, of $850,000 bonds of the Walker company due 1916 secured by mortgage on the property and plant of the Walker Foundry Company, Cleveland, Ohio.
*Subject to dividend declared March 21, 1906, payable April 10, 1906

Digitized by Google

Values of Ties of Different Materials.

In Bulletin No. 75 of the American Railway Engineering and Maintenance of Way Association W. C. Cushing, chief engineer of maintenance of way, Pennsylvania lines west of Pittsburg, southwest system, gives a series of tables showing the cost delivered which a white oak tie, lasting ten years, must reach before it will be economical to use other kinds of tie; how long ties of different materials must last in order to be as economical as white oak costing seventy cents and lasting ten years; and the first cost which can be paid for different kinds of ties in order to be as economical as white oak costing seventy cents and lasting ten years. Mr. Cushing states that some of the data used are costs established from actual practice and from reliable information given, while in other cases assumptions have been made from the best information available, and from these apparently trustworthy premises the following deductions have been made.

With white oak ties costing seventy cents delivered on the railroads, it is economical at the present time to buy inferior woods at a price not to exceed fifty cents, have them treated with zinc-chloride or zinc-tannin, lay them in the tracks without the use of tie-plates (except where it is necessary to use them on oak ties), and use a standard railroad spike. A life of ten or eleven years has been found to be a maximum for such ties without the use of tie-plates and better fastenings, and if the life of ten years is not attained, there will be that much loss to the company.

When a white oak tie reaches a cost of eighty-six cents or eighty-seven cents delivered on the railroad, it will be economical to use the zinc-creosote process, or straight creosote costing thirty cents, if the tie costs forty-six cents delivered on the railroad and will last sixteen years; or, it will be economical to use straight creosoting, costing eighty-five cents for treatment, if the tie can be made to last thirty years, which is French practice, before the oak tie reaches a cost of eighty cents delivered on the railroad. In both of these cases it is assumed that tie-plates, wood screws and helical linings are used because ties can not be made to last more than ten or twelve years without the use of proper fastenings; since, otherwise, the tie will be destroyed by mechanical wear. It is necessary, therefore, to use improved fastenings when we expect to obtain a life of ties greater than ten or eleven years.

It will also be economical to use a steel tie costing $1.75 delivered, if it will last twenty years.

When the white oak tie reaches a cost of ninety cents delivered on the railroad, it will be economical to use either ties of inferior woods treated with zinc-tannin if a life of fourteen years can be obtained, the improved fastenings being used; or a concrete tie costing $1.50 if it will last twenty years.

When the price of white oak ties reaches $1 it will be economical to use a steel tie costing $2.50 if it will last thirty years, a concrete tie costing $2.25 if it will last thirty years, or an inferior wood tie treated with zinc-chloride if a life of twelve years can be obtained.

With ties of inferior woods costing forty-six cents delivered on the railroad we must obtain a life of from eighteen to twenty years, whether treated with zinc-chloride, zinc-tannin or zinc-creosote, to make them as economical as white oak ties costing seventy cents. It is assumed, of course, that they must have the most approved fastenings in order to attain an age as great as that.

With inferior woods costing forty-six cents delivered on the railroad, and if the creosoting costs thirty cents, it will be necessary for us to obtain a life of twenty-one years in order to make them as economical as white oak ties costing seventy cents delivered.

With inferior wood ties costing forty-six cents delivered, and with the creosote treatment costing eighty-five cents as in French practice, it will be necessary for us to obtain a life of thirty-six years from the ties in order to make them as economical as white oak ties costing seventy cents delivered.

With steel ties costing $1.75 each delivered, it will be necessary for us to obtain a life of twenty-eight and one-half years in order to have them as economical as white oak ties costing seventy cents delivered. This price is a little less than the cost of the Buhrer steel ties in the tracks at Emsworth.

With concrete ties costing $1.50 each delivered, it will be necessary for them to last twenty-eight years before they will be as economical as the white oak ties costing seventy cents delivered.

With steel ties costing $2.50 delivered and concrete ties costing $2.25 delivered, which are approximately the prices of the Seitz steel tie and the Buhrer concrete tie, in the tracks at Emsworth, it is necessary for them to last over fifty years each in order to make them as economical as the white oak ties costing seventy cents delivered.

In order to make treated inferior woods as economical as white oak costing seventy cents delivered, when the treated ties are equipped with proper fastenings in order to make them last as long as has been found practicable by experience, we can only afford to pay for the ties delivered on the railroad, ten cents each when treated with zinc-chloride; twenty cents each when treated with zinc-tannin, or creosoted at thirty cents; twenty-three cents each when treated with zinc-creosote, and twenty-nine cents each when creosoted in accordance with French practice.

In order to make them as economical as white oak ties costing seventy cents delivered, we can only afford to pay $1.48 each for steel ties which last twenty years, and $1.79 each when lasting thirty years.

In order to make them as economical as white oak ties costing seventy cents delivered, we can only afford to pay as first cost of concrete ties delivered, $1.15 each if they last twenty years, and $1.57 each if they last thirty years.

We know nothing about the life of concrete ties, and it is at least very desirable to experiment with them for yard and side tracks, even though we do not use them in the main tracks, because they might lie undisturbed in yard tracks for many more years than they would in main tracks.

When white oak ties are costing seventy cents delivered (about present prices), we can afford to buy inferior oak and other hard woods at forty-five cents to fifty cents (present prices), and have them treated with the zinc-tannin or zinc-chloride processes, and only use common spike fastenings.—*Railway Age.*

Wireless Apparatus to Prevent Collisions at Sea.

Consul J. I. Brittain, of Kehl, reports that a Berlin engineer has applied for a patent for an invention to avoid collisions between vessels at sea. By the inventor's system vessels are supplied with special wireless telegraphic apparatus which acts over a short circuit, even as short a distance as half a mile. As soon as a vessel enters within a certain distance of another vessel, this telegraphic apparatus acts automatically in such a manner as to close the steam tube to the screw on each vessel. The machinery is thus instantly checked, and the steamers have time to reverse the engines or reduce speed. In this manner accidents can be prevented. The apparatus is for use in fogs and other heavy weather.

Digitized by Google

The Electric Car Equipment of the Long Island Railroad.

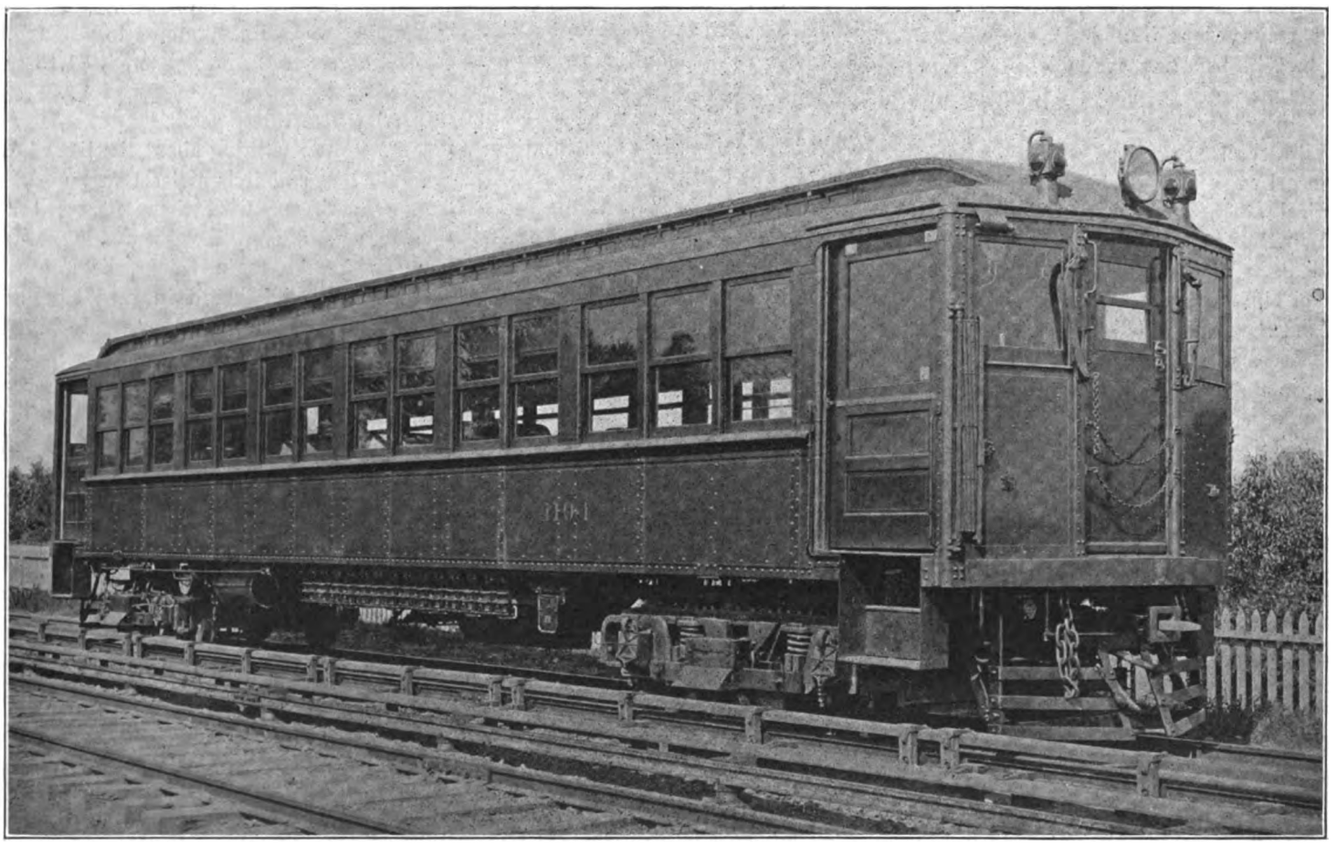
By W. N. Smith.

The design of the car equipment of the Long Island Railroad is based upon a careful study of the traffic conditions as they were outlined by the railroad officials at the commencement of the undertaking, calling for trains with the number of cars varying from two to six per train at different hours of the day, in regular operation, while heavy excursion travel to the beaches and race-tracks would occasionally require trains of ten or twelve cars. Some of the service is express and some local. It was deemed of the greatest importance to provide a single type of equipment that should be uniformly available for all the varying conditions of train service.

The proposed local service on the Atlantic avenue division involved making stops at an average of about 1.6 miles. The express service originally contemplated between Flatbush avenue station and Jamaica provided for only one intermediate stop in the 9.63 miles between them. On the Rockaway Beach division, a local train making all stops between Flatbush avenue and Rockaway Park would average one stop every 0.99 mile, while an express run to Rockaway Park involved a run seven miles in length at the highest practicable speed.

These runs called for a schedule speed including stops of about twenty-five miles per hour for local trains on the Atlantic avenue division, and about thirty and one-half miles per hour for the express trains. Upon the Rockaway Beach division, with relatively more frequent stops, the local run called for a schedule speed of about twenty miles per hour, while the express run, with seven stops in the 15.88 miles, called for about twenty-five miles per hour. The average length of stop was usually assumed at thirty seconds.

The fact that the Atlantic avenue division is partly in a subway, and the need for interchangeability with the rolling stock of the Interborough Rapid Transit subway, has much to do with the design of the cars. The complete success of the first all-steel passenger cars ever built, and which were designed by George Gibbs for the New York subway, led him, in his capacity as chief engineer of the Long Island Railroad electric conversion, to advocate their use on this road as well. To the Interborough Rapid Transit Company and the Long Island Railroad Company belong, therefore, the distinction of being the first railroads in the world to adopt this radical departure in car construction, thus insuring to the public complete immunity from the danger of fire in cars equipped with apparatus carrying powerful electric currents. The incidental advantages of these steel over wooden cars in superior strength and durability are, of course, likewise of importance in insuring their adoption. As the Long Island Railroad cars were obliged to meet very similar conditions, both as to the physical nature of the route to be traversed and the class of travel to be handled, they were built along practically the same lines as the above-mentioned steel cars for the New York subway. In fact, except for the steps, which are made necessary by the low platforms at stations in the suburban districts, the steel car bodies are practically identical with those designed for the New York subway.



Steel Motor-Car, Long Island Railroad.

The principal dimensions of the steel car bodies are as follows:

Length over body corner posts	41 ft. ½ in.

Digitized by Google

Length over buffers.....	51	ft.	2	in.
Length over draw-bars.....	51	"	4	"
Width over side sills.....	8	"	6¾	"
Width over sheathing.....	8	"	7	"
Width over eaves.....	8	"	8	"
Width over window sills....	9	"	½	"
Width over platform floor...	8	"	10	"
Height from under side of sill to top of plate.....	7	"	1	"
Height from under side of centre sill to top of roof..	8	"	9¼	"
Height from top of rail to under side of sill at truck centre (car light).....	3	"	3⅝	"
Height from top of rail to top of roof with car light.	12	"	¾	"

The principal dimensions of the steel trailer-cars are the same as those for motor-cars, and they may, if desired, be readily converted into motor-cars.

Car Body Framing—While the conformation of the car body is practically identical with the conventional type of steam railroad coach, the adoption of steel as the constructive material is responsible for some differences in the general designs of car framing that have been hitherto followed in wooden-car construction.

The principal members of the car framing are of the following rolled-steel shapes:

Side sills, 5 by 3 by ½-inch angles.
Centre sills, 6-inch I-beams, 17.25 pounds per foot.
Body end sills, 3 by 2 and 4 by 2-inch angles.
Body end posts, 2½ by 2 by ¼ and 2 by 1⅝ by ¼-inch angles.
Compound side posts, 3 by 2 by ¼-inch tees.
Single side posts, 3 by 3 by ¼-inch tees.
Side plates, 4½ by 3 by 5-16-inch angles.
Body end plates, 3 by 2 by ¼ and 3 by 3 by ¼-inch angles.
Platform sills, 4 by 3 by ⅝-inch angles.
Platform end sills, 6 by 3½ by ½-inch angles.
Belt rail, 4½ by 2¾-inch bulb angles.
Carlines, 1¾ by 1¼ by 3-16-inch angles.
Purlines, 1½ by 1½ by ⅛-inch angles.
Hood curve angles, 1¾ by 1¼-inch angles on top and 3 by 2 and 2 by 2-inch angles on end.
Vestibule end bow, 3 by 3 by 5-16-inch angles.
Cross truss, horizontal ties, 4 by 3 by ⅜-inch angles.
Cross truss, diagonal brace, 4½ by 3 by 5-16-inch angles.
Bridging, ⅜ by 4½-inch plates.

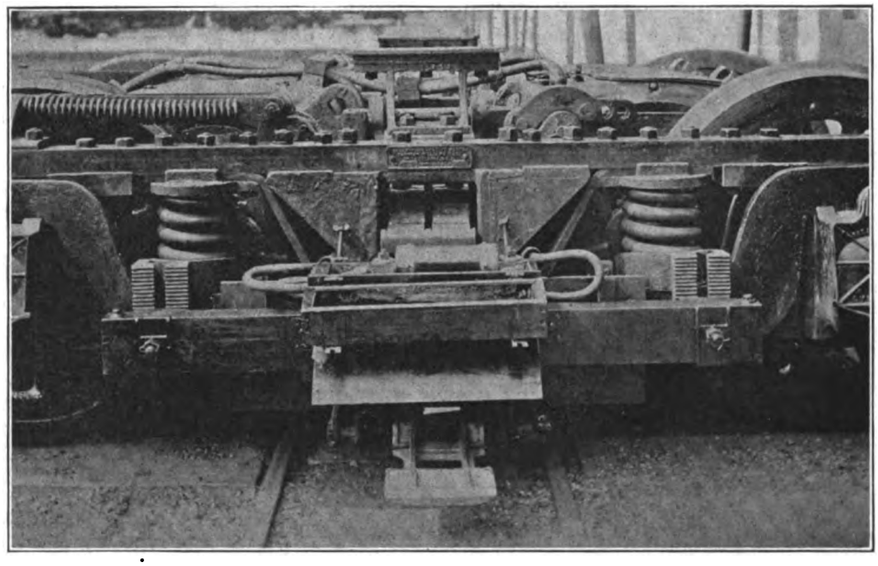
The draft gear comprises a spring draw-bar of the Van Dorn automatic type, supported on a sector bar under the car platform, the radius bar being centred upon a pin set in a cast-steel auxiliary bolster bolted to the centre sills about two feet seven inches in advance of the body bolster. Reaching back from this pin to the body bolster, where it is fastened in a similar way, is a continuation of the radius bar, the above-mentioned pin construction being designed to form a sort of knuckle in the radius bar, which can not be made long enough to reach all the way back to the body bolster because of the ninety-foot radius curve around which the cars are designed to run. At either side of the draw-bar, safety coupling chains have been provided, fitted with springs and anchor forgings fastened to the anti-telescoping plate under the platform end sill. To carry the weight of the radius bar, its outer end is carried in a sector guide directly over the draw-bar proper, just back of the draw-head.

The buffer beams are of oak, faced with one-half-inch-by-six-inch steel plates.

The vestibules are of the Gibbs patent type with floors of steel plates. The vestibule side doors are arranged to slide in pockets in the sides of the car, leaving the entire platform to the passengers. These doors close against pneumatic cushions so as to readily release the clothing of passengers if caught by the closing of the door. The device for operating the side doors consists of a series of bell cranks and levers so arranged that the movable parts are either overhead in the vestibule or entirely outside of it, leaving the entire interior of the vestibule clear. The side doors are operated by brakemen standing outside of the doors at the extreme end of the vestibule. Side steps are provided with plain wooden treads, the gangway being fitted with trap doors of three-sixteenths-inch sheet steel, to enable the use of the entire width of the vestibule when the side doors are closed. The vestibule floor and drop doors are covered with the Mason patent floor covering. The vestibule end door, when in the extreme open position, is folded over the master controller, the brake valve and all other apparatus in the motorman's compartment. The upper half of this door is glazed, like the others. When this door is shut, and the side doors closed, the entire vestibule is available as a motorman's compartment, and the above-mentioned control apparatus is then entirely exposed.

The body end doors are of the double sliding type and are fitted with a door-coupling device that will hold them in any desired position to prevent them from closing when trains are rounding curves. The marker lamps, which are mounted on the hood over the vestibule platforms, are operated from inside of the vestibule by handles extending through the canopy sheathing. The handles are fitted at the lower end with discs carrying colored crystals that correspond to the color of the lenses on the four sides of the marker lamps.

In the vestibule at the motor end of the car, just forward of the end door pocket on the left-hand side facing outward, is placed a swinging door, made convex, of pressed steel, so as to form a pocket to contain the auxiliary control switchboard panel.



STEEL MOTOR-CAR EQUIPMENT OF THE LONG ISLAND RAILROAD—THIRD-RAIL SHOE, FUSE AND CONNECTIONS.

All motor-cars are equipped with pilots suspended from the platform buffers, and the vestibules are fitted with pantagraph safety gates and guard chains to prevent trainmen and passengers from falling between the cars. The usual grab-handles are also fitted to the sides and ends of the vestibules. An air whistle is also provided over each vestibule, with its operating valve situated conveniently to the control apparatus. Wooden paddles are carried in the vestibules of all cars, which are used to raise the contact shoes from the conductor rail when necessary.

The side sheathing of the car consists of steel plates one-eighth inch thick, their lower edges being flush with the bottom

Digitized by Google

of the sill. The bulb angles which form the belt-rail and the window sills overlap this sheathing. The post covers between the windows are of special pressed steel, flanged out at their lower ends to fit over the belt-rail which runs along the entire length of the car body outside of the posts. The top ends of the post covers extend under the letterboard, which is a steel plate seven and one-sixteenth inches wide, running the entire length of the car, riveted to side plates. The letterboard in turn is overlapped by the eaves moulding as described above. In this manner the entire outside covering of the car is waterproofed by simply overlapping its component parts, avoiding all cracks into which the water can run by gravity. All joints between the side sheathing plates are covered with sheet-metal battens, laid on with thick red lead and secured by rivets.

The flooring of the car body is of corrugated sheet iron, and is supported by the longitudinal sills and the steel-plate bridging that is riveted across the space between the sills. The corrugated sheets are provided with metal clips which are riveted to the sheets at about ten-inch centres, to secure the "Monolith" plastic floor upon which, after being finished, the maple floor strips are laid with brass screws. This monolithic floor is absolutely fireproof and is laid on in the form of a cement, which, when set, has a smooth hard finish.

The interior of the car is finished as follows: the window panels, end panels, and mouldings inside of the car are of sheet steel painted a dark green color and relieved by gold stripes. The headlinings are composite board, painted light green, decorated in gold. The hardware fittings are of lacquered bronze. The arrangement of the seats is similar to that used in subway and elevated railway cars generally. The seat frames are of steel construction carried upon brackets riveted to the side posts. The cushions and seat backs are of rattan. The seating capacity of each car is fifty-two persons. Strap rails of polished mahogany are also provided running along each side of the car in the clerestory, supported in bronze brackets.

The wainscoting is of steel, backed by asbestos "Ceilinite," so as to make it conduct heat less readily.

The side windows are arranged to raise from the bottom and glass in all doors and windows is polished plate. The deck sash are arranged to secure ample ventilation without drafts, all being operated simultaneously by operating levers at both ends of the car. The sash are fitted with double thick chipped sheet glass.

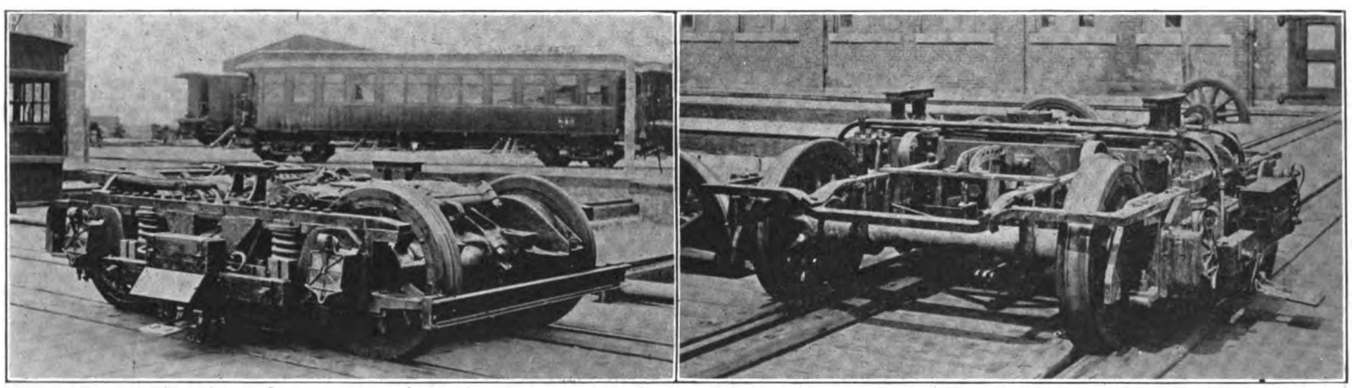
The side windows and the body end doors are provided with Pantasote curtains. The window sash are fitted with counterbalancing steel springs and sash locks and lifts of an improved type. All window capping and other mouldings inside of the car are of aluminum shapes secured by nickel-plated brass screws. The front windows of the vestibules are stationary. Ventilation in the vestibules is secured through the movable sash in swinging doors, or through side vestibule doors, which are equipped with combination door holder and motorman's arm rest.

There are 130 steel motor-cars and four steel trailers, all of which were built at the Berwick, Pa., shops of the American Car and Foundry Company. They were personally designed by George Gibbs, chief engineer of electric traction of the Long Island Railroad, and a number of United States and foreign patents have been issued to him covering the various features of the construction.

The motor and trailer trucks are of the Master Car Builders' type, the wheel base of the motor trucks being six feet eight inches for thirty-six-inch wheels, the trailer trucks being five feet six inches wheel base for thirty-inch wheels. The distance between truck centres is thirty-four feet. The general dimensions of the motor truck are:

Gauge of track	4 ft. 8½ in.
Distance between backs of wheel flanges	4 " 5⅝ "
Height of truck centre-plate above rail, car body loaded with 15,000 pounds	31½ "
Height of truck side bearings above rail, car body loaded with 15,000 pounds	35½ "
Wheel base	6 " 8 "
Weight of truck complete with two gears, but without motors	13,800 lbs.
Weight on centre-plate with car body loaded	30,885 "
Weight of one motor on truck transom	3,500 "
Torque of one motor on truck transom	3,000 "

The trailer trucks are of generally similar type, but of five feet six inches wheel base, and somewhat lighter construction. The bolsters are of white oak, in three pieces, with iron plates placed between the timbers, securely bolted together with rough machine bolts, which also carry the bolster chafing plates.



STEEL MOTOR-CAR EQUIPMENT OF THE LONG ISLAND RAILROAD—MOTOR TRUCK AND TRAILER TRUCK.

Both motor and trailer trucks were manufactured by the Baldwin Locomotive works.

The standard third-rail shoes on the Long Island cars are of the hinged-slipper type, supported on the usual wooden beam, which is clamped against the notched face of the equalizer spring seat castings, providing means for vertical adjustment. Upon the centre of the beam is placed a 600-ampere enclosed-type fuse in a wooden box, with a hinged cover and lined with asbestos.

Trains from the Brooklyn Rapid Transit Company's elevated lines operate over the Atlantic avenue and Rockaway Beach divisions by way of Chestnut Street Junction to Rockaway Park.

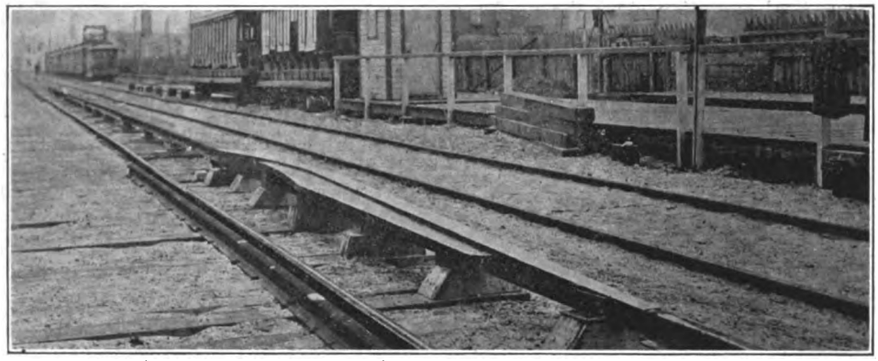
The Brooklyn elevated lines have been for some years operated by the third rail, but the location of their rail is twenty-two

Digitized by Google

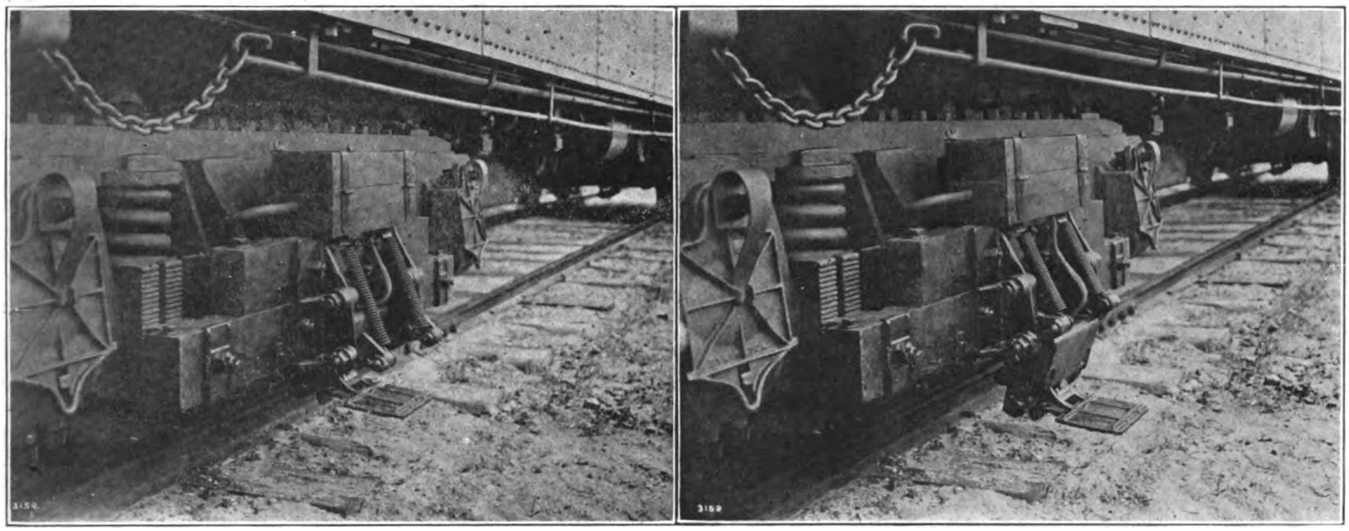
and one-quarter inches outside and six inches above the track rail, while the Long Island Railroad third rail is twenty-six inches out and three and one-half inches up. This made it necessary to devise some form of adjustable third-rail shoe which would operate with equal facility over both third rails and be able to change from one to the other at reduced speed without requiring attention on the part of the motorman or train crew. Such an arrangement has been worked out, and patents on it have been applied for by James C. Boyd. It consists essentially of a hinged-slipper type of shoe mounted upon a movable lug which is held in either position by means of coil springs and is actuated by an arm that engages with a stationary cam mounted alongside of the track, in line with the third rail. The movement of the car past this cam in one direction changes the shoe from the inner to the outer low position, while a reverse movement of the car past the cam changes it from the outer to the inner raised position. These adjustable shoe equipments have been fitted to such cars of the Brooklyn Rapid Transit Company as are to operate over the lines of the Long Island Railroad.

The cars are equipped with hand brakes and with the Westinghouse quick-service automatic air brake. This brake is of the new design developed from the quick-action brake. Compressed air is supplied to the system by a Westinghouse D-2 electrically driven air-compressor on each motor car, controlled by a standard Form "J" Westinghouse governor. This pump has a rated capacity of twenty-four cubic feet of free air per minute, and supplies both the air brake and the pneumatic control system, but the brake and the control systems are operated from separate reservoirs.

Careful investigation showed that the greatest flexibility would result from a two-motor-car equipment, using the most powerful motors practicable. The limitations were mainly the dimensions imposed by the largest trucks that could be operated under the conditions prescribed by the tunnel and curve clearances, which restricted the wheel base of the motor truck to six feet eight inches. This restricted the size of the motor to about 200 horsepower.

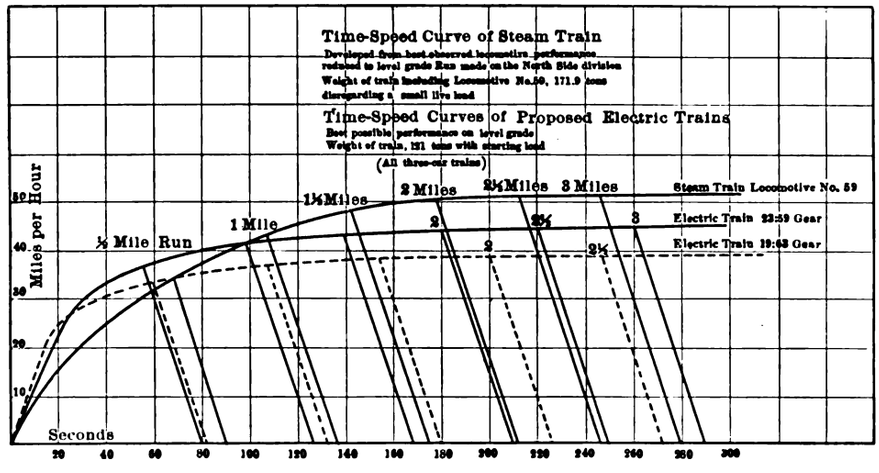


STEEL MOTOR-CAR EQUIPMENT OF THE LONG ISLAND RAILROAD—CAM FOR SHIFTING ADJUSTABLE THIRD-RAIL SHOE.



STEEL MOTOR-CAR EQUIPMENT OF THE LONG ISLAND RAILROAD—ADJUSTABLE THIRD-RAIL SHOE—INNER AND OUTER POSITIONS.

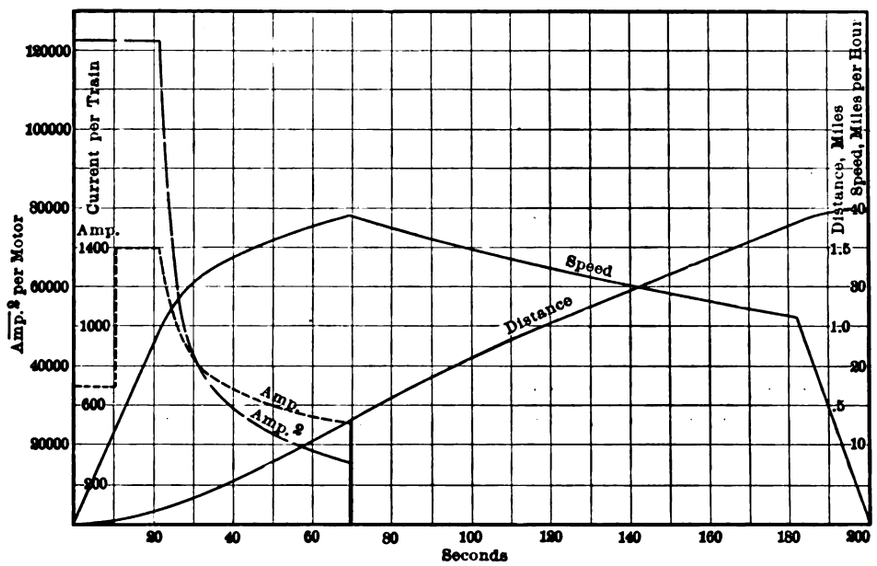
At the outset, a series of speed tests was made on various steam trains of the Long Island Railroad in order to compare the actual running time with that laid down


Time-Speed Curve of Steam Train
Developed from best observed locomotive performance reduced to level grade Run made on the North Side division Weight of train including Locomotive No.10, 171.9 tons disregarding a small live load
Time-Speed Curves of Proposed Electric Trains
Best possible performance on level grade Weight of train, 171 tons with starting load
(All three-car trains)
Miles per Hour
Seconds
½ Mile Run
1 Mile
1½ Miles
2 Miles
2½ Miles
3 Miles
Steam Train Locomotive No. 59
Electric Train 23:59 Gear
Electric Train 19:68 Gear

SPEED-TIME CURVES OF STEAM AND PROPOSED ELECTRIC TRAINS, LONG ISLAND RAILROAD.

Digitized by Google

in the time-tables, and with the times which the railroad officials desired to be met by the electrical equipment. An ordinary passenger coach was fitted with speed-recording devices and a number of speed curves were obtained. The best performance of a relatively light steam locomotive train, weighing 171.9 tons with the locomotive, is shown herewith. The difference in the running time of an equivalent electric train is shown in the same diagram, and in general indicates that for all suburban services up to about two miles, the electric train is the faster. The average length of run over the Atlantic avenue division, the first to be equipped, was originally estimated at 1.6 miles, but in practical operation since the road was equipped, this has been reduced to about one mile, giving the electric trains a still greater advantage in speed, due, of course, to their higher rate of acceleration.



TYPICAL SPEED-TIME CURVE OF 117-TON TRAIN.

The results given in table No. 1 show a comparison of steam and electric runs of average length, based upon the curves above mentioned, and others of similar character. The runs in this table are partly express and partly local; for the sake of simplicity the elapsed times of each run shown are those made by a three-car-train.

The general solution of the problem was worked out by the aid of speed-time curves, whose value for this purpose began to be recognized when electrical rapid transit problems first began to come up for solution on a large scale in connection with elevated railways. The general type of curve referred to is that shown herewith, now so familiar that it does not need explanation, which has the advantage of showing the instantaneous fluctuations of the current applied per motor, or for an entire train; and from this record of current fluctuation with regard to time, the average output in watts and the total power in watt-hours is easily computed.

The general result of the motor computations, as determining the size of the car equipment, was that a medium gear ratio (25:58 for the No. 113 Westinghouse motor) was fixed upon and the number of motor cars and trailers per train was recommended in accordance with the following table:

Length of Train.	Local.	Express.
2-car train	2 motor-cars	1 motor-car
	No trailers	1 trailer
3-car train	2 motor-cars	1 trailer
	1 trailer	2 motor-cars
4-car train	3 motor-cars	2 motor-cars
	1 trailer	2 trailers
5-car train	3 motor-cars	3 motor-cars
	2 trailers	2 trailers

DATA FOR SUBURBAN RUNS.

Run.	Distance, Miles.	Run, Letter.	Time, Minutes.	Train Sheet Schedule, Speed Entire Run.	Intermediate Number of Stops per Trip.	Time Out for Stops.	Average Length of Run, Miles.	Time of Average Run, Minutes.	A, Average Speed Between Stops, M. P. H.	B, Limit Average Speed Best Steam, M. P. H.	Ratio of A, B, % Steam.	C, Limit Average Speed Electric Train, 23/59 G. Ratio.	Ratio of A, C, % Electricity.
L. I. City to Port Washington.	18.18	a	41.5	26.3	7	4.5	2.27	4.62	29.5	36.0	81.9	35.5	83.2
		b	43.0	25.4	8	5.0	2.02	4.22	28.7	34.0	84.4	34.0	84.5
L. I. City to Whitestone Landing.	11.75	c	31.0	22.8	7	3.5	1.47	3.44	25.6	30.8	83.2	31.8	80.5
L. I. City to Rockaway Park.	16.3	d	39.25	24.9	5	2.5	2.72	6.12	26.7	37.5	71.2	36.5	73.2
		e	39.0	25.1	6	2.75	2.33	5.18	27.0	36.0	75.0	35.5	76.1
		f	40.0	24.4	7	3.5	2.04	4.57	26.8	34.0	78.8	34.0	78.8
		g	41.0	23.8	8	4.25	1.81	4.08	26.6	33.0	78.8	33.5	79.5
		h	43.0	22.8	10	4.0	1.48	3.55	25.0	30.8	81.2	31.8	78.7
		i	43.75	22.3	11	4.5	1.36	3.27	25.0	30.0	83.3	31.0	80.7
		j	47.0	20.8	14	5.5	1.09	2.76	23.7	27.0	88.0	29.0	81.8
L. I. City to Valley Stream.	22.97	k	59.5	23.1	11	7.5	1.91	4.33	26.4	33.7	78.4	33.7	78.3
L. I. City to Manhattan Beach.	16.1	l	37.0	26.1	3	3.0	4.03	8.5	28.5	41.0	69.5	39.0	73.0
		m	38.0	25.4	4	2.5	3.22	7.1	27.2	39.0	69.8	37.5	72.6
		n	40.0	24.2	5	3.75	2.68	5.87	27.4	37.5	73.2	36.5	75.0
		o	44.0	22.0	11	6.5	1.34	3.12	25.8	29.8	86.5	31.3	82.5
Flatbush to Rockaway Park.	15.88	p	39.5	24.5	7	4.0	1.98	4.56	26.0	34.0	76.5	34.0	76.5
		q	44.75	21.5	11	6.0	1.32	3.37	23.9	29.5	81.2	31.0	77.2
		r	45.5	20.9	12	5.75	1.22	3.06	23.9	28.5	84.0	30.0	79.6
		s	47.0	20.2	15	6.5	.99	2.53	23.5	26.5	88.6	28.5	82.5
		t	48.0	19.8	16	6.75	.93	2.43	23.0	26.0	88.5	28.0	82.2
Flatbush to Jamaica.	9.63	u	19.0	30.4	1	1.0	4.81	9.0	32.0	42.5	75.3	40.0	80.0
		v	23.0	25.1	5	3.0	1.61	3.33	29.0	31.5	92.1	32.5	89.2
Flatbush to Valley Stream.	22.55	w	60.5	22.4	13	9.0	1.61	3.68	26.1	31.8	82.0	32.0	82.4

Digitized by Google

6-car train	4 motor-cars 2 trailers	3 motor-cars 3 trailers
7-car train	4 motor-cars 3 trailers	4 motor-cars 3 trailers
8-car train	5 motor-cars 3 trailers	4 motor-cars 4 trailers

The Westinghouse electropneumatic multiple-control system was adopted for the cars of the Long Island Railroad.

The apparatus constituting the main control system comprises the following:

(a) Group of unit switches.
(b) Resistances.
(c) Electrically operated line-switch.

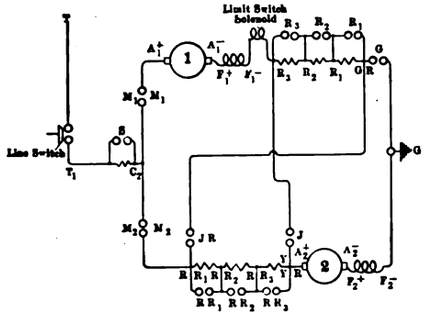
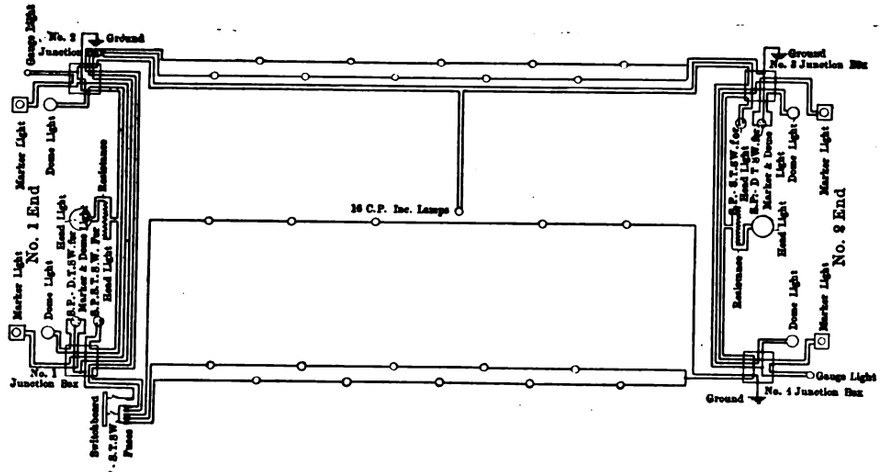


DIAGRAM OF MAIN MOTOR-CONTROL CIRCUITS.

(d) Supply system, comprising the third-rail shoes, supply mains and bus line, connecting the main control apparatus on all the cars, including the necessary fuses and jumpers.

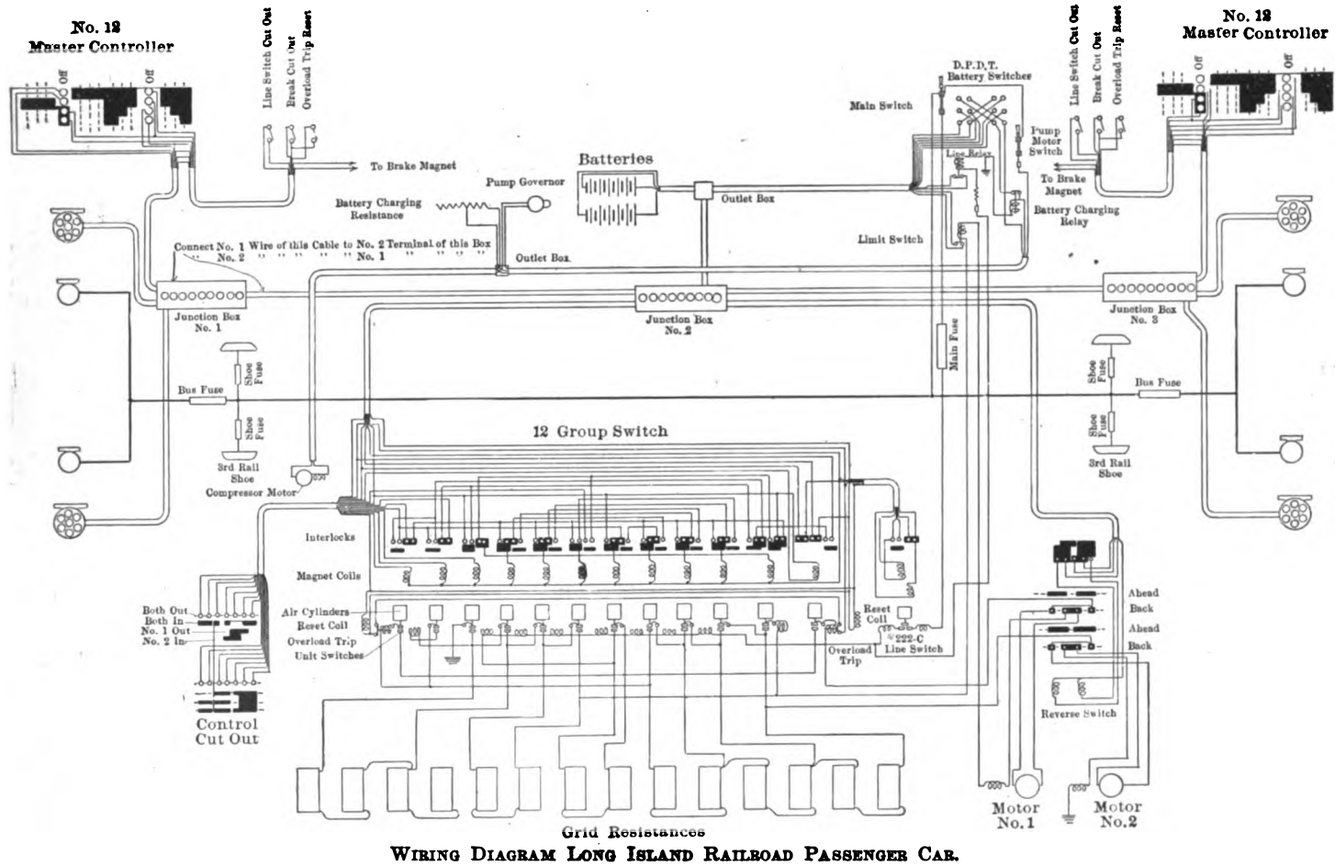
A diagram is shown of the wiring arrangements of the electric motor and control equipment, so disposed as to give a clear idea of the manner in which they are related to one another.

The diagram of the main motor control circuit is also shown. This shows only the connections from third rail through the line switch and the resistance to the motors and finally to the ground. The relative positions of the twelve unit switches forming the switch group are indicated by the following capital letters: "S," short-circuiting switch for switching resistance; M-1 and M-2, leading to the individual motor circuits; J and JR, bridging switches from one motor circuit to the other; G, ground-connection switch, and R-1, R-2, R-3, RR-1, RR-2 and RR-3, six switches which short-circuit six separate sections of the main rheostat.



STEEL MOTOR-CAR EQUIPMENT OF THE LONG ISLAND RAILROAD. DIAGRAM OF LIGHTING CIRCUITS.

For the sake of clearness, the reverse-switch connections are not shown in this diagram, it being understood that its sole function is to reverse the direction of the current through the armatures; for example, the diagram shows the armature connection A-1- directly connected to



WIRING DIAGRAM LONG ISLAND RAILROAD PASSENGER CAR.

Digitized by Google

switch M-1, with the A-1- directly connected to F-1-plus, the field connection of No. 1 motor. The function of the reverse switch is simply to interchange A-1-plus and A-1- and A-2-plus and A-2-, so that when it is thrown the direction of the current through the armature of motor No. 1 and also of motor No. 2 is reversed. In other respects, it is independent of the rest of the other switch connections.

The trailer cars are fitted with bus lines and their third-rail shoe connections for the main circuit, and also with the train line, including the necessary junction boxes and connector sockets with the auxiliary-control circuit, these being necessary for connecting motor cars which are separated by a trailer.

The current for operating the control system in each car is derived from one of two small storage batteries consisting of seven cells each. These are so connected that one is being charged while the other is working upon the control circuit.

The batteries are charged from the circuit of the air-compressor motor. This is done by connecting the battery in multiple with an adjustable resistance so arranged that the proper charging current will pass through the batteries when the compressor is operated, the circuit through the battery being closed by a relay mounted on the switchboard panel.

The interior of each car is lighted by twenty-six sixteen candle-power incandescent lamps. Two sixteen candle-power lamps are placed in each vestibule in such a manner as to effectively light the platform and the steps. One sixteen-candle-power lamp is located in each marker, and a fifty-candle-power lamp is placed in the headlights, which are permanently fixed on the vestibule roof between the markers. Snap switches are placed within easy reach of the motorman for the control of the headlight, the markers and the platform lights. All other light and heater switches and fuses are located on the switchboard.

The cars are heated throughout with electric heaters of the panel type, each having a ventilated sheet-iron back and being placed under the seats. There are twenty-four heaters in the body of the car and at each end there is one of a special type in the motorman's cab.

The heaters in the steel motor-cars were supplied by the Consolidated Car Heating Company. Those in the wooden trailer cars were manufactured by the Gold Car Heating and Lighting Company, and are of the truss-plank type of construction.

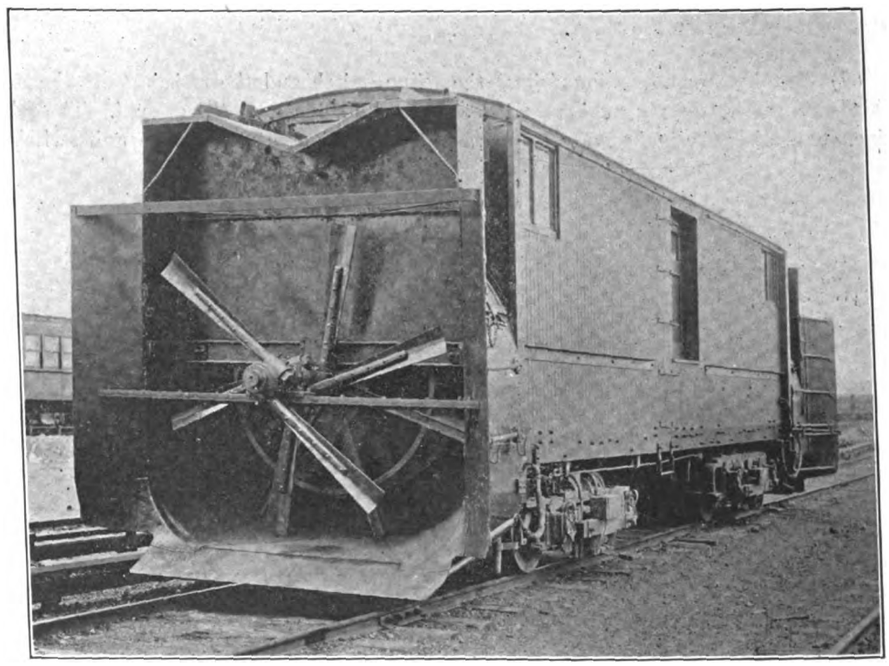
All wires and cables, for whatever purpose, are run in iron conduits. The sizes of wire used in the car wiring were No. 12 and No. 14 for the auxiliary control, and No. 0, No. 00, 144,000 circular mils and 250,000 circular mils for the main motor control circuit.

The steel cars as thus constructed and equipped have now been in successful operation for over a year.

Besides the steel cars above described, fifty-five wooden trailer cars, which had been built six or seven years previously with a view to using them in electrical trains, were equipped to run in trains with the motor cars; provisions had been made in designing these car bodies for conveniently disposing the electric-lighting circuits, but the class of work then in use was not considered safe now. These trailers are forty-six feet long and eight and one-half feet wide, over all. These wooden trailers had formerly been used in certain Long Island Railroad trains that had been run on the Brooklyn elevated lines between Flatbush avenue station and the Brooklyn Bridge. They have open platforms, side doors, and cross seats, and seat fifty-six people. They were wired for electric lighting and heater circuits and fitted with bus-line and train-line connections. The lighting and heater circuits are supplied by a connection tapped from the bus line through a fuse, and leading to a small switchboard panel from which the distribution is made. There are thirty sixteen-candle-power lamps in each trailer.

Five electric express cars were provided, equipped with the standard type of motor and trailer trucks, two 200-horse-power standard motors, and with the standard multiple unit-control apparatus. These cars are built of wood, fifty-two feet five inches over all in length, nine feet nine and one-half inches in width, and with roof twelve feet six and three-quarters inches above the top of the rails. They are equipped with standard Master Car Builders' couplers, and haul the old standard steam baggage and express cars as trailers.

Reference has been made in former articles[1] describing the substations, to the two all-steel portable substation cars which were designed to carry a complete rotary-converter substation of 1,000-kilowatt capacity, being so fitted that they can be used at a number of different places on the system on the Long Island Railroad where connections to the high and low-tension systems of distribution could readily be effected.



STEEL MOTOR-CAR EQUIPMENT OF THE LONG ISLAND RAILROAD—THE ELECTRIC ROTARY SNOW-PLOW.

A rotary snow-plow has also been provided, built by the Peckham Manufacturing Company, and equipped with one motor and one trailer truck of standard type, and all of the standard motor-car electrical equipment. A set of revolving blades with fan and housing is mounted at each end of the car, operated by one line shaft running through the car and fitted with two friction clutches, one for each end section, the centre section carrying two

[1] ELECTRICAL REVIEW, Vol. 48, No. 26.

Digitized by Google

fifty-horse-power railway-type motors, run by a series-parallel controller of the standard platform type.

The facilities for inspection and repair of electric cars of the Long Island Railroad system consist partly of a section of the original car shop at Morris Park, near Jamaica, which has been to a certain extent remodeled to better accommodate the new motive power.

At Morris Park, a new shop was built paralleling the old car shop, and with a transfer table situated between them. It is 216 feet long by 110 feet wide, and is connected with the mill that runs across the end of the old shop by a two-story structure containing space for pattern, upholstery and brass-finishing shops. The walls of the shop are built of brick and the roof is made in the saw-toothed form so commonly used for this purpose. There are thirteen pit tracks sixteen feet apart between centres. The shop is wide enough to accommodate two fifty-one-foot cars with a space between the ends of the cars, and three feet between the ends of the cars and walls. The pits are about twenty-six inches deep below the top of the rail. A transfer table is seventy-five feet wide, and long enough to accommodate the largest type of Pullman coach. The transfer table is operated electrically, and is provided with an electric capstan to assist in moving cars and trucks out of the shops.

Over the two tracks at the south end of the new shop there are light travelling cranes for handling the motors and axles, and facilitating general truck repairs. These cranes are of about five tons' capacity and are hand operated. Hydraulic jacks are used for hoisting the cars.

The original machine shop is already equipped with tools for turning wheels and axles, and for pressing wheels and gears upon the axles. The machinery used in the machine shop has since the beginning of electrical operation been operated by three-phase motors receiving current from the Woodhaven Junction substation, which is something less than a mile distant.

Besides the repair shop facilities at Morris Park, two inspection sheds have also been provided for effecting the periodical inspection and light repairs that are required to keep the cars in fit operative condition. The smaller of the inspection sheds is adjacent to the Rockaway Park Terminal.

The larger inspection shed is located at Dunton on the Jamaica Division directly west of Jamaica.

The Rockaway Park inspection shed will accommodate twelve cars, and that at Dunton, twenty-four. The latter station is provided with room for an office upon a gallery running across one end of the building, reached by an iron staircase coming up between the tracks.

The equipment of the steel passenger cars, the auxiliary stock, and the building of inspection sheds, were carried out by Westinghouse, Church, Kerr & Co., who, as in the other portions of the complete equipment, acted as constructing engineers. The entire work of design and construction was in charge of George Gibbs, chief engineer of electric traction of the Long Island Railroad.

With the preceding account of the electric car equipment, the description of the newly installed system for operating the Long Island Railroad trains with electric power is brought to a close. The car equipment has proved itself in every way equal to the demand made upon it both for regular and emergency conditions of travel. The electropneumatic multiple-unit control system has worked perfectly from the start, and throughout the entire installation, including the power station, transmission system, substations and cars the endeavor was made not only to take advantage of the most recent progress, but, as opportunity offered, to establish new precedents in the art. In achieving the distinction of being the first one of the main steam railroad lines to initiate and make effective the change of motive power for its suburban service to meet the needs of the territory, the Long Island Railroad Company has set an example of foresight, thoroughness and sufficiency in the execution of the undertaking.

The contract with the American Car and Foundry Company for the steel car bodies was let on January 20, 1905. The first car body was received at the Locust avenue shops for equipment early in April, 1905, and another one was exhibited at the International Railway Congress in Washington, D. C., early in May. By August 18, the entire number of steel cars had been delivered at the shops, where they were mounted upon trucks and all parts of the electric equipment assembled. During the summer the cars were equipped at the rate of ten per week. The first test of a completely equipped car was made on May 13, 1905. A month later, fully equipped trains were running on the branch between Jamaica and Springfield for testing the equipment, and for the instruction of the motormen. Regular electrical operation was first inaugurated between Flatbush avenue and Rockaway Park on July 26, 1905. Service between Flatbush avenue and Rockaway Junction was inaugurated on August 30. In October, the heavy excursion traffic to and from the Belmont Park race-track was successfully handled. On December 11, the electric service was extended to Far Rockaway and Valley Stream, and the use of steam locomotives for hauling passenger trains to and from the Brooklyn Terminal of the Long Island Railroad was discontinued.

On April 27, 1896, the act creating the Atlantic Avenue Commission passed the New York State Legislature, this being the formal beginning of the working out of a transportation problem that was of immediate and far-reaching importance to the citizens of Brooklyn and the Long Island Railroad. Several years elapsed before the results of the work, first of the Commission and then of the Board of the Atlantic Avenue Improvement, began to be noticeable, but it progressed year by year until finally consummated on the above date, a little less than ten years from its inception. The respective parts taken, first, by the Atlantic avenue commission in formulating a concrete plan of improvement of such far-reaching importance; and later by the Board of the Atlantic Avenue Improvement in planning and executing the work; and by the Long Island Railroad in cooperating with all the duly constituted authorities for the advancement of a plan so conducive to the welfare of the community served by it, have not been enlarged upon in the foregoing technical description of the work, but they are now matters of history, a full knowledge of which is available for other municipalities and corporations which may be confronted by similar problems.

But the record will be incomplete without an acknowledgment of the credit due to the late William H. Baldwin, Jr., president of the Long Island Railroad from 1896 to 1905, whose foresight, public spirit and initiative played such a leading part in the solution of a difficult rapid transit problem. Could he have lived but one year longer, he would have witnessed the consummation of his labors, which have conferred a lasting benefit on the community.

The New York Edison system now supplies, according to the *Bulletin*, installations aggregating 4,153,723 equivalents of sixteen candle-power, of which 122,234 horse-power are in electric motors.

Digitized by Google

LIVE STEAM HEATED FEED-WATER—ITS EFFECT ON THE OUTPUT AND EFFICIENCY OF STEAM BOILERS.[1]

BY G. WILKINSON.

(Concluded.)

Several experiments have shown that the rate of transmission of heat through the heating surface of boiling area increases largely as the draught of steam increases, and does not greatly depend upon increased temperature of the furnace, though, of course, the maintenance of the temperature of the furnace by an increased rate of combustion corresponding to the increased draught on the steam is necessary. Speculations on the nature of the act of evaporation which are put forward by Mr. Dales may not be out of place at this point. Taking the heat required for evaporation from a quantitative point of view, and assuming 100 pounds pressure absolute as a basis of argument, the total heat of the water from the abs: zero at the point of evaporation is 686 units per pound, whilst the instant after the total heat is 1,568 units per pound. Each atom of water which passes to vapor absorbs additional heat to 2.29 times the quantity which it contained whilst in a liquid condition. This absorption takes place with the rapidity of an explosive action, which readily explains the cause of the increased efficiency of boiling surface; and whether the extra heat is absorbed from surrounding superheated particles of water or from the plate of the heating surface, the sudden convection must lower the temperature of either one or the other source of heat. The resistance of the plate to the rate of transmission which either the water or steam is capable of producing is relatively small, and almost a negligible quantity. Following the previous argument, gentle boiling may be defined as a condition of the water where the process of evaporation is taking place at sparse intervals over the heating surface, while more or less violent ebullition is a condition in which the intervals between the vaporized atoms of water are closer, and if this speculation has a sound basis, it is evident that the rate of transmission depends on the maintenance of the supply of heat on the one side and the draught of steam on the other rather than upon any considerable increase or decrease in the difference of temperature between the source of heat and the evaporating water. That this is likely to be so is easily demonstrated by boiling water on a gas stove, from which the flame is at all times of about the same temperature. If it is desired to increase the evaporation it is necessary to burn more gas, the temperature of the flame being about the same in both cases. A suitable conclusion to this line of argument may be, that from boiling surface a quantity of steam can be obtained which is approximately proportioned to the quantity of coal consumed, and that this phenomenon is, within limits, practically independent of time. The limit of rate of evaporation evidently depends upon the possibility of maintaining a sufficient supply of heat to produce a condition of evaporation or boiling at the heating surface corresponding to the draught of steam, and it would appear that the provision of any considerable amount of heating surface over and above such as can be supplied by the furnace, with the necessary quantity of heat to produce boiling at the pressure, is largely futile and useless, and that a very plain and simple boiler when supplied with hot feed can reach the maximum of efficiency. What this maximum efficiency is depends, of course, on the temperature of the waste gases of the chimney and the weight of air per pound of coal consumed. Without useless tedium of illustration, perhaps the most authoritative figures may be quoted. An average sample of coal burnt with the theoretical minimum quantity of air produces 18.9 per cent of CO_2, and as other products are of negligible quantity, this may be taken as the highest standard. The most extreme percentage of CO_2 which has occurred in practice to the knowledge of the writer is sixteen. This would give an excess of air over the absolute theoretical minimum of $\frac{18.9}{16} = 1.18$, and as the theoretical minimum weight of air per pound of coal is about twelve pounds, $12 \times 1.18 = 14.17$ pounds of air per pound of coal. The total weights of the product of combustion per pound of coal burnt would in this case be 15.17 pounds, and if the products entered the chimney at 400 degrees Fahrenheit, with a specific heat of .2386, a waste would occur of 400 degrees—say, fifty degrees temperature of atmosphere = 350 degrees $\times$ .2386 = about eighty-four units per pound of products, which at 15.17 pounds per pound of coal = 1,275 units about per pound. Taking 14,200 units of heat developed per pound of coal, the available heat in this case is about ninety per cent of the total value of the coal, and deducting seven per cent for radiation, the remainder, or eighty-three per cent, would be the total efficiency of the boiler and economizer (192 pipes, Green's). This case, however, is very extraordinary, and was provided with mechanical induced draught, the rate of combustion being about eighteen pounds per square foot of grate area. The pressure in the boiler was also low, about sixty pounds.

There are few cases in practice where less than seventeen pounds of air are used per pound of coal, and this would give eighteen pounds of products of combustion, which at, say, 400 degrees Fahrenheit—fifty degrees Fahrenheit = 350 degrees Fahrenheit terminal temperature,

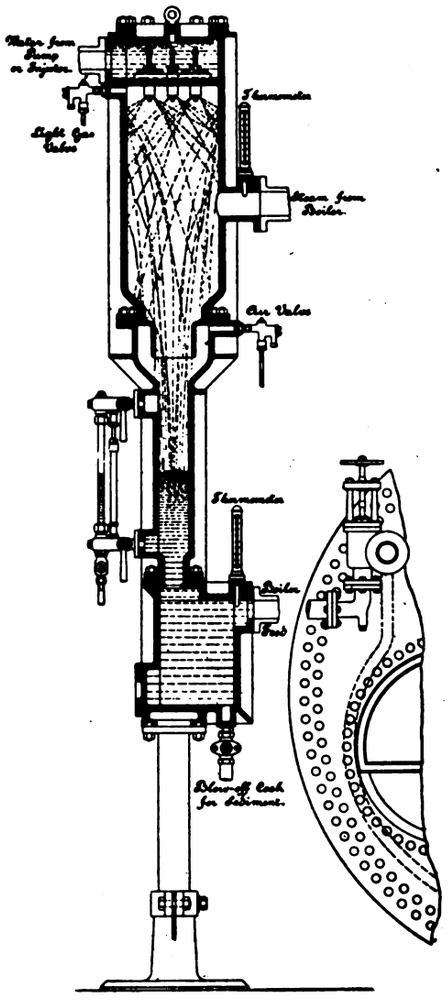


FIG. 1.—LIVE STEAM FEED-WATER HEATER.

would have again eighty-four units per pound waste heat to the chimney; and at eighteen pounds of products would carry off 1,512 units per pound of coal burnt. The available heat therefore at an ordinary maximum would be 14,200 — 1,512 per pound of coal, or 89.35 per cent, which, after deducting an allowance of seven per cent for radiation (which is perhaps rather low), the maximum efficiency in an unusual case of low air supply would be 82.35 per cent. It should be observed that no allowance in this

[1] Abstract of a paper read before the meeting of the Incorporated Municipal Electrical Association, London, England, June 22.

Digitized by Google

reckoning is made for infiltration of air to the flues, as regards the 400 degrees Fahrenheit terminal temperature of the products of combustion, and as this is usually great, the terminal temperature would not be much over 250 degrees Fahrenheit, this being as little as will give any sort of practical chimney draught even where it is induced by mechanical means.

In the case of the boiler of plain Lancashire type at the Harrogate electricity works, with which the tests appended to this paper were made, a set of comparative trials was made for ascertaining the extra efficiency of very high temperature feed as against the high temperature feed of a three-set economizer of Green's type containing 288 pipes. The temperature of the very high temperature feed was only ten degrees Fahrenheit below the steam temperature, and was made by the Dales & Braithwaite's live steam feed-water heater shown in Fig. 1. The temperature of the economizer feed supplied to the heater was 265 degrees Fahrenheit, already very high; and 218 degrees Fahrenheit above the cold water, which was forty-seven degrees Fahrenheit. The steam temperature was 358 degrees Fahrenheit, so that the heater had to supply ninety-three degrees Fahrenheit to steam temperature, and actually did contribute eighty-three degrees Fahrenheit.

The general conditions were reproduced as exactly as possible for the comparative test with the economizer only, and the net result was over seven per cent in favor of the live steam feed heater. With so little margin for improvement as existed in the efficiency of the boiler and economizer, the above result is remarkable, and as the tables of tests appended show, this live steam heated feed reached the maximum efficiency attainable under the conditions, the terminable temperature at the chimney bottom being lowered by infiltration of air to the flues, and the chimney draught was low, being an average of about 0.475 inch of water.

With greater differences between the economizer feed and the steam temperature, correspondingly greater improvement would naturally follow the use of full temperature feed.

The particulars of these trials, which were made at normal rates of combustion for Lancashire boilers, namely, 22.147 pounds and 24.27 pounds of coal burnt on the square foot of grate area per hour, are stated below.

1. Economizer and live steam heated feed:

Calorific value of coal, 14,200 B. T. U. per lb.
Rate of combustion per ft. sup. grate per hour, 221.47 lbs.
Steam pressure, 150 lbs. absolute temp., 358° F.
Economizer feed to heater, 265° F.
Heater feed to boiler, 348° F.

	Per Cent.
Efficiency of boiler and economizer from water at 47° F.	76.4
Efficiency of superheater	3.0
Radiation taken at	7.0
22 lbs. of air at 50° F. per lb. of coal = 23 lbs. of products at 400° F. + 50° F. (atmos.) = 350° F. above atmos.	13.6
Total heat of fuel	100.0

2. Economizer heated feed only.

Calorific value of fuel, 14,200 B. T. U. per lb.
Rate of combustion per ft. sup. grate per hour, 24.27 lbs.
Steam pressure, 150 lbs. absolute temp., 358° F.
Economizer feed, 234° F.

	Per Cent.
Efficiency of boiler and economizer from water at 56° F.	69.844
Efficiency of superheater	3.27
Radiation taken at	7.0
22 lbs. of air to 1 lb. coal; 23 lbs. products at 571° F. terminal temp.	19.886
Total heat of fuel	100.000

In the terminal temperatures given no allowance for infiltration is made; the quantity of gas leaving the boiler is calculated from the CO_2, which was about ten per cent. The actual terminal temperatures were much lower than shown by the figures.

Periodically, during the highest rate-consumption tests, a curious phenomenon was observed. The flues and economizers became full of burning gas at a red heat, which, being generally distributed, gave a periodical increase in the efficiency of the plant. Over 1,200 degrees Fahrenheit were registered at the economizer, after the three runs of the boiler flues had been traversed. This is very remarkable.

Concluding this section of the paper, the author ventures to say that hot gas more generally distributing the heat than is the case with fires immediately surrounded by water-heating surface, would conduce to the efficiency of boilers generally, and with a view to test this important point, he is fitting the furnaces of a Lancashire boiler with fire-brick lining and special air-inlet provisions for utilizing high-rate combustion in this manner.

The rate of combustion is limited by the temperature of the furnace, and only fire-brick lining can raise this to the necessary point for the rapid rates of combustion which are required.

The construction of the feed-water heater is shown in Fig. 1, which almost explains itself. The water is fed from pump or injector to spray valves in the upper part of the apparatus, which forms a steam chamber in direct open communication with the boiler steam at full pressure. Steam free of air or gas is maintained by constant slight blowing at the lower or heavy gas or air valve and also at the light gas valve in the upper part of the steam chambers. Air is, of course, about double the weight of steam of any given pressure, and it settles to the lower part of the steam chamber to be eliminated by the air valve, while lighter gases than steam, sometimes generated from bad water and often very troublesome in condensers, are eliminated from the upper valve. Without this arrangement the air and gases would accumulate, and both spoil the conductivity of the steam for heating and exclude the steam from the vessel by displacement. The water gauges indicate the level of the water in the heater, for comparison with that in the boiler.

The heated water overflows by gravity to the boiler from the top of the deposit vessel, and the separated incrusting matter is eliminated at the blow-off cock at the bottom.

American Navy Safety Appliances at Milan.

One of the few American exhibits at the Milan Exposition, now open for the season of 1906, is that of the "Long Arm" system of electrically operated bulkhead doors. The exhibit consists of a horizontal sliding door, a vertical sliding door, a hatch gear and the electrical emergency station, from which, aboard ship, all important bulkhead doors and the armor hatches are operated. The types of doors and the hatch forming this exhibit are all of the latest model. A great deal of interest has been manifested in Italy in the "Long Arm" system, which is in use on all the new warships of the United States Navy, and it is doubtless somewhat due to the educating influence of this exhibit that a movement has been started in Italy to have incorporated in the governmental regulations for passenger ships a clause making the installation of power doors obligatory.

Telharmonic System in New York City.

The first set of apparatus for the production of music electromechanically under the Cahill telharmonic system is being established in New York city under the supervision of J. G. White & Company, the wiring being done by the Lord Electric Company, of Boston, Mass. The plant is being installed in Park & Tilford's store on West Thirty-ninth street. The apparatus will be operated by a 200-horse-power motor, taking current from the Edison service. A second plant is now being constructed for shipment to the Pacific coast.

Digitized by Google

Electrical Notes from Europe.

(By Our Special Correspondent.)

ONE of the most important electrical enterprises which has been carried out in France is the system of electric tramway lines now in operation on the Mediterranean coast in the region of Nice. Some of the sections of the line, especially the part which lay in the suburbs of Nice, were constructed several years ago, and afterward different sections of tramway running along the coast were added, until at present there is a continuous line running from Cagnes, through Nice and Monte Carlo, and ending at Menton. This line is nearly thirty miles long altogether. Over it the cars run direct from Menton and Nice to Monte Carlo, without changing. The tramway system is operated in three sections—Cagnes-Nice, Nice-Monte Carlo and Monte Carlo-Menton. Of these lines the second is the one on which the greatest amount of work had to be done in laying out the route. Here the coast is made up largely of cliffs overhanging the sea, and the road had to be enlarged so as to accommodate the track, tunnels cut, retaining walls on the side nearest the sea constructed, and bridges built over the deep gorges which form the beds of the mountain torrents. This section has the heaviest traffic during the winter season, and the cars are run in some places at intervals of three minutes. Between Nice and Menton the line is double tracked. Broca rails, weighing 100 pounds per yard, are used for the track in general, laid flush with the road. In a short section the Vignole rails are laid on ties. The trolley line is supported upon bracket posts and lies over the centre of the track in some cases and in others at the side. The second or Cagnes section runs from the west suburb of Nice, then crosses the Var and follows the national road as far as Cagnes. A depot is erected at this latter point to accommodate the freight traffic, which is made up largely of products of the farms of the region, and special trains are run so as to bring the products into Nice at early hours. An important branch is the Contres line, which runs from the coast up the Paillon valley. Along the route is a large cement works, which assures the line at least 70,000 tons yearly freight traffic. These products are sent to the port of Nice or to different storehouses in the city which have special branches running from the main line. An arrangement is to be made with the railroad company which will establish connection between the port of Nice and the different railroad stations of the coast, as the railroad is also of narrow gauge (one metre). Over the tramway lines the trains will use a specially built form of tractor with four motors.

The current for the tramway lines is supplied from a number of substations which receive high-tension current at 10,000 volts and twenty-five cycles from the lines operated by hydraulic plants, and deliver direct current at 550 volts for the trolley. At present there are six of these substations working, and these are located at Nice, where there is a main substation running in connection with a steam plant; at Californie, midway between Nice and Cagnes; at Beaulieu, also in the suburbs of Monaco; and at Monte Carlo; besides the substation of Cap Martin, near the end of the line. The outfit of these substations consists in general of direct-coupled groups formed of synchronous motors working at 10,000 volts, and railway generators which supply 550 to 625 volts, with capacities of 250 kilowatts or less, or of rotary converters supplied from banks of transformers. These units range in capacity from 150 to 250 kilowatts. Batteries of accumulators are used in most of the substations.

The rolling stock at the present time consists of 100 motor-cars, three freight-hauling cars equipped with motors, and twenty-two freight cars, this apparatus having been in operation during the first period. Since then has been added an outfit consisting of six large motor-cars carrying two motors, twenty trailers of the closed type and twenty-two open cars. Later on were added twenty cars of a short type designed to be coupled in pairs and operated by one controller. This form of car was adopted with a view of going more easily around the sharp curves which occur on the lines. They are equipped with the multiple-unit system. The equipping of the tramway lines, as well as the substations, has been carried out by the Compagnie Française Thomson-Houston, the material coming from the Paris shops of the company.

The Paris Aerial Telegraph Company, of which M. Victor Popp is the promoter, has recently made an arrangement with the Roumanian government for installing four wireless telegraph posts, one on land and three others upon the vessels of the fleet. M. Popp recently informed the writer that this equipment was now complete and ready to operate. The contract was made between the Paris company and Lieut.-Commander Cesar Boerescu, inspector-general of the Roumanian maritime service, acting as a delegate of the government. The aerial telegraph station which forms the land post has been installed at Constanza and is well equipped with apparatus upon the Popp-Branly system, which has already been described. This apparatus uses the tripod coherer which Professor Branly brought out a few years ago. With this apparatus it is expected to signal for long distances, especially across the Mediterranean, either to other stations on the coast or to vessels. For charging the storage batteries the Constanza post is equipped with a direct-coupled generating group. The posts which have been placed upon the vessels Regele Caral, Principesa Maria and Romania, three in number, are each equipped with apparatus similar to the above, which will allow them to signal for more than 300 miles in the case of the Romania, which has masts of 105 feet height above the deck; for 300 miles in the case of the Regele Caral, using eighty-seven-foot masts, and as far as Constantinople for the third vessel, which is provided with sixty-five-foot masts. After the posts had been put in working order, the construction company left an engineer on the spot in order to instruct the personnel as to the operation of the system.

On the Continent, the Nernst lamp is manufactured principally by the Allgemeine Electric Company, of Berlin, which now has a large factory devoted to the purpose, and which is now producing the lamps in quantity by the most improved methods. One of the interesting features of the lamp factory is the testing laboratory, of which the accompanying view has been kindly furnished by the company. It is well equipped with measuring instruments of standard type, besides many other testing instruments which have been specially designed for use with the Nernst lamps. The various types of lamps which the company is now making will be observed here. Besides the smaller lamps,

Digitized by Google

which are built on the lines of the incandescent lamp, there is a type of large lamp which is intended to replace small arcs, especially for inside use.

At a recent meeting of the Société des Ingeniers Civils, M. Guillet brought out some points about the manufacture of steel in the electric furnace, according to the recent data presented to the mining and metallurgical section of the Rome Congress. On the Continent there has been considerable progress in the production of steel by the electric method. In Italy Commandant Stassans, who is one of the leading champions of the process, has been carrying on a number of researches in order to find the best and most economical methods. He claims to have been very successful with his recent processes, and recommends especially the use of the arc by reverberation. A new type of furnace built on this plan has lately been adopted by the Italian government, and is under the control of the war department. In other countries there is also considerable progress. The Froges-Heroult process may now be said to have passed beyond the experimental stage. Besides the large plant located at La Prag, using hydraulic power to give an output of 4,000 tons of steel, there are two other plants which have been lately erected. One of these is at Kortfors, Sweden, and the second is located in Germany, at Remscheid. Another large plant, which will soon be in operation, has been installed at Saut-Du-Tarn recently.

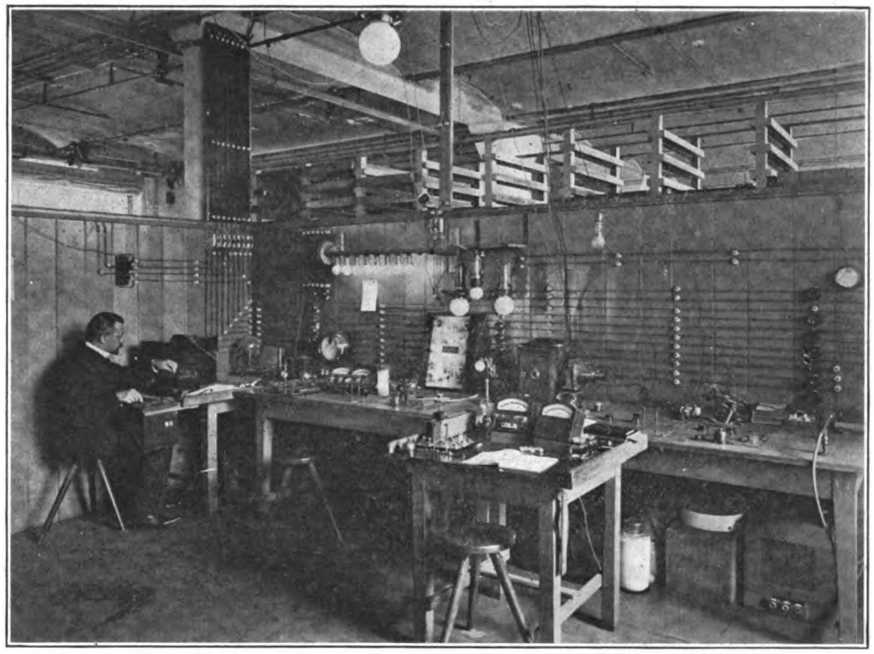
A new method which it is purposed to use at the German factory consists in first heating Siemens-Martin steel and then introducing it into the electric furnace, the latter carrying out the final processing of the steel, thus turning out a high-grade product. In this way it is expected to replace the ordinary grades of steel by a superior quality for use in general work, where heretofore the common grades of steel have been employed. It is found that the steel which is turned out by the Froges-Heroult process is superior to the ordinary steel, by reason of the fact that for an identical chemical composition, or, again, for an equal breaking strain, the new steel shows a greater elongation and a higher resistance to shock than the usual carbon steels, even including crucible steels. This is considered to be due to the neutral atmosphere which is obtained in the electric furnace and the absence of gases. Another point to be especially noted in regard to the steel made by the electric process is that it shows a much less deformation after tempering than other steels.

In this connection may be added some information, which has been given by O. Engelhardt, concerning the electric furnace plant erected some time ago at Gysinge, Sweden. This plant is operated on the Kjellin process, and is now turning out a good quality of steel. The furnace uses current to the extent of 170 kilowatts or more. Some trouble was found at first with the external protecting layer of the furnace. A silica composition had been used for this covering, but this was soon destroyed by the heat. It was replaced by a better covering which has a basic character and which is applied in a twelve-inch layer. It consists of a mixture of ten parts of magnesia and forty parts of Holland clay, with enough water to give a good stiffness. Some three tons of this mixture were used to coat the outside of the furnaces. As to the amount of metal which is now being produced at the Gysinge plant, it is stated that 285 tons of steel were turned out within twelve weeks, using an average of forty-eight charges of the furnace in eight days. The amount of power needed there is 770 kilowatt-hours per ton of steel. This amount may be reduced by placing in the furnace 0.72 ton of melted iron to 1.43 tons of cold iron, making the consumption only 650 kilowatt-hours per ton. The new furnaces, which are now building, are expected to lower the amount of current needed to produce the steel. This will not exceed 590 kilowatt-hours by the former method, or 490 by the latter. In the Gysinge plant the current used is 3,000-volt, fifteen-cycle monophase current, supplied by a hydraulic plant in the region. The production of steel can be carried out very economically, in view of the fact that the power can be supplied for $0.05 per kilowatt-hour.

At the Milan Exposition may be noted among the electrical features an international concourse relating to different methods of applying electric motors to agricultural implements, especially for plowing, and it is expected that a number of apparatus will be exhibited. A practical test of the motor-driven machines is to be held on a piece of ground near the city. The concourse is under the direction of the minister of agriculture, industry and commerce. It is to relate especially to the types of apparatus which are best adapted to fulfil the economic and agricultural conditions prevailing upon the Continent, and especially in Italy. The concourse was opened on the first of August and will continue to the end of the month. A special prize is to be awarded for the best apparatus. All the devices which are entered are to be put through an actual trial on the testing ground under the supervision of the jury. The extra labor which may be needed is to be furnished by the exposition.

C. L. DURAND.

Paris, July 28.



LAMP TESTING LABORATORY OF ALLGEMEINE ELECTRIC COMPANY.

Digitized by Google

The Indianapolis, New Castle & Toledo Electric Railway.

The state of Indiana, already netted with interesting systems of interurban railways, will soon have added to those now in successful operation a new line of electric railway between Indianapolis and New Castle, Ind., as the main terminals, with branch lines to Greenfield, Anderson, Muncie, Winchester and Richmond, the total mileage of which is as follows: Indianapolis to New Castle forty-five miles; Maxwell to Greenfield five miles; Shirley to Anderson sixteen miles; New Castle to Muncie twenty miles; New Castle to Winchester twenty-eight miles; New Castle to Richmond twenty-six miles; total, 140 miles.

The road will serve as the only means of railway communication with Indianapolis for a large proportion of the population reached by its service; in fact, no portion of the trackage is crossed by a competing railway. A private right-of-way, fifty feet wide, and terminal facilities controlled by the company in the city of Indianapolis, place the new system in a favorable position for maintaining high speed through the country, and secure rapidity of entrance and exit from the city proper. In addition to the passenger traffic, the company's franchise permits the transportation of freight without any restriction.

The engineering features of the road include the building and equipment of a main power station, located near New Castle, and ten permanent and one portable substations, one substation being installed in the main power plant building. The contemplated use of a portable substation is in keeping with well-established recent practice in general electric railway service. There are many interurban systems of which portions are liable at times to exceptionally severe loads, and the portable station is proving useful in dealing with them. It can readily be shifted from town as occasion requires, following up the shifting of spare cars and supplying additional power even at somewhat severe loss in the high-tension feeders.

The main power station will contain units of 1,000 kilowatts each, two Allis-Chalmers steam turbo-generating units being installed for present use to supply 25-cycle alternating current to the line by a system of step-up transformers operating at 33,000 volts. A line voltage of 33,000 volts was adopted, not only to meet the engineering requirements of the present system but also because the voltage at the frequency selected would enable the system to mesh properly practically all of the other similar systems now operating in Indiana, should future conditions so demand.

All transmission, both high tension and railway service, will be carried on pole lines, no third-rail construction being considered advisable.

Seventy-pound A. S. C. E. tee section rails, heavily ballasted, will permit of high-speed train operation.

The schedule so far prepared contemplates hourly runs between Indianapolis and Richmond, with connections for branch roads laid out to provide the most thoroughly satisfactory service. Limited high-speed service will also be established between Indianapolis and Richmond, operating on three-hour headway and making proper connections with branch roads. An express service is allowed for, as well, and two fifty-ton electric locomotives will be provided for freight haulage and switching purposes.

The contract for the entire construction of buildings and road-bed has been awarded to the Electrical Installation Company, of Chicago. Complete Allis-Chalmers power and electrical equipment will be installed in the main power station and three rotary converter substations, which will be built at once, the building of the remaining substations being delayed until later. The equipment for the main power station will, for the present, consist of two 1,000-kilowatt Allis-Chalmers turbo-generators to operate at 175 pounds steam pressure and fifty degrees Fahrenheit superheat, the electrical ends of these units being wound for twenty-five cycles, three-phase, 2,300 volts.

The boiler equipment will be made up of three horizontal water-tube boilers, 175 pounds gauge, with nominal rated capacity of 400 boiler horse-power each and fitted complete with mechanical stoking devices. Two boiler feed pumps are provided, each of sufficient capacity to handle the total amount of feed water necessary for operation of six 400-horse-power boilers at their normal rated capacity. The feed pumps are to be of the horizontal outside, centre-packed plunger type. A feed-water heater of the open cast-iron type will be provided, capable of handling 45,000 pounds of water per hour.

Two complete surface condenser equipments will be furnished, consisting of condenser proper, steam-driven air-pump and centrifugal circulating pump, direct connected to a simple engine, each outfit capable of condensing 20,000 pounds of exhaust steam per hour. Two Allis-Chalmers exciter generators will be furnished, one for each of the 1,000-kilowatt turbo-alternators. Six 350-kilowatt Allis-Chalmers oil-filled, water-cooled, step-down transformers for a ratio of 2,300 to 33,000 volts, are provided. They are to be arranged in two banks of three each for connection to the alternators. Three Allis-Chalmers converter transformers, each 150-kilowatt, oil-filled, self-cooled, step-down type for 33,000 to 405 volts, will be provided for supplying current to the 400-kilowatt, compound-wound Allis-Chalmers rotary converter to be installed in the main power plant, 400 kilowatts, twenty-five cycles, 405 volts, alternating-current to 650 volts direct current.

A forty-kilowatt, 120-volt direct-current Allis-Chalmers generator provided for direct connection to a high-speed engine, will be so connected as to form a reserve for either one of the two direct-connected exciters specified, so that, in case of the break-down of either one, the corresponding alternator will not be disabled. This generator will also furnish the station lighting.

The switchboard equipment for the main power station will be designed especially to meet the requirements of the service as laid out, with all the necessary protective apparatus and modern switchboard appliances.

The outside substations will each be provided with a 400-kilowatt, twenty-five-cycle, three-phase Allis-Chalmers rotary converter and three 150-kilowatt, oil-filled, self-cooled transformers, similar to those already described.

Eight complete Allis-Chalmers car equipments will be provided, each consisting of four seventy-five-horse-power railway motors, two controllers, Christensen air-brakes, one set of rheostats and miscellaneous apparatus.

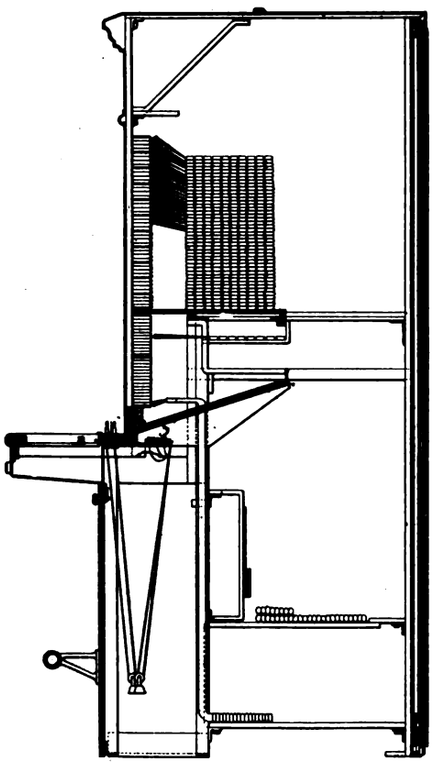
The motors specified for the car equipments are of liberal design, provided with large bearing surface, and particularly adapted to heavy interurban service.

The controllers which have been developed for use with these motors are made suitable for two and four-motor equipments. They are of the series-parallel type, and are provided with an efficient magnetic blowout. The various combinations of motors and starting resistance are such as to give a smooth acceleration, and the controller operating handle may, if desired, be fitted with an automatic device which prevents the operator from notching the controller too fast and drawing an excessive current from the line. The buildings provided for the system are, in general, designed with a view to rapid additions to the initial equipment when necessary.

Digitized by Google

Electrical Patents.

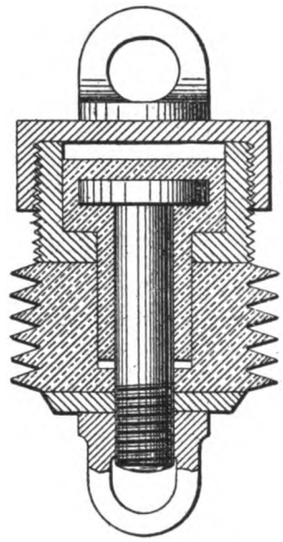
Benjamin F. Merritt, East Orange, N. J., has obtained a patent (826,680, July 24) for an improved multiple-switchboard construction, which he has assigned to the New York Telephone Company. The object of the invention is to more securely separate and individualize the different sections of the switchboard and guard against the spread of incipient fires which are liable to be started at the cord shelf connections, in the cabling, or in the branches or extensions which connect with the multiple jacks of the subscribers, or in fact in any part of the conductors or their connections. This is accomplished while at the same time securely supporting the several parts of the switchboard frame. The invention consists in the combination



MULTIPLE SWITCHBOARD CONSTRUCTION.

with a cord shelf, of connecting cords hanging from the shelf spring jacks in the face of the board above the shelf, cables at the rear of the switchboard, skinners extending forward from the cables to the spring jacks, horizontal partitions separating the spaces occupied by the multiple jacks, the answering jacks and the connecting cords from each other and transverse vertical fire-resisting bulkheads or partitions extending forward at intervals from the line of cables and dividing the spaces occupied by the skinners and connecting cords into separate compartments.

Max Meirowsky, Cologne-Ehrenfeld, Germany, has obtained a patent (826,589, July 24) for an improved electrical insulator. The present invention relates to an insulator for the trolley wires of electric tramways, for high-potential conductors, switches, implements, tools and



ELECTRICAL INSULATOR.

the like, laminated insulation, particularly mica, being preferably employed. The utilization of laminated insulation, especially of mica, hitherto offered great difficulties, in the case of conductors in the open. These difficulties are overcome in the case of the present insulator, in the first place, by the laminated insulation being surrounded by a cap, preventing the loosening and coming apart of the laminations, or by mica rings, and, in the second place, by both metal parts and also the parts of the insulation being so arranged and formed that the non-uniform forces which come into action, particularly in the case of trolley wires, exercise no injurious effect on the parts of the insulation, and these parts in case of need can be easily separately exchanged. Moreover, care has been taken to provide as large an insulation surface as possible, in order to prevent leakage currents. The invention consists in the combination of a metal cap having an opening at its end, a metal member having a head portion and a shank portion, the head portion lying in the metal cap and the shank portion projecting through the opening in the cap, and having a screw thread, insulating material surrounding the metal member and partly surrounded by the metal cap, insulation consisting of mica rings having furrows in their circumferences surrounding the above-mentioned insulating material surrounding the projecting shank portion of the metal member, and a nut on the screw thread of the shank pressing the above-mentioned mica rings against the end of the metal cap.

BOOK REVIEW.

"The Wire Tappers." Arthur Stringer. Boston. Little, Brown & Company. Decorated cloth. 324 pages. 5½ by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.50.

Apart from any value this book may have as a story, it will be read with considerable interest by a great many who have known of wire tappers by reputation, but who have no conception of what their calling means. The hero is a broken-down telegraph operator who has, through force of circumstances, drifted into nefarious practices. Once having fallen under the ban of the law it is difficult for him to make an honest living, and upon being discharged from custody he affiliates himself with a sporting gentleman who has urgent need of his services. In the employ of this person he meets the heroine, who, for some reason or other (the story never divulges the secret) is under the influence of this wire tapper and card sharp. This unfortunate pair endeavor to escape from the quagmire into which they have drifted, and the story of their operations, interspersed with more or less technical descriptions of the apparatus used and the methods followed, is quite interesting. The story, of course, has a happy ending. There is hardly any danger that any one will try to emulate the hero's wire-tapping exploits, for now that the Western Union and telephone companies have been given a chance to see the inside workings of such a scheme they will be on the lookout.

Electrical Accidents.

The annual report of the chief inspector of factories and workshops in Great Britain for the year 1905 includes a report from G. S. Ram, the electrical inspector of factories, on accidents due to electrical causes. The number of fatalities reported during the year was thirty-two, of which number seven were mechanical accidents. The number of non-fatal accidents amounted to 370, half of which were due to mechanical causes. Of electrical accidents at stations of electricity supply companies nine were due to arcing of switches, two of these from mistakes on the part of injured persons, and six to bad design or faulty apparatus. One was due to insufficient working space in front of a high-pressure board. Two were caused by the arcing of fuses, one being an oil fuse. One accident, which occurred when working close to live conductors, shows the danger of the common practice of locating fuses for small instrument transformers in places where they can not be got at without danger of coming in contact with exposed conductors at high pressure. With regard to accidents at private generating stations, none was fatal.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Some Causes of Error in Photometry.

Lancelot W. Wild holds that few photometrists properly appreciate the importance in photometry of the elimination of angularity errors. In general the art of photometry may be said to consist in judging the illumination of two contiguous surfaces, each being lighted from a separate source. A perfect screen may be defined as one which appears equally illuminated at no matter what angle it is viewed, the illumination being also exactly proportional to the cosine of the angle from the perpendicular at which the light rays strike its surface. It is hardly necessary, however, to say that such perfect screens do not exist outside the domain of mathematics. The apparent illumination of a screen varies slightly with the angle of view. From tests made by the author it would appear that with the screen under observation the best angle of view is at about fifty to sixty degrees. For very accurate work it is advisable to fix the angle of view accurately. There are very few photometers in use the carriages of which can not be deflected from the perpendicular by one degree. This would increase the illumination of one surface by three per cent, and reduce that of the other by three per cent, making a total error of six per cent. Errors are also caused by incorrect alignment of lights. A displacement of one-half inch, either vertically or horizontally, is by no means abnormal when ordinary incandescent lamps with irregular filaments are dealt with. Even if arrangements are made for moving the lamps in all directions, with a view to bringing them into exact alignment, it is difficult to judge sufficiently exactly the true photometric centre of the filaments. With a photometer screen so arranged that the ray shall fall perpendicularly upon the surfaces to be viewed, the error due to a want of alignment is quite negligible, a displacement of one light by one-half inch in thirty inches producing an error of only 0.02 per cent, this being the difference between the cos 0° and cos 1°. To avoid the angularity error, the two surfaces to be viewed must be absolutely parallel, so that side play between carriage and bar may affect the illumination of both surfaces in the same direction and to the same degree. Both surfaces must be normally perpendicular to the light rays falling upon them, so that, should their light be out of true alignment, the effect upon the illumination would be negligible. The surfaces must be viewed through a tube, so that the angle of view can not become changed to any appreciable extent. A telescope answers the purpose very well. Having these general principles in mind, the writer proposes a flicker photometer quite free from angularity errors. This consists of a special form of Bunsen disc revolved by an electric motor, and viewed by the agency of a mirror and telescope. The disc is cut out of ordinary white blotting paper and has about half of its surface treated with white paraffine wax, so that half the disc is opaque and reflecting, the other half translucent and diffusing. The disc is revolved on its centre by means of a small motor. A small portion of the upper part of the disc is viewed through a mirror and telescope. The object of using a telescope instead of a simple lens is that if no diaphragm is used the eye finds it difficult to keep in focus on the disc, which, when revolving, shows no detail. As arranged, an image of a portion of the revolving disc is formed in the air, so to speak, inside the diaphragm. The eyepiece is adjusted until the diaphragm appears in focus, and thus the eye is automatically trained upon the revolving disc. Keeping the disc in absolute focus increases the sensitiveness of the photometer, and, at the same time, reduces the fatigue to the eye. These photometers have been tried tilted as much as ten per cent out of true, and with one or both lights as much as six inches out of alignment. Within the limits of experimental error (about one-half of one per cent) no angularity error has been found.—*Abstracted from the Electrician (London), July* 20.

The Control of Tram-Cars on Gradients.

The four most recent accidents in Great Britain all occurred through a car getting beyond control while descending a gradient. The need of brakes which can be absolutely relied upon to control the car on any grade is unquestioned. The types of brake in general use on tram-cars consist of the ordinary wheel brake, applied by hand power; the rheostatic brake deriving its power from the momentum of the car driving the motors as generators, the current derived in this way passing through an external adjustable resistance; the mechanical slipper brake, which consists of some form of slipper or shoe carried on the car, which is pressed against the track rails by means of powerful levers or screws; and the electromagnetic slipper or track brake, which consists of a powerful electromagnet suspended on the car in close proximity to the track rails, deriving its power from the momentum of the car driving the motors as generators, the current thus generated being passed through the coils of the magnetic brake. Its operation is entirely independent of the line current, and is unaffected by loss of contact between trolley wheel and wire. Tests carried out by A. L. C. Fell, chief officer of the London County Council's tramways, prove that the electromagnetic brake is the most powerful, safest and most easily manipulated. Perhaps the most useful feature of the electromagnetic track brake is its ability to control a car descending a gradient. It is possible with this form of brake to allow the car to descend a hill at practically any desired uniform speed. In order to do this it is necessary for the driver to set his controller handle at any of the brake notches on his controller. This will bring the car to a definite speed, and it will continue at that speed as long as the controller remains in the corresponding position. The successful operation of any form of brake can only be attained if the wheels continue to revolve. Should anything occur to lock the wheels, all forms of car brakes at once become inoperative. The retarding force to the car then consists only of the friction between the wheels' circumference and the track, and in most cases this is not sufficient to control the car once it has attained a certain speed. Unfortunately, experience has shown that in many cases accidents have been caused through a too strenuous application of the brakes. It would seem, therefore, that every effort of inventive skill should be directed toward the development of such appliances as will prevent the locking of wheels, so as to allow the present known powerful forms of brake to operate when they are called upon. The perfection and development of the electromagnetic brake has unquestionably contributed largely to increased safety, but even with this brake the human element can not be entirely eliminated. If placed in the hands of

Digitized by Google

an inexperienced or careless driver the most efficient form of brake is of little value, because when most needed there is no definite assurance that it will be manipulated properly.—*Abstracted from the Tramway and Railway World (London), July 12.*

The Nickel-Iron Accumulator.

The experiments of Herr J. Zedner demonstrated that the nickel electrode of the Jungner-Edison cells did not contain any otherwise unknown nickel peroxide, but only the long-known sesquioxide, Ni_2O_3. The amount of hydration by the oxide was left uncertain, however. By comparing the water-vapor tension of this hydrate to the water-vapor tension of sulphuric acid of twelve graded concentrations, Zedner has found that the hydrate, $Ni_2O_3 3H_2O$, is stable when the vapor tension of the sulphuric acid is below three millimetres of mercury; and the hydrate, $Ni_2O_3 6H_2O$, is stable when the tension is above six millimetres. An intermediate hydrate was not observed. The caustic potash of the accumulators appears to contain the hydrate, Ni_2O_3-$6H_2O$, which is called the nickeli-hydrate, and generally written $Ni(OH)_3$. This is the oxide contained in the pockets of the charged electrode. The electrode potential, measured against a hydrogen electrode, diminishes when the concentration of the caustic potash increases, and the temperature coefficient of this potential is negative with 0.0007 volt per degree centigrade. The discharge of the cell, all investigators have agreed, occurs in two steps: the first at about 1.3 volts; the second at about 0.7 volt. Zedner finds that during the first step some nickeli-hydrate is reduced to nickelo-hydrate, $Ni(OH)_2$. The second step is not connected with the formation of some other oxide, and appears to be due to the discharge of the oxygen which is occluded by the electrode during the charge. It has been noticed that the nickel electrode liberates some oxygen during the period of charge. More oxygen seems to be occluded by the graphite which is added to the nickel oxide to increase its conductivity than by the nickel oxide. The evidence on this point is conflicting. An electrode not containing any graphite, especially prepared by the Kölner Accumulatorenwerke G. Hagen, did not indicate any second step at all, but an electrolytically prepared electrode of Zedner's, also free of carbon, showed it. The behavior of the electrodes when in a partial vacuum and when submitted to alternate discharges and charges supports the view that the oxygen liberation is an essential feature. When the discharge is suddenly turned into a charge, the potential of the nickel electrode rises slowly on the first step of the curve, but abruptly on the second step. In the first case the rise depends upon the naturally slow diffusion of the alkali from the pores of the nickel oxide back into the cell. In the second case, the beginning of reoxidization is at once marked by the high potential. The behavior of the nickel electrode is now fairly understood, though it should at once be mentioned that Ballucci and Clavari, contrary to Zedner, deny the existence of the oxide, Ni_2O_3. What is wanted now is a systematic investigation of the iron electrode, which is rather difficult to oxidize outside the cell, but is generally credited with twice the capacity of the nickel electrodes and with a one-step potential curve. Gräfenberg, on the contrary, seems to ascribe the two steps to the iron electrode. There is no doubt that the electrolyte—the alkali—is concerned in the reaction, though not to the same extent as the acid in lead cells. At the same time, most of the active material is, in both cases, ballast, as the reactions do not penetrate deeply. In practice we hardly obtain more than thirty watt-hours per kilogramme of cell weight in lead cells, and twenty-four in nickel-alkali cells.—*Abstracted from Engineering (London), July 20.*

The New Close Works of Ernest Scott & Mountain, Limited.

The new Close works of Ernest Scott & Mountain, Limited, are situated adjoining the Northwestern Railway from Newcastle to Sunderland. Their total area is nearly seven acres, two of which are under cover. A direct siding is provided to the Northeastern Railway, and full-gauge tracks to the extent of about a mile are laid throughout the works. The light machine shop, which forms one of four main bays, is 234 feet long by thirty-four feet wide, and includes the whole of the light machinery, such as small lathes, slotting and milling machines and other tools of this description. It is served by a hand crane of five tons capacity. By the side of the light machine bay is the heavy machine bay, the total length of which is 558 feet, and the width forty-three feet. It is intended that the light machine bay shall be extended to the same length as this shop, and the original plan for the works contemplates the erection of two further bays of the same length, on the west of the present building. The large bay comprises the heavy machine tool shop, which is situated at the north end; the core-building department, in the centre, and the general erecting shop and light fitting department, at the south end. The far end of the shop is devoted to the final testing of all classes of machinery. The testing department includes a very complete equipment for the testing of high-speed engines, dynamos of all kinds, including continuous-current and three-phase machines, electric motors, three-throw and centrifugal pumps. Adjoining this bay is the electric and brass shop, in which the whole of the armatures, field magnets, commutators and other electrical details are constructed. This bay is 264 feet long by thirty-four feet wide. The adjoining shop, of the same size, is devoted to general stores, including finished and unfinished stock, electric cable, steel stampings for armatures, switches, switch gear, etc. At the north end of this bay is the drying and varnishing department for the armature sections and magnet windings, which are constructed in the adjoining electric shop. The foundry is situated a few yards distant from the stores. This building is 175 feet long by 112 feet wide. There are two cupolas with a combined capacity of eleven tons per hour. The air blast is supplied by a Roots blower driven by a fifty-two-horse-power electric motor. At the back of the cupolas are a number of beams, over which a siding is carried, so that the foundry materials can be deposited inside the building with a minimum of trouble. The brass foundry, which is under the same roof, comprises four pot holes and a small drying stove. The boiler house adjoins the foundry. The equipment includes a modern Babcock & Wilcox boiler working at any pressure up to 300 pounds per square inch. There are also two locomotive boilers, which are used for testing purposes and to supplement the larger boiler at times of pressure. The generating station includes a vertical long-stroke compound engine capable of developing 250 indicated horse-power. This drives by belt a compound-wound, continuous-current generator running at 110 volts, with an output of 120 kilowatts. There is also a combined high-speed compound engine with a direct-connected dynamo of forty-five kilowatts capacity. The artificial lighting in the works is by means of arc lamps, each of 1,000 candle-power, the total number installed being seventy-two. A large number of incandescent lamps is also provided for separate tools, offices, etc. The heating of the shops is done by live steam carried throughout the whole of the buildings in specially constructed pipes with radiating grids.—*Abstracted from the Engineering Times (London), July 19.*

Digitized by Google

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

ORGANIZATION AND CONDUCT OF A NEW-BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.

(Concluded.)

BY S. M. KENNEDY.[1]

Soliciting—Advertising in the electric business is principally to arouse curiosity and invite investigation. Its object is to induce the reader to ask questions, and prepare the way for getting business. But it requires a personal interview to close a contract, and the prospective consumer must either hunt some one up, or some one must hunt him up in order to bring matters to a desirable climax. It is a good plan for a representative of a company to do the hunting. The man who reads the advertisement might have good intention, but a bad memory.

"The best cause requires a good pleader," and the best-managed new-business department requires good solicitors. There are some lines in which a solicitor requires only to be a good talker. Not so in selling light and power. A good talker is all right, but he must first be honest, earnest and straightforward, and what he says must carry with it the ring of truth. The solicitor goes out among the public. He meets the people in their homes, offices and places of business. He does not represent himself, he represents the company, and the public is going to judge the company by the action and words of the solicitor. Often he is the only one about the company whom the customer knows.

Regular Solicitors' Meeting—There is a great difference between a man coming to you to do business and you going to him. The first presupposes a desire in him to act; the second a desire in you to induce him to act. Consequently, solicitors should be trained and instructed. In this connection it is well for the manager of the new-business department to gather his staff around him at least three times each week to discuss matters in hand, to answer questions and smooth out difficulties. New conditions are constantly arising which require to be met. Information is constantly coming in which requires to be distributed. Reports about new buildings, new building permits and new tenants must be dealt with, and often a daily meeting is necessary—and advantageous. Direct solicitation is the safest and surest way to obtain business, and the solicitor must be equipped for his work. The electric company has much to do to overcome competition, indifference and inertia, and it is through the solicitor that a large amount of this active and passive opposition may be removed. He must educate and demonstrate. He must make the public realize that what his company is selling is something in which every one should be interested; something that lessens the cares and responsibilities of life; something that is superior to everything else for doing similar things; something that reduces work, lightens labor and saves their pocketbooks from certain ravages.

Solicitors' Tactful Work—It is essential that solicitors should not be too technical in their talks with prospective consumers. There is nothing to be gained in befogging a man by injecting into a conversation a mixture of amperes, ohms and volts. The solicitor is not selling kilowatts; he is selling light. He is not selling amperes, he is selling heat and power. If he has acquired technical knowledge, let him forget it when talking to an ordinary man or woman, and he will sell electric current with less trouble. Those engaged in the electric business are apt to forget that the public does not know as much about it as they do. It is a fact that a very large percentage of the community does not know of the conveniences and simplicity of handling the current—even when they have it for lighting their homes. Many people have a fear of electricity on account of its mysterious nature; some thinking it as dangerous as lightning. Here is where the careful work of the solicitor may do good every day.

To the merchant the solicitor points out the advantages of electric light for showing his goods. For keeping his ceilings and store clean, by an absence of smoke and smut, for reducing the heat in summer and permitting good air at all times. For improving the decoration of his windows and keeping them clean winter and summer, so that the public may see what he wishes to display. And then he shows him the score of electrical devices which may be operated to advantage inside his store, and help him make money. And, lastly, the solicitor takes his merchant to the door and points out how and where an electric sign will work for him while he sleeps; how he can burn his name and business into the public mind, and how the company will take care of the sign, turn the current on and off at the proper times and relieve him of all responsibility in the matter.

The power user has much to learn, and to a great extent the solicitor must be his instructor. He goes into a factory in the crowded part of the city, and what does he see? Probably fifty per cent of the power generated wasted and dissipated in shafting and belting before the machine commences to work. Probably ten times as much space as is necessary given up to engines and boilers—and valuable space, too. Probably twice as much money invested in the power end as there should be, and, consequently, twice as much interest and insurance, and four times as much depreciation continually piling up. He probably finds plenty of noise, smell, dirt and inconvenience, to say nothing of high-priced skilled labor to keep the wheels moving. Little by little the solicitor can show that electrically driven machinery represents economy of power by means of direct-connected units; that motors occupy little space, and may be taken off the floor and stuck on the walls and ceilings; that they cost less than half the price of any other kind of power machinery; that they are clean, noiseless, convenient and reliable, and do not require skilled labor to operate them.

Appliance Showroom—The work of the solicitor may be greatly aided by the company having a showroom in which all kinds of electrical appliances, big and little, may be seen and their usefulness and convenience demonstrated. The public may thus become familiar with the workings of the different apparatus, and the solicitor will have an advantageous place to which he may invite prospective consumers, and there explain the actual operation of what he wishes to sell. Too

[1] General agent, Edison Electric Company, Los Angeles, Cal. Winner of the $300 prize offered by the Cooperative Electrical Development Association.

Digitized by Google

much care and attention can not be given in the arrangement and fitting up of this room. Lamps of every size and design should be tastefully displayed so as to obtain the best effects out of each. With them there should be shown the current-saving devices, and also electric motors in operation. The latter will help to educate the people to be familiar with the meter's mechanism, and tend to inspire confidence. Then there should be specimens of all sorts and varieties of practical appliances which may be used in the house, office, store and workshop. In short, a continuous exhibition of what may be had in electric apparatus and what may be done with them. In this showroom there should always be plenty of small booklets, giving illustrations and concise information regarding the different kinds of appliances, so that those inspecting them may have something to carry away to refresh their memories and arouse the interest of others.

Electric Office Display—But the manager of a central station must show his belief in what he produces and sells by using freely what he wants others to buy. He preaches that an electric sign is the best kind of an advertisement. Does his company use one?

He advocates a well-lighted store and a brilliant window. But how about the company's office? Is there plenty of light, and is it burned far into the night? Has he electric fans, foot-warmers and radiators installed for the benefit of employés and customers? What is the use of his saying that "trade follows the light" if he does not illuminate his own premises. If he has no electric sign over his office, what is the use of his preaching that the same law which draws the moth to the flame of the candle also draws the buying public to the brilliantly lighted store. Let deeds as well as words show that he has plenty of confidence in his own product.

System—It was Thomas A. Edison who said that "genius is partly inspiration, but mostly perspiration." In other words, energy is what produces results. But much energy may be lost because it is not systematically applied. The manager of a new-business department will find that system is a good servant for him to employ. The larger the business transacted, the better must be the system, and that system is best which substitutes knowledge for guesswork, and economize time, labor and money. There must be system in advertising, and system in laying out the work for solicitors. There should be system in noting the results of advertising and the returns which solicitors bring in. There will be inquiries, leads and prospects, the data concerning which requires to be kept up-to-date and accessible. There should be system in handling what has to be done, and what has already been accomplished. System in noting sales, terms, proposals and contracts—records of buildings to be constructed, names of owners, contractors and tenants, and the particulars regarding the probable requirements of each. In records of prospective power consumers, complete information is necessary about present installations, kind of machinery, makers' name, horse-power, use and hours of operation.

Care of Customers—In all branches of the new-business department's work, system is needed, but not the kind of system which becomes a tax and a burden. The longer he is at his work, the longer he is dealing with the people, and the longer he is trying to sell electricity, the more will the new-business manager be impressed with the fact that the best advertisement is a pleased customer, and the best possible solicitor is a consumer who is satisfied. All the work of his department is practically wasted if the new business taken on is not properly cared for.

Good Service—The new-business department must be backed by good service, and "good service" only begins with the production of the current. Good service requires that there should be polite and attentive clerks, collectors, meter readers and trouble men; that complaints shall be listened to and promptly investigated, and the settlement of disputes and adjustment of claims shall not be sidetracked and postponed beyond reason. The very existence of a company depends upon the good will of its customers, and for this reason inattention and discourtesy on the part of any of its employés should be considered unpardonable.

The agents of the new-business department go out after business. They approach a man in his own house or office, and then it is that a man is liable to talk freely of how the company has treated him. If the treatment has been bad, the agent's chances of doing more business are very slim. If the treatment has been good, the chances for more business are excellent. Again, it is pointed out that the best means for advertising a business is to be advertised by its friends. If a man is a consumer, look after him. If he has a complaint or is in trouble, give his case immediate attention. His general opinion may be that corporations have no souls, but he will find that individuals in the corporations have, and it is by the work of the individuals that he is going to judge your particular corporation. If a man is a power user, he is depending on that power to help him earn his daily bread. He may have a large number of employés, or he may be operating a motor by himself. In either case, if the power goes off, or some trouble occurs with his service, he is put to inconvenience and expense until the trouble is rectified. As a rule, when he has trouble with his motor or service, the first thing he does is to call up the electric company. The first thing the electric company should do in such a case is to give this man's trouble the right of way. Whether the cause of the trouble is the fault of the company or the consumer does not much matter; the fact that the consumer is shut down is sufficient reason to see that he may be running again as quickly as possible. It is this kind of treatment that make friends for the company. It will be found that one of the most successful ways of convincing prospective power users that the energy you have to sell is the energy they need, is to take them to plants which are being operated by electric power for similar purposes to what they would use it. Then have these consumers who have been using power for some time tell the prospective customer how electricity works; what are the advantages and troubles (if any) and what is the cost of operation. The prospective customer is liable to think that the agent of the company is prejudiced, and you can not blame them. Besides, the man who is trying to sell him a steam or gasolene plant has probably told him something just the opposite to what your agent has said. But if he is going to run a machine shop, or a planing mill, or a foundry, or a peanut stand, take him or send him to some of your customers who have been running similar plants with your electric power. And if you have treated your customers right, they will honestly help you to win others—and frequently put themselves out of the way to do it.

Results—However, results are the best test of all work, and there is nothing problematical about the results to be obtained by a new-business department if it is operated with diligence, intelligence and perseverence. Let the department manager cultivate among his assistants a spirit of pride in the work. Let him encourage and enthuse them, so that a healthy emulation may exist; an emulation to excel each other for the benefit of the company's business, and to pull together, so that the successes of to-day may be but the stepping stones for the achievements of to-morrow. Let there be politeness, attention and courtesy in all ranks and at all times, and under such conditions the central stations will surely prosper, and the tiny stream of new business which had once to be coaxed and persuaded will eventually begin to flow as a river, and continue to grow in force and volume day by day.

Digitized by Google

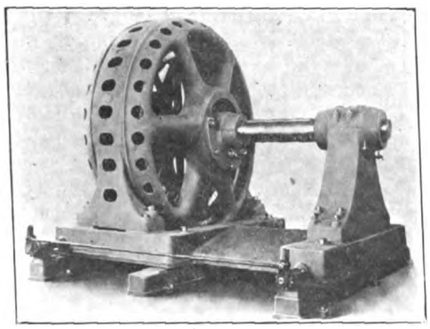
INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Large Allis-Chalmers Induction Motors for the Washoe Smelter of the Anaconda Copper Company.

Four large induction motors have been purchased for the equipment of the 10,000-ton concentrators of the Washoe smelter, a new portion of the $9,000,000 reduction plant of the Anaconda Copper Mining Company at Anaconda, Mont. They were designed and built at the electrical works of the Allis-Chalmers Company, Cincinnati, Ohio. This plant is to operate with power supplied by the two stations of the Helena Power Transmission Company, on the Missouri river near Helena, nearly 100 miles from Anaconda. In addition to power being furnished for the smelter and street railway of Anaconda, the improvements now in progress will, when completed, make it possible for the mines of Butte to utilize Missouri river power.

The output of copper from the Washoe smelter, which has been equipped throughout with electrical drive, is from 15,000,000 to 17,000,000 pounds per month. Formerly all the power required was supplied by steam engines, and a certain amount of steam power will probably always be used,

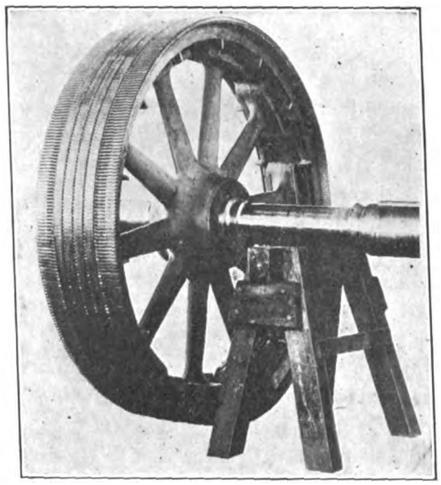


1,200-HORSE-POWER, 360-REVOLUTION, THREE-PHASE, 2,080-VOLT INDUCTION MOTOR.

as some of the steam boilers utilize the heat contained in the waste gases from the furnaces. However, this power, obtained from a by-product, is not nearly sufficient to operate the whole plant, and all additional power in the future is to be supplied by electricity.

A second dam is being built across the river, near Helena, by the Missouri River Power Company, by which the waters will be backed up to form a lake near the capital city. The transmission of power at a pressure of 70,000 volts over a double line to Anaconda, nearly 100 miles distant, involves a pole line and accessory equipment which will be one of the electrical features of the West.

A substation at the smelter contains the step-down transformers for lowering

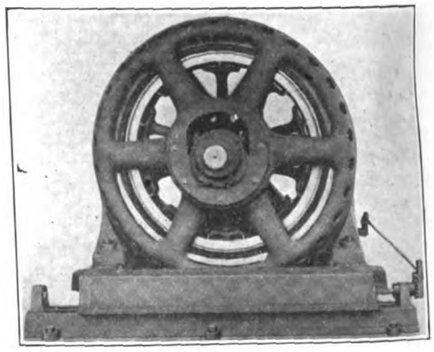


ROTOR OF 1,200-HORSE-POWER INDUCTION MOTOR.

the pressure to 2,200 volts for distribution to the various parts of the plant. The Anaconda company has also recently purchased a water-power plant located at Flint creek about thirty-one miles from the smelter and capable of supplying about 1,500 kilowatts; the power from this plant will be used principally for the operation of blowers and air-compressors in the smelter power-house.

The concentrating plant is the first unit to be driven by electric power exclusively, the four large induction motors being used for this purpose. The concentration building is 600 feet long with the steam plant heretofore used for driving it, located in the centre. The jigs, tables, etc., are driven from a main line shaft, 500 feet long, to which the engines have been connected by rope-driven and friction clutch pulleys. It is intended to leave this steam plant intact, to be used as a reserve in case the electric power fails, and disconnect the shaft at each side where it enters the engine room, thus dividing the shaft into three parts, a live section on each side of the engine room. The mill as a whole is divided into eight sections, four on each side of the engine room. Two induction motors will be installed in each half of the mill, and connected to the main shaft by rope-driven and friction clutch pulleys. Each motor has a 1,200-horse-power output at 360 revolutions per minute synchronous speed, and will furnish power sufficient to operate easily two mill sections; connection is made to the main shaft by eighteen two-inch ropes, and the pulley dimensions are such that the main shaft will be driven at 250 revolutions per minute.

These motors are notable not only on account of their large size, but also because of their having squirrel-cage rotors, something unusual in motors of this size. Their guaranteed full-load efficiency is ninety-one per cent and full-load power-factor, ninety-two per cent. Squirrel-cage motors were chosen for this installation because the conditions under which they have to start are favorable. The motors being connected to friction clutches, start up light and as the mill runs continuously, it is not expected that the motors will be started at all frequently. The power system of the Missouri River Power Company is so large that the occasional starting of one of these motors will not cause undue disturbance, while the higher power-factor under ordinary running conditions is a decided advantage. Tests



1,200-HORSE-POWER, 360-REVOLUTION, SIXTY-CYCLE, THREE-PHASE, 2,080-VOLT INDUCTION MOTOR.

show that those motors exceed the guaranteed power-factor of ninety-two per cent, and that the starting current taken from the line will not exceed full-load running current when starting the motor with its ropes and friction pulley connected.

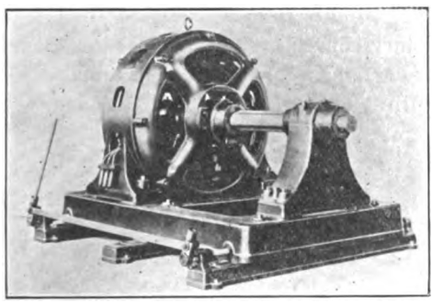
Starting is effected by an oil-immersed controller connected to an autotransformer which lowers the applied voltage at starting. The controller has six steps, so that the motor can be brought up to speed gradually. Since the motors are arranged in pairs in the mill, one controller is provided for each pair of motors, and the

Digitized by Google

necessary instruments, switches, etc., are mounted on two two-panel marble switchboards placed near the motors; the controller is operated by means of a handwheel on the front of the board.

The main switches and also the transfer switch for connecting either motor to the controller are of the oil-immersed type and interlocked with the controller handle in such manner that it is impossible to close the main switch of either motor while the controller is at the "on" position.

The general construction of these large induction motors is practically the same as that of the smaller ones built by the Allis-Chalmers Company. The stator punchings are supported in a substantial yoke to which the housings carrying the bearings are bolted. The bearings are adjustable to permit compensation for wear, and thus maintain a uniform air-gap between stator and rotor. The stator is wound with copper strip with the slot insulation forced around it under pressure in steam-heated moulds. The end connections of the winding are rigidly supported to prevent any distortion due



200-Horse-Power, 450-Revolution, Sixty-Cycle, 2,080-Volt, Variable-Speed Induction Motor.

to abnormally large current. The rotor is mounted on a spider provided with cast-steel end rings between which the laminations are held. The rotor slots are of the partially closed type and the rotor bars are securely held in place by the overhanging tips of the teeth. The bars are bolted at each end to bronze short circuiting rings, thus making a very strong rotor that can be safely run at high peripheral speed.

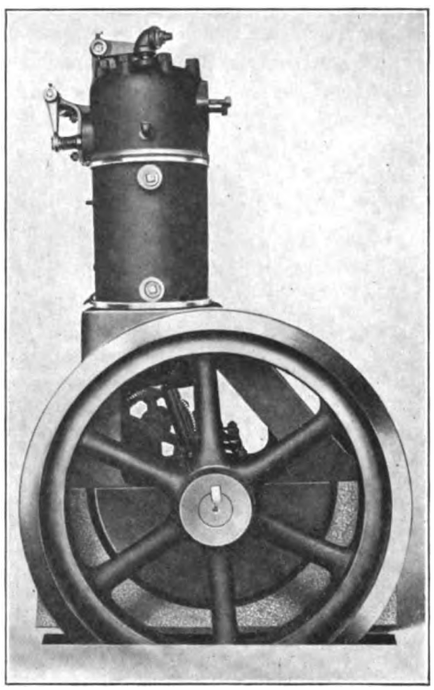
In addition to the four large motors there is also provided a 200-horse-power, variable-speed, sixty-cycle, 2,080-volt induction motor for operating the pumps in the mill. This motor is of the standard type with wound rotor and collector rings for the insertion of resistance in the secondary. The normal speed is 450 revolutions per minute, and can be reduced to 225 revolutions per minute by means of a grid type resistance furnished with the motor. The motor also has adjustable bearings.

For the equipment of the substation the Allis-Chalmers Company has furnished three synchronous motor-generator sets of 300 kilowatt output each, and one small induction motor-generator set for starting and exciting the synchronous sets. The 300-kilowatt sets are driven by twelve-pole, 2,080-volt, sixty-cycle synchronous motors and run at a speed of 600 revolutions per minute. The direct-current generators for these sets are compound-wound for 550 volts, and are able to carry fifty per cent overload for two hours without heating more than fifty-five degrees centigrade and without sparking. At normal full load the temperature rise does not exceed thirty-five degrees centigrade in any part. The sets have three bearings and the stator of the synchronous motor is arranged to slide sideways on the base to give access to the field and armature windings. These units will be used for operating direct-current crane motors throughout the plant and also for furnishing power to the Anaconda street railway. During parts of the day the load will be quite light, and it is intended to operate the synchronous motors with over-excited fields so as to compensate to some extent for the lagging current caused by the induction motors.

The fields of the synchronous motors are excited from a 120-volt, twenty-five-kilowatt, direct-current generator driven by an induction motor. The same motor is also coupled to a small 500-volt direct-current machine which supplies current for starting the sets. This machine has commutating poles, and a large current can be taken from it for short intervals without sparking at the commutator or undue heating in any part of the machine.

A Novel Crank Mechanism for Internal-Combustion Single-Acting Engines.

The accompanying photograph shows the crank mechanism which is now being offered by the Ramsey Engine Company, Bullitt Building, Philadelphia, Pa., to builders of single-acting engines. The chief feature of this device is the placing of the engine cylinder vertically over or horizontally in line with the crank pin when the crank stands at right angles to the axis of the cylinder. This disposition of the cylinder changes the angularity of the connecting rod, so that the thrust comes nearly at right angles to the crank when the internal pressure in the cylinder is greatest; and, moreover, during the power stroke this angularity varies much less than it does in engines in which the main shaft lies in the axis of the cylinder. The advantages of this are the more direct thrust upon the crank pin and less side thrust on the piston; and, at the same time, the arrangement increases somewhat the travel of the piston for a given crank throw when compared with engines of the ordinary type. This increase in the travel of the piston and reduction in angularity, which reduces the frictional losses in the cylinder, are said to increase considerably the efficiency of the engine. Of course, such an arrangement would lose on the return stroke as much as it gains on the



Ramsey Crank Mechanism.

forward stroke in a double-acting engine but when applied to single-acting engines the greater angularity of the connecting rod during the return stroke is not against the high pressure which exists in the cylinder during the power stroke, and there is, in consequence, less side pressure against the cylinder walls. The arrangement is said also to allow of a quicker opening of the exhaust valve and a reduction in the back pressure during the exhaust stroke.

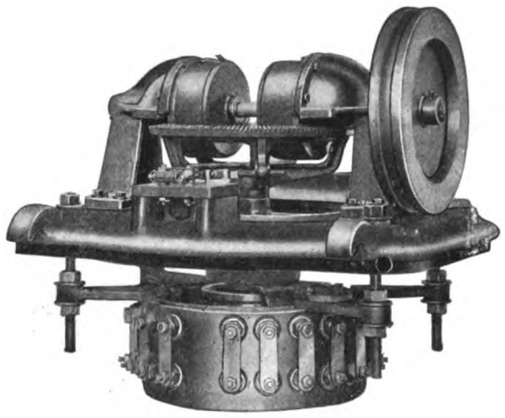
A series of tests was made of an engine constructed in this way, under the supervision of the University of Pennsylvania. This was a gasolene engine of the vertical marine type, having a nine and one-half-inch by fourteen-inch cylinder. This engine, it is said, developed one horse-power with a consumption of from one-tenth to one-eleventh of a gallon of gasolene per hour, when working under loads of from twenty-two to thirty horse-power. The total efficiency of the engine was said to vary from 24.1 to 25.9 per cent. These figures include the thermal efficiency and the mechanical efficiency of the engine.

The Ramsey Engine Company does not purpose building engines, but will license manufacturers of internal-combustion engines to utilize this mechanism.

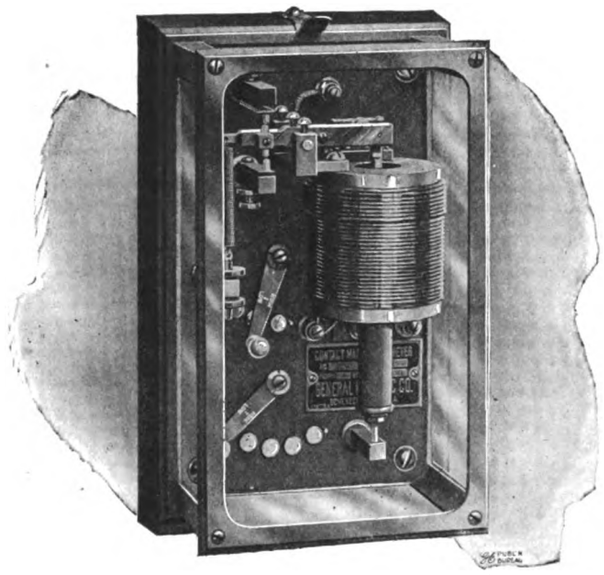
Digitized by Google

Automatic Feeder Regulators.

Proper voltage regulation of individual feeder circuits for both power and lighting is recognized as an important factor in the economical operation of a power plant. Such regulation may be controlled by the station attendants or automatic methods of regulation may be adopted. For automatic regulation of feeder circuits the General Electric Company, Schenectady, N. Y., manufactures two forms of voltage regulation which are of special interest, known respectively as type BR and type IR. The general principle of operation of both these forms of regulators is similar in that they are in effect variable ratio transformers or compensators having two separate windings. The primary or shunt winding is connected across the line, while the secondary or series winding is connected in series with the line to be controlled. While both forms of regulator boost or lower the voltage by changing the transformer ratio, the methods used in the two cases are quite different.

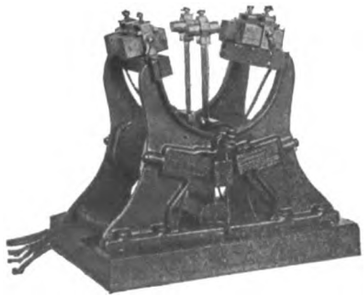


SWITCHING MECHANISM OF BR REGULATOR.



CONTACT-MAKING VOLTMETER.

In the BR type of regulator the windings are assembled on a shell-type core and taps are brought out from the secondary winding to stationary slip rings.

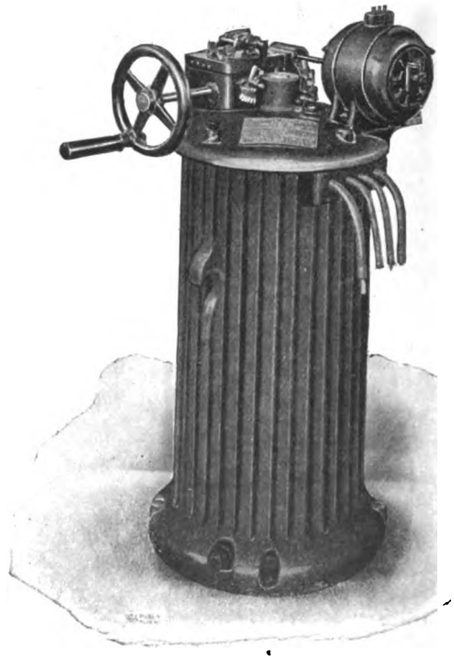


RELAY SWITCH.

The various combinations of turns producing the voltage change are made by the controlling mechanism of the regulator. In the IR type of regulator, on the other hand, the secondary and primary windings are assembled upon separate cylindrical and concentric sheet-iron cores. The series or secondary winding is arranged in slots on the inside circumference of the stationary outer core, and the shunt or primary winding is placed in similar slots on the outside circumference of the movable inner core. The change in the angular position of these cores varies the flux distribution and so produces the boost and lower in the voltage. The coils on both stationary and movable cores are in effect polar windings, and both are similarly wound. With a given pole of the primary opposite a given pole of the secondary, the regulator will boost the line voltage, while, if dissimilar poles are opposite, the voltage will be lowered.

The mechanical arrangements of the regulators are compact and simple. In the BR regulator, in which there is no moving core, the connection changes are made by a rotating switch. The moving member of this switch carries a series of fingers, each of which is connected to a corresponding stationary collector ring by means of a suitable brush, and the ring is connected to the line through a preventative resistance. This resistance allows a small exchange of current between the fingers, and thereby prevents any break in the circuit when passing from one step to another. The switch is operated on a vertical shaft by a bevel gear which in turn is driven by magnetic clutches on the horizontal shaft, the switch rotating in one direction or the other, depending upon which clutch is excited.

In the IR type of regulator the mechanical arrangement is exceedingly simple. The movable or primary core is mounted on a vertical shaft, the upper end of which carries a worm-gear segment, while the other end rests in a step-bearing. Both primary and secondary windings are brought out by means of flexible cables, with the exception of large regulators for rotary converters, which have the secondary arranged with bus-bar terminals. The entire arrangement is simple and substantial in construction, and, with the exception of the windings, is practically indestructible.

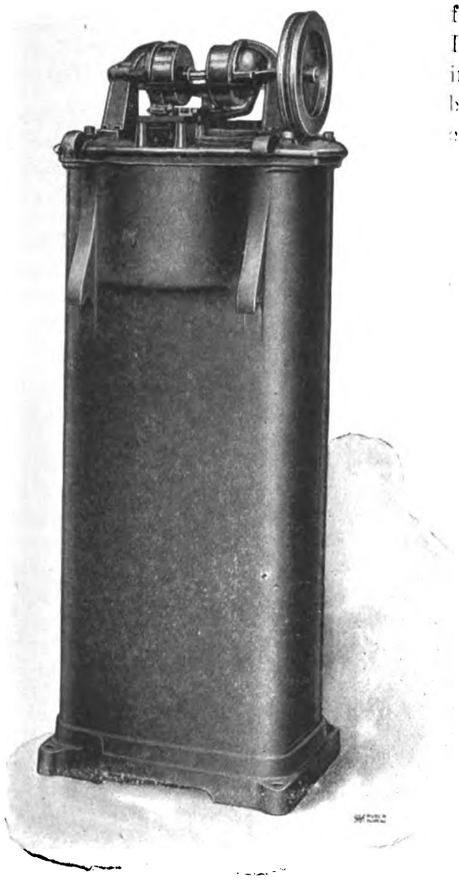


IR TYPE REGULATOR.

Both types of automatic regulators are operated by polyphase motors, but the method of control is different. In the

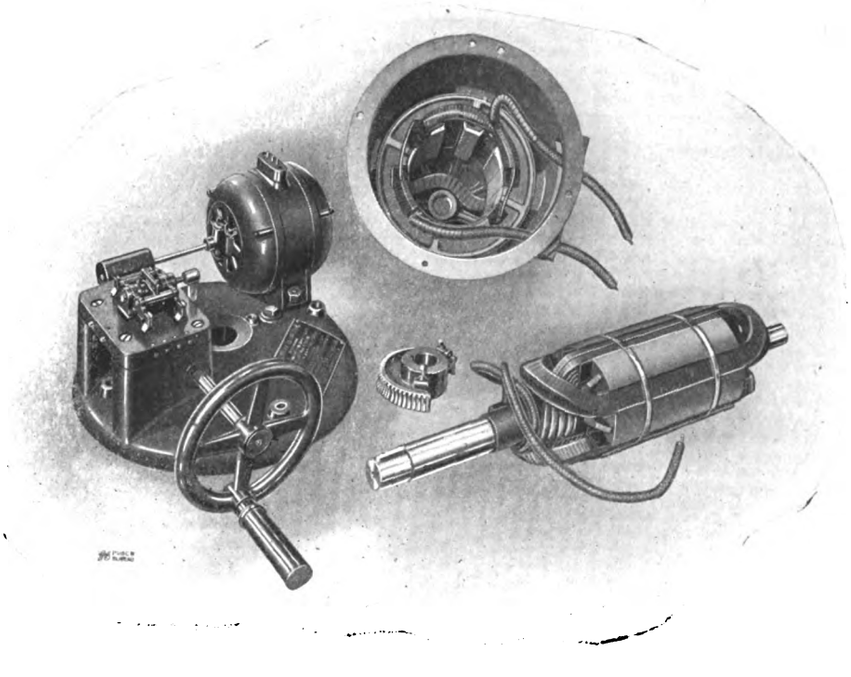
Digitized by Google

IR or movable core regulator the operation is as follows: across the potential transformer, in the feeder line, is placed a contact-making voltmeter, the regulator being in series with the line. As the line voltage rises or falls, the contact-making voltmeter responds, making contact on one of two points respectively. These contacts in turn close the circuits in a relay switch, which starts the polyphase motor. This relay switch operates the motor in either direction, according to the "boost" or "lower" position taken by the contact-making voltmeter. The motor then revolves, adjusting the main circuit voltage by changing the angular position of the cores as described, until the line voltage becomes normal. At that instant the contact-making voltmeter opens, in turn opening the relay switch and the motor circuit.



BR Type Regulator.

In the BR type of regulator, the contact-making voltmeter forms an essential part of the control, but the relay switch is omitted. In this type of machine the driving motor, which may be of any type, revolves continuously, but operates the revolving switch mechanism only when the magnetic clutches on the horizontal shaft are energized. A single motor may operate a number of regulators. The contact-making voltmeter, responding to the rise and fall of the line voltage as in the case of the IR regulator, sends a direct current through one or the other of the clutches. These clutches then rotate the switch by means of the mechanical arrangement of the bevel gear drive as explained. If it is desired to compensate for line drop and maintain a constant potential at some distant point on the feeder, it is only necessary to provide the relay with a compensated winding, connected in series with the line, or through a suitable current transformer. The compensated winding on the relay is arranged with two sets of dials, as shown, so that a very close adjustment can be obtained within the limits for which the device is designed. In the IR regulator, where there is considerable inertia in the moving parts, a magnetic brake operates when the motor circuit is opened, which prevents hunting, but this device is not required on the BR type, since the parts are light and stop when released by the clutches.



Parts of IR Regulator.

Each of these regulators has its individual application according to the operating conditions. The BR regulator is particularly designed for feeder circuits where the fluctuations in voltage are very rapid. Such conditions are imposed when both lamps and induction motors are operated on the same circuit. The rush of current taking place when a large induction motor is thrown on the line makes the lamps flicker unpleasantly unless a quick acting regulator is provided. The BR type of regulator meets these conditions and smooths out the fluctuating voltage curve, as it operates over its full range from lower to boost in six seconds. The IR type, on the other hand, is well adapted for lighting circuits where the load comes on more gradually and such quick regulation is not essential, as, for example, the regular lighting load at a power station which increases rapidly toward nightfall.

While both these types of regulators have very good efficiencies and power-factors, these are of relatively small importance. Take, for example, the IR type of regulator. Feeders seldom require a regulation exceeding twenty per cent, and a regulator having even as low a power-factor as eighty-five per cent does not have any appreciable effect on the line. Such a regulator would have a magnetizing current and a reactance exceeding twenty-five per cent, and assuming that the regulator is arranged for a ten per cent boost and lower, and that the power-factor on the line is 100 per cent, the effect of the regulator having this low power-factor and with full load on the line will only reduce the power-factor on the line 0.2 per cent; in other words, the power-factor would become 99.8 per cent. With a five per cent boost and lower regulation under the same conditions the line power-factor would be 99.9 per cent. It is therefore evident that the reactance in the regulator has a negligible effect on the power-factor of the system as a whole.

Both types of regulators are built in standard sizes for sixty cycles and 2,200

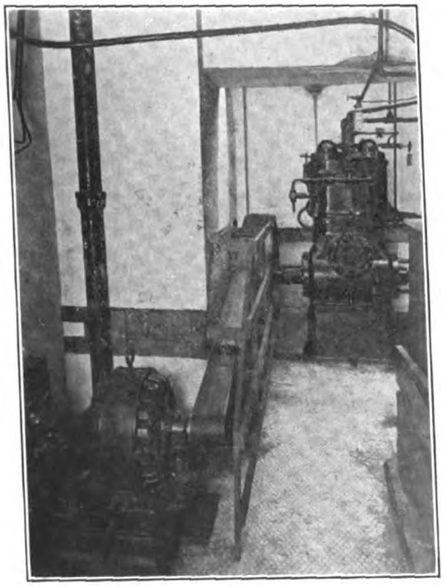
Digitized by Google

volts to boost and lower the voltage either five per cent or ten per cent above and below normal. The BR regulator is usually built in sizes from eleven to twenty-two kilowatts, while the IR types for single or polyphase circuits range in size from 5.5 kilowatts to forty-four kilowatts. Their capacity, however, is practically unlimited and has already been extended to 1,200 kilowatts. The General Electric Company is also prepared to furnish automatic regulators of the same general construction as the standard types but wound for special voltages or frequencies.

Electrically Operated Refrigerating Plant in the Gallatin Hotel, Uniontown, Pa.

Mechanical refrigeration employing electric motors as its source of power is covering a very broad field and has almost unlimited application in the preservation of food products and maintaining a low temperature in many industrial processes, as well as in domestic and household use.

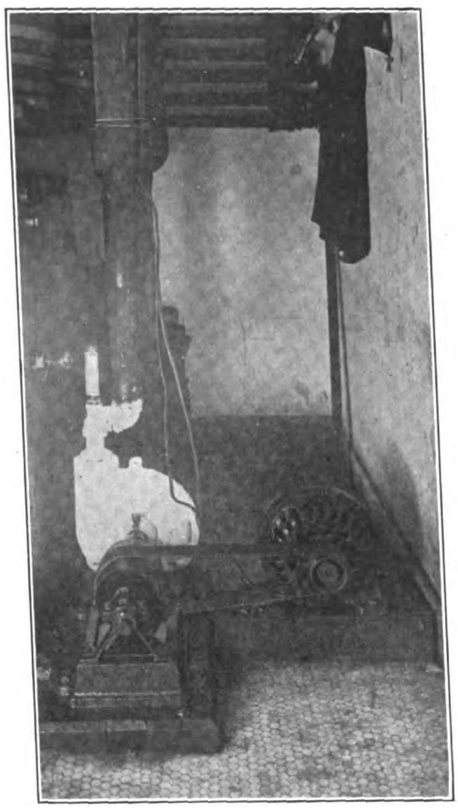
In some cases the adoption of mechanical refrigeration depends greatly upon the question of economy, and in others cost is sacrificed for cleanliness, convenience and easily controllable temperature. Refrigeration is not confined to the cooling of various products, however, but is largely used in furnishing cooler air in private and public buildings during the heated seasons of the year.



TEN-HORSE-POWER WESTINGHOUSE TYPE CCL INDUCTION MOTOR DRIVING AMMONIA PUMP.

The machines now used to produce a reduction in temperature are nearly all based on the principle of production of cold by the evaporation of liquid to the gaseous form; and of the many systems of ice-making and refrigerating in extensive use to-day, the ammonia compression system occupies a preeminent position. It consists of a complete cycle of operations, involving three successive steps—compression, condensation and expansion. These three steps are made continuous and are constantly repeated.

An illustration of the foregoing is found in the refrigerating plant in the Gallatin Hotel at Uniontown, Pa., views of which are given herewith.



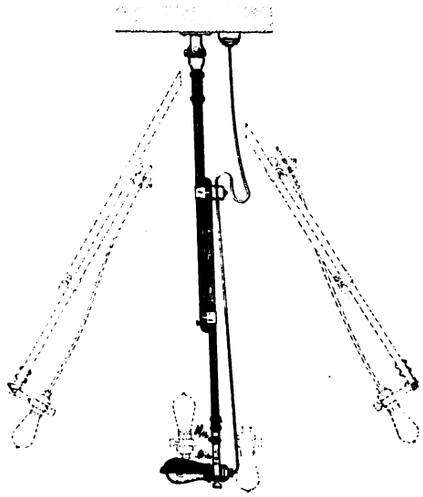
TWO-HORSE-POWER WESTINGHOUSE TYPE CCL INDUCTION MOTOR DRIVING BRINE PUMP.

The ammonia compressor, made by the Brunswick Refrigerating Company, is driven by a ten-horse-power Westinghouse type CCL motor. From the compressor the liquid ammonia is circulated in coils within the brine tank and returns in a gaseous form. The cool brine is used for the double purpose of making ice for table purposes and for cooling the beer cellar and ice-boxes. Ice-cans filled with fresh water are submerged in the brine tank, and the average output of ice is six tons per day.

A circulating pump driven by a Westinghouse two-horse-power, type CCL motor forces the brine to the beer cellar, which is nine feet by sixteen feet by seven and one-half feet, and is maintained at an average temperature of forty degrees Fahrenheit. Besides the beer cellar there are three ice-boxes, each five feet by six feet by seven feet, and one cook's box, four and one-half feet by five feet by seven feet. Two of the ice boxes are used for freezing purposes and are maintained at an average temperature of sixteen degrees Fahrenheit.

The "Universal" Electric Light Holder.

The Gail-Webb Manufacturing Company, 6-8 Lock street, Buffalo, N. Y., has placed upon the market a device for holding an electric lamp, designated as the "Universal" electric light holder. This device allows the light to be swung in a complete circle, raised and lowered at will, and twisted and turned to any conceivable angle. The holders for twelve-foot ceilings have a total length of nine feet, six inches. Their scope is any position within a circle of ten feet in diameter. They have four feet of longitudinal travel. The holder is flexible, having a universal joint at the top and bottom, with a sliding joint between. Automatic friction devices at all joints enable the lamp to be moved into any position and keep the lamp in that position. The slack in the cord is always out of the way. The accompanying illustration shows a few of the applications of this device.



DROP-LIGHT HOLDER.

Erratum.

The address of the DeLamar Copper Refining Company was given as Perth Amboy, N. J., on page 149 of the issue of the ELECTRICAL REVIEW for July 28. This should have been Chrome, N. J.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

SYRACUSE RAILWAYS USE NIAGARA POWER—On the afternoon of July 29 the cars on the Dudley, East Genesee, Grape and Butternut street lines in Syracuse, N. Y., were operated by means of power from the plant of the Niagara, Lockport & Ontario Power Company at Niagara Falls.

CHICAGO TELEPHONE COMPANY—The Chicago Telephone Company has put into effect reductions in charges and made other concessions in the way of improved service. Prices for measured service are reduced so as to make a much lower schedule for ordinary business telephones. Under the new schedule the company sells 600 calls per year for $60, a reduction of twenty-five per cent. For additional calls there is a graded charge of six, five, four and three cents.

MASSACHUSETTS POWER PLANT—The Light, Heat and Power Company, Boston, Mass., of which Arthur E. Childs is president and Addis M. Whitney is treasurer, has purchased the Royal Cheney farm of sixty-three acres at Still River, seven miles from Ayer, Mass., for the purpose of erecting a central power station to furnish light and power for the towns of Leominster, Clinton, Ayer, Harvard and Groton. The purpose of the company is to abolish the present local plants in the towns mentioned and to supply power and light from a central station. The company already controls the Leominster Gas Light Company.

SOUTHERN BELL INCREASES STOCK—The stockholders of the Southern Bell Telephone and Telegraph Company at a recent meeting in Richmond, Va., decided to increase the capital stock of the company from $2,500,000 to $3,000,000. The $500,000 of new stock is for the purpose of paying for new fireproof buildings in Richmond and Norfolk, underground cables and extensions and other improvements. Among the contemplated improvements is said to be the construction of a number of standard long-distance lines for the purpose of connecting Richmond with every town of importance in Virginia. It is expected that this work will be done within a year.

NEW ST. JOSEPH-KANSAS CITY AIR LINE—The St. Joseph & Southern Railway Company has been chartered at Jefferson City, Mo., by John Donovan, John D. Richardson, N. B. Biles, Edward C. Swift, James N. Burns, Henry Krug, Jr., J. C. Schneider and Jesse I. Roberts to build an air line between Kansas City and St. Joseph, Mo. John Donovan, head of the enterprise, is the western representative of the Swift interests in numerous projects, and is president of the St. Joseph Stock Yards Company. The capital stock of the new company is $500,000, and the term of incorporation, 200 years. Motor-cars are to be used on the road to take care of suburban and local passenger traffic.

SAYS CITY OWNERSHIP PAYS—The ninth annual report of the electrical department of the city of Chicago, Ill., gives figures which show apparently that the municipal ownership of street lights has been a financial success. City Electrician William Carroll figures that the cost of rented service since 1888 would aggregate the sum of $5,332,113, to which he adds interest at four per cent, making a total of $6,687,910. The city has expended $4,748,890 for construction and operation of the municipal plant, which, with the interest computed at four per cent, will give a total of $6,212,846. This, Mr. Carroll declares, shows an actual saving in cash to the city of $475,068. From this, however, he deducts $85,784 as lost taxes for the first thirteen years of operation, and an additional loss of $65,474 in taxes for the last five years, leaving a saving to the city of $323,805.

MEXICAN POWER FRANCHISE—A concession has been obtained by Messrs. Norcross & Taylor from the Mexican government to utilize 3,500 litres of water per second from the Salado river or from the Nogales lagoon, in the canton of Orizoba, state of Vera Cruz, for generating electricity. The concession carries authority to establish a transmission line or an underground distribution system and to construct all such hydraulic works and canals as may be necessary for the purpose. Surveys for the location of the works must be commenced within six months. The plans and profiles must be submitted within twelve months, and the construction of the works must be commenced within twenty-four months. The whole installation must be completed within seven years. The franchise includes the free importation of machinery and the construction of telephone and telegraph lines.

MICHIGAN STATE TELEPHONE—The Michigan State Telephone Company is threatened with more rivalry in Detroit. This is due to the formation of the Home Telephone Company, to be financed by the issuance of $3,000,000 six per cent bonds. The bonds have been sold through the Electric Construction Company to the Commonwealth Trust Company, of St. Louis. The promoters are largely St. Louis people with whom are associated the Brailey group of independent telephone promoters. The independent company has been engaged for several weeks in a house-to-house canvass to secure subscribers. Public sentiment, however, seems against a double telephone service, and the new company has obtained only a comparatively small number of subscribers. The Michigan State Telephone Company has nearly 20,000 subscribers' stations in that city alone, and has made arrangements to increase the capacity of the Detroit exchange to 60,000 subscribers' stations. It will spend in Detroit next year over $1,000,000.

WISCONSIN TELEPHONE COMPANY INCREASE—Out of a $10,000,000 increase in the capital stock of the Wisconsin Telephone Company decided on at a recent meeting of the directors of the company, approximately $250,000 will be expended in rebuilding the entire South side district in Milwaukee, and erecting the addition to the South side exchange that is now under way at Hanover and Washington streets. The improvements on the South side include a fine new switchboard to be installed as soon as the new building reaches the requisite stage of completion, and new poles and wires wherever needed, and in fact a general renewal of the whole district. Other improvements to be hurried to completion and paid for out of the $4,500,000 that will become available at once as a result of the action of the directors will be the completion of improvements at Waukesha now under way. A new switchboard is also to be installed at the Spring City. Improvement and extension work at Beloit, Janesville, Port Washington, Neenah, Kaukauna, Sturgeon Bay and many other important points in the state has also been decided on and outlined for prompt attention.

LOW LIGHTING BIDS—The city of Oneida, N. Y., after January 1, 1907, will be one of the cheapest lighted cities in the state. Bids were opened recently showing a considerable difference in the cost of this public utility. The specifications under which the bids were made call for ninety street lamps to burn until one o'clock and forty lights to burn all night. Seventy-five free incandescent lights for municipal buildings, etc., are also required. At present the city of Oneida is paying about $7,000 a year for lighting its streets, etc., or at the rate of about $70 for all-night lights and $55 for one-o'clock lights. The bid of the Empire State Power Company, of Amsterdam, which is low, shows a difference of about one-half in the total yearly cost. This company's bid for extra lights that may be required by the city is $25 for the one-o'clock lights and $37.50 for the all-night lights. The rate per light now paid is about double this figure. The Empire State Power Company is the company which has the contract for furnishing power for the West Shore trolley service, and if this company is awarded the contract the current for lighting Oneida will be switched from the West Shore at Oneida Castle. Under the terms of the contract to be awarded, the successful bidder must give heavy bonds to furnish a light satisfactory in every way to the board of public works.

Digitized by Google

ELECTRIC RAILWAYS.

OSKALOOSA, IOWA—The contract has been let to the Cooke Construction Company, of Minneapolis, to build the Oskaloosa & Buxton Interurban.

ATHENS, GA.—The Athens Electric Railway Company will increase its capital from $125,000 to $275,000, and make a number of extensive improvements.

BROCKPORT, N. Y.—At a meeting of the Brockport village board the franchise granting the Buffalo, Lockport & Rochester Railway Company a right of way through the village was signed.

PROVIDENCE, R. I.—The North Smithfield town council has granted a franchise to the Worcester & Providence Street Railway Company to construct and operate in the town an electric street railway.

SOUTH BEND, IND.—Arrangements have been made to begin work on the Chicago, Lake Shore & South Bend Railway, which will connect Michigan City, New Carlisle, Gary and Indiana Harbor, Ind., and Chicago.

TAYLOR, TEX.—J. A. Thompson, chairman of the executive committee of the proposed Taylor & Houston Railroad, has closed a contract with F. L. Dormant, of Houston, for a preliminary survey of the road.

CINCINNATI, OHIO—A movement has been started for the organization of a company to build an electric traction road from Rose Hill, in Avondale, north through Sharon, to Middletown and Franklin, a distance of about forty miles.

RAVENNA, OHIO—Thomas Childs, of Akron, is behind a plan to build an electric railroad from Ravenna to Garrettsville, a distance of twelve miles. Mr. Childs is the man who promoted the Canton-Akron line and the New Philadelphia line.

MAYSVILLE, KY.—At a meeting of the stockholders of the Maysville, Carlisle & Millersburg traction road it was decided to commence work immediately. Eastern capitalists will furnish the money. The cost of the road will amount to about $1,000,000.

IOWA CITY, IOWA—The people of Holbrook and vicinity are eager for the building of the proposed Iowa City, Montezuma & Des Moines Railway. They have agreed to subscribe $30,000 in cash and right of way for the six miles of territory in which they are particularly interested.

SEATTLE, WASH.—It is announced that the Portland & Seattle Railroad Company, a subsidiary corporation of the Northern Pacific and Great Northern roads which has acquired the old Union Pacific right of way, will operate the line between Seattle and Portland with electric power.

INDIANA, PA.—The Indiana town council has granted a franchise to the Indiana Street Railway Company for a right of way through Fifth and Sixth streets. This company was formed by the merging of the Indiana & Blairsville, Indiana, Clymer & Creekside and the Indiana Railways companies.

BARBERTON, OHIO—The name of the Barberton, Wadsworth & Western electric railway has been changed to the Akron, Wadsworth & Western. Work on the Wadsworth line is progressing rapidly, and the right of way has now been secured, so that the work can go on without interruption.

HARTFORD, CT.—The Consolidated Railway Company has decided to use the steam tracks of the Norwich & Worcester division for trolley purposes between Taftville and Central Village. Trolley wires will be strung over the tracks as far as Taftville, where the cars will be diverted to the Norwich trolley system.

NEW HAVEN, CT.—President C. S. Mellen, of the New York, New Haven & Hartford Railroad, has issued orders to electrify the line from Middletown to Berlin and from Middletown to Meriden, to be operated as a trolley. The construction department of the company is already preparing material for the work.

MANITOWOC, WIS.—Actual work on the new Fox river electric line from Manitowoc to Sheboygan has been started at Cleveland station, and officers of the road state that it will be finished by March 1, 1907. The line is twenty-five miles long, and is the connecting link between Manitowoc and Milwaukee. The company will carry both passengers and freight and will operate on a one-hour schedule.

LIMA, OHIO—A special meeting of the Western Ohio railway stockholders will be held at the company's office in Lima on August 15 to vote on a proposition for increasing the capital stock of the company from its present figure, $3,000,000, to $3,400,000. The increase of $400,000 is to be six per cent cumulative preferred stock.

NORRISTOWN, PA.—The Montgomery Rapid Transit Company has awarded contracts for the building of its twenty miles of new line between Souderton and Trappe as follows: grading, to Walter Derr, Norristown; masonry for bridges, to James M. Smith, Schwenksville; steel superstructure for bridges, to the Pennsylvania Steel Company.

OLEAN, N. Y.—The Rock City Railroad Company, of Olean, a reorganization of the Olean, Rock City & Bradford Railroad Company, running between Olean, N. Y., and Bradford, Pa., a distance of twenty miles, has been incorporated with a capital of $100,000. Among the directors are Charles V. Nellany, Oscar F. Corgi and Albert M. Hartung, of Buffalo.

DES MOINES, IOWA—The Des Moines City Railway Company is preparing to build a new central power-house to cost $200,000. It will be run in addition to the present plant, and the current will be used for power on a number of proposed city extensions and interurban lines, as well as for supplying additional power needed for operating the present mileage.

DAYTON, OHIO—An important franchise has been granted to the Cincinnati, Dayton & Toledo Traction Company, a Schoepf syndicate line, by which the company will build double tracks north and south of Dayton on the Salem and Cincinnati pikes, respectively. It is proposed also to extend the service, and, according to plans, a new line will be built from Dayton View to Oakwood, the northern and southern suburbs.

ST. PAUL, MINN.—With the avowed purpose of constructing an electric line from Anoka to Minneapolis *via* Osseo and Robbinsdale, A. B. Robbins, of Minneapolis, has applied to the city council of Anoka for a franchise to use the streets of that city for tracks, poles and wires and for such concessions as the city may be willing to grant his company. Mr. Robbins is president of the North Minneapolis Street Railway Company.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company has begun the operation of the new Canarsie line, connecting Canarsie with Williamsburg, a distance of about six miles. From Broadway ferries to East New York the trains run on the elevated structure and thence on the surface. Ten-minute headway between trains is maintained in the day and half an hour at night. The running time between the two points is thirty-five minutes.

KALAMAZOO, MICH.—A franchise has been granted to the Kalamazoo, Gull Lake & Northern Electric Railroad by the Kalamazoo city council. The road is to extend to Grand Rapids *via* Gull Lake and the Barry county lake district and to Battle Creek. The franchise provides for an interurban loop around the business section of the city, to be used in common by all interurban roads, and also provides for remuneration to the city of one-half cent per passenger,

CLEVELAND, OHIO—The Municipal Traction Company has perfected its organization and taken over the property of the Forest City Railway Company. A. B. Du Pont was elected president of the Municipal Traction Company; Frederic C. Howe, vice-president; W. B. Colver, secretary, and Edward Wiebenson, treasurer. **Mr. Du Pont was selected as the general manager and F. C. Alber, who was general manager of the Forest City Company, was made his assistant.**

YOUNGSTOWN, PA.—J. G. White & Company, of New York, have been engaged as engineers for the electrification of the steam railroad between Youngstown and Columbiana, Ohio. This road was built by the White company several years ago. The Youngstown & Southern, as the road has recently been named, is now engaged in extending this line to Leetonia, and this extension will be electrified by the White company. The contract covers the necessary rolling

Digitized by Google

stock, transmission, substations, etc. This line will provide through electric service from East Liverpool to Youngstown and from Canton, Akron, Alliance and Salem to Youngstown. J. G. White & Company will actively push this work, and expect to have it completed this summer.

RUTLAND, VT.—The interests who purchased the Rutland Railway and Gas Company and the Chittendon Power Company, and who consolidated these companies into the Rutland Railway and Power Company, have purchased the Rutland City Electric Company, which is also to be included in the consolidation. Tracy Rogers has been elected president, and Leo H. Wise, vice-president, of the electric light company. This consolidation will now include all the public service corporations of Rutland.

BUCYRUS, OHIO—Work has been begun on the Bucyrus, Marion & Columbus Electric Railway, which will connect Bucyrus with Marion, and will operate with and over the Columbus, Delaware & Marion line from Marion to Columbus. The Bucyrus-Marion line is virtually an extension of the line already in operation from Columbus to Marion. From Bucyrus the line will make connection for Toledo with the Toledo & Columbus Railway Company, and for Cleveland with the Bucyrus, New Washington & Plymouth line.

AVON, N. Y.—The work of electrifying the Mount Morris branch of the Erie Railroad has been commenced, with Avon as the distributing point. Several carloads of materials have arrived and surveyors are at work driving stakes where the poles to support the wires will be erected. An extra gravel-train crew has been put on for the purpose of reballasting the roadbed between Avon and Mount Morris, and the work is well under way. The Erie officials claim that they will have electric cars running on an hour schedule by October 1.

SPOKANE, WASH.—Articles of incorporation have been filed by the West Coast Traction Company. The capital stock is to be $750,000, and the incorporators are: C. H. Weeks, of Spokane; B. J. Weeks, of Tacoma; D. D. Leverson, of London, England; Cyrus Bradley, of Spokane; J. W. Reynolds, of Chehalis; F. B. Hubbard, of Centralia, and W. W. Cannon, of Centralia. The company is formed for the purpose of constructing and operating steam and electric railway lines in Chehalis and Centralia, with a line running to Olympia.

ALLENTOWN, PA.—In connection with its new system of transmitting power from the power station on Front street, the Lehigh Valley Transit Company will erect eight substations. The power plant is expected to be put in use by the middle of September. The substations will be put up at Schnecksville, Slatington, Catasauqua, Hecktown, Coopersburg, Sellersville, Lansdale and Ambler. The contract for four has been let. G. H. Hardner will erect those at Coopersburg and Hecktown and M. T. J. Ochs those at Catasauqua and Schnecksville.

HANOVER, PA.—Announcement has been made that a trolley line will soon be built from York to Gettysburg *via* Hanover. The local line will be continued from the McSherrytown terminus through Edge Grove, Centennial and Bonneauville to Gettysburg. When the line is completed to Gettysburg and the recently surveyed line from York to Hanover is finished there will be a continuous roadway from Philadelphia to Gettysburg. The distance of 150 miles will have only one break, that being at the Susquehanna river, where a ferry will be used.

EASTON, PA.—A mortgage for $500,000 given by the Easton & South Bethlehem Transit Company to the Girard Trust Company, of Philadelphia, to secure bonds, has been filed in Northampton county. The new trolley company is controlled by the capitalists who own the Easton Transit Company, and will be operated in conjunction with the latter's lines in this section. The new route is by way of Freemansburg, and will pass through the territory on which the Bethlehem Steel Company will erect its new buildings and establish its additional plants.

PHILADELPHIA, PA.—Articles of consolidation have been filed at the state department in Harrisburg between the Philadelphia, Morton & Swarthmore Street Railway Company and the Media, Middletown, Aston & Chester Street Railway Company, to be known as the Darby, Media & Chester Street Railway Company. The capital is $600,000. These two companies recently leased their properties to the Philadelphia Rapid Transit Company for a period of 999 years. The rapid transit company is operating the lines in connection with its Darby division.

DETROIT, MICH.—The American Trackless Trolley Company, of Boston, will make application, it is said, to the council at an early date for a thirty-year franchise on a three-cent-fare basis. The company will propose using practically the same route as that specified in the pending People's Railway Company's franchise. The Detroit United Railway is said also to be about to apply for permission to extend its tracks under its present franchises, embodying six-for-a-quarter tickets on all five-cent lines, universal transfers, and an extension of the workingmen's ticket time.

CUMBERLAND, MD.—The Pennsylvania & Maryland Street Railway Company has been granted a charter to construct and operate a line thirty miles long through the Meyersdale region. The capital stock is $200,000 and the road is to run from Somerset to the following places: Berlin, Brothers Valley, Garrett, Meyersdale, Salisbury, Jennings and Frostburg. The officers and directors are C. H. Jennings, Garrett county, president; George W. Kipp, Congressman M. E. Lilly, Towanda, Pa.; D. H. Clark, Punxsutawney, Pa.; H. H. Maust, John N. Wright and J. L. Barchus, Elk Lick.

CHESTER, PA.—A notice has been issued calling for a special meeting of the stockholders of the Darby, Media & Chester Street Railroad Company, to be held at the offices at Folsom, on September 10, 1906. The above name is that adopted at a recent meeting of the Philadelphia, Morton & Swarthmore and Media, Middletown, Aston & Chester Electric Railway companies, called for the purpose of combining the two chartered companies. The stockholders at the coming September meeting will be called upon to decide the question of increasing the capital stock of the concern from $850,000 to $1,500,000.

EUGENE, ORE.—The Eugene city council at a meeting passed an ordinance granting to the Willamette Valley company a franchise for the construction of an electric street railway in Eugene. The franchise has a life of thirty years, and provides that construction work shall begin within six months from the time the franchise is accepted. The company is to build an electric line from Eugene to Springfield, to be completed within eighteen months. A bond of $500 is required, and after the city's population reaches 15,000 one per cent of the gross earnings of the system within the city limits shall be paid to it.

DOLGEVILLE, N. Y.—A trolley franchise was granted to the Little Falls & Canada Lakes Railway Company at a meeting of the Dolgeville village board. The franchise is for ninety-nine years, and after the first ten years the company will be required to pay three per cent of its gross earnings to the village. A bond of $5,000 will be posted to insure a faithful observance of the provisions of the franchise. It is stated in the franchise that work on the road must be started by June 1, 1907, that half the trackage here must be down by December 1 of the same year, and that cars between Dolgeville and Little Falls must run at least once every two hours by July 1, 1908.

CLEVELAND, OHIO—The bondholders' committee of the Springfield & Xenia Traction Company held a meeting recently and decided upon plans for the reorganizing of the company. The committee is composed of J. M. Hutton, of Cincinnati, W. H. Lamprecht and W. S. Hayden, of Cleveland. The following statement concerning the plans decided upon was issued after the meeting: "It is proposed to make a reorganization, effective about October 1, 1906, in accordance with a plan such that the new company will issue $300,000 five per cent preferred stock and $300,000 common stock; the preferred stock to be convertible par for par in first mortgage fives if and when the net earnings of the property reach $20,000 per annum. All of the new securities will be distributed pro rata among the holders of the certificates of deposit which were given for Springfield & Xenia Traction Company bonds. Certain claims against the original company are yet to be disposed of and the carrying out of the committee's plans is more or less dependent upon the results of negotiation with the holders of the claims referred to."

Digitized by Google

TELEPHONE AND TELEGRAPH.

NEW MARKET, IOWA—The Farmers' Mutual Telephone Company has placed in operation a new switchboard.

SKIATOOK, I. T.—A new telephone exchange is being installed at Skiatook under the management of T. F. McVay.

HARTFORD, CT.—The Southern New England Telephone Company will lay 75,000 feet of duct in Hartford during the current season.

CHICAGO, ILL.—The telegraph lines of the Rock Island-St. Louis & San Francisco system are being reconstructed at a cost of $500,000.

ALBANY, N. Y.—A certificate filed at the secretary of state's office certifies the merger of the Elba Telephone Company with the Bell Telephone Company, of Buffalo.

MONTREAL, QUEBEC—The Canadian Pacific Railway Company has authorized the construction of 7,000 miles of new telegraph lines, a large part of which will use heavy copper wire.

RUTLAND, VT.—The New England Telephone and Telegraph Company has leased a suite of rooms in the Mead Building, now being erected, and will install a new $28,000 switchboard.

KENNET, CAL.—The private telephone line owned by the Golinsky company, and operating eight miles of line between Kennet and the Balakala mine, is to have a four-mile branch to the town of Coram.

CLEVELAND, OHIO—The Cuyahoga Telephone Company will erect a new exchange building at Collinwood. The plans have been prepared by Architects Searles, Hirsh & Gavin, and the general contract has been awarded to the Samuel Austin & Son Company.

HOWARD, KAS.—It is announced that J. H. Close has sold his telephone system in Howard and at Severy, and his toll line between the two towns, to the O. B. Walker Telephone Company, of Howard, which has recently built a new plant and which is at work on one at Severy.

HADDONFIELD, N. J.—John T. Windrim, architect, has awarded a contract to J. S. Cornell & Son for the erection of a new telephone exchange at Haddonfield for the Bell Telephone Company. The building will be two stories high, and will measure twenty-eight by forty-two feet. The cost will be $40,000.

SYRACUSE, N. Y.—The Central New York Telephone and Telegraph Company has awarded to D. C. Weeks & Son, of New York, the contract for its new building in Montgomery street adjoining its present building. It will have a frontage of thirty-three feet and a depth of 125 feet, and will be five stories high.

SALT LAKE CITY, UTAH—The Rocky Mountain Bell Telephone Company has completed the construction of its line from Twin Falls, Ida., to Filer and Buhl, a distance of twenty miles. This line within a year will be carried on through to Boise, giving the company a much shorter route from the Idaho capital to southern points.

WOONSOCKET, R. I.—The Providence Telephone Company is planning to put the greater portion of its wires in the second ward of Woonsocket under ground, and has also obtained telephone rights and installed additional instruments in Blackstone, Millville and East Blackstone, including these sections within the limits of the local exchange.

EAU CLAIRE, WIS.—The Wisconsin Telephone Company is to expend between $50,000 and $60,000 in Eau Claire during the period of three or four months in improvement—consisting of cable and additional central office facilities. The plans and specifications have been completed, and the work will begin as soon as the necessary material to start it arrives.

SYRACUSE, N. Y.—A certificate filed with the secretary of state at Albany shows a merger of the Central New York Telephone and Telegraph Company, the St. Lawrence Telephone Company, the Oneonta Telephone Company, the Milford Telephone Company and the Madrid Telephone Company, under the title of the Central New York Telephone and Telegraph Company.

ANGLETON, TEX.—The Southwestern Telegraph and Telephone Company has begun work putting in a telephone exchange at Angleton. An entirely new long-distance line is being built from Houston down the Columbia Tap Railroad to Columbia and thence to Brazoria, with a branch line from Anchor Junction through Angleton to Velasco. With the new long-distance line and the local exchange in Angleton the telephone service will be greatly improved.

RACINE, WIS.—It is announced that the Union Grove Telephone Company has been reorganized and incorporated with a capital stock of $5,000. The system is to connect with adjacent towns, covering fifteen miles north and south and six miles east and west. Further announcement has been made that a deal has been closed with the Wisconsin Telephone Company to connect the Union Grove and farmers' lines with the Wisconsin Telephone Company's wires, thus giving them long-distance service.

CANANDAIGUA, N. Y.—The Seneca-Gorham Independent Telephone Company at its annual meeting elected the following directors: Thomas B. Wilson, of Halls; William Pulver, of Gorham; A. D. Allen, of Gorham; Duncan S. Allen, of Seneca; Edwin E. Hall, of Stanley; Rice Macauley, of Stanley; John A. Driscoll, of Rochester. Mr. Driscoll was elected president for the third term. Duncan S. Allen, vice-president; Rice Macauley, secretary and general manager; William Pulver, treasurer. The executive committee is composed of Messrs. Wilson, A. D. Allen and E. E. Hall. The treasurer's report showed a prosperous year.

PERSONAL MENTION.

MR. J. P. GILBERT, of Niles, Ohio, who is prominently known in connection with the incandescent lamp industry, is spending the summer with his family at Hull, Mass.

MR. C. O. BAKER, who now has charge of the sale of the Sawyer-Man incandescent lamp manufactured by the Westinghouse Electric and Manufacturing Company in Ohio and the Middle States, has his offices in the New England Building, Cleveland.

MR. HENRY A. CLEVERLY, for years associated with the Cleverly Electric Company, at Philadelphia, Pa., and lately with the Baldwin Locomotive Works, of the same city, has suffered a sad bereavement in the loss of his wife, Sarah Irene, daughter of James C. and Sarah (Holbrook) Gardener, on June 23. Mr. and Mrs. Cleverly were married July 25, 1871.

MR. JOHN A. BUGGY, who for several years has been chief engineer of the plant of the Delaware County Line and the Citizens' Electric Heat, Light and Power Company, Chester, Pa., the interests of which have been purchased by the Philadelphia Suburban Electric Company, has been appointed superintendent of the Delaware County Line, to succeed Arthur G. Jack, who will take charge of the Chester traction lines.

NEW PUBLICATIONS.

REPORT OF THE COMMISSIONER OF EDUCATION—Vol. I of the report of the commissioner of education, Washington, D. C., for the year ending July 30, 1904, is being distributed. This volume is replete with interesting and instructive literature concerning this important branch of the work of the Department of the Interior.

THE MURGAS SYSTEM OF RAPID WIRELESS TELEGRAPHY—The Universal Aether Telegraph Company, Philadelphia, Pa., has published a descriptive treatise relating to the Murgas system of rapid wireless telegraphy, invented and perfected by Joseph Murgas, Wilkesbarre, Pa. The system is carefully described and the text is illustrated by a series of fine half-tones.

WASTE OF WATER IN NEW YORK AND ITS REDUCTION BY METERS AND INSPECTION—The Merchants' Association of New York has issued a valuable volume including a report by James H. Fuertes, C. E., to the committee on water supply of the Merchants' Association, on "Waste of Water in New York and its Reduction by Meters and Inspection." There is also a digest of laws governing the use of water meters in New York by Alfred L. Marilley, and a summary of present conditions relating to the water supply of New York, by J. Hampden Dougherty.

Digitized by Google

NEW INCORPORATIONS.

ALBANY, N. Y.—Elmira & Seneca Lake Traction Company. $200,000.

LOCKPORT, N. Y.—The Undercurrent Traction Company, of Lockport. $100,000.

DOVER, DEL.—Chester Electric Company. To deal in electricity for heating, lighting, etc. $300,000.

DENVER, COL.—The Iri County Electric Company. $50,000. Incorporators: William C. Barker, William F. Crossley, L. C. Duncan.

NEWARK, N. J.—Newark Block Lighting Company. $100,000. Incorporators: James M. Seymour, Jr., David Seymour and Thomas Thompson.

TRENTON, N. J.—The Stover Telephone Company, Frenchtown. $10,000. Incorporators; John J, Stover, Carrie C. Stover, Matilda C. Stover, Samuel Eddy, Josiah C. Butler.

COLUMBUS, OHIO—Ruggles Telephone Company, Ruggles. $2,000. Incorporators: F. A. Hamilton, H. H. Sutherland, Byron J. Ferris, W. C. Sturtevant and O. A. Quinn.

ALBANY, N. Y.—Berkshire Home Telephone Company, Berkshire. To operate in Tioga and Cortland counties. $5,000. Directors: C. Royce, G. Brown and E. F. Lynch, of Berkshire.

ALBANY, N. Y.—The Cross Island Traction Company. To operate forty-two miles of road, Brookhaven to West Sayville. $500,000. Directors: William M. Moyer, Leroy Baldwin and Paul T. Brady.

PORTLAND, ME.—Buxton & Hollis Power Company. To carry on the business of manufacturing, selling and supplying electricity for light, heat and power in the towns of Buxton, Hollis, Limington and Standish. $1,000.

SAN FRANCISCO, CAL.—Coast County Light and Power Company. $1,500,000. Incorporators: Leo H. Susman, Henry Molloch, L. W. Prior, Walter T. McLean, Henry Bostwick, William B. Bosley and Raymond A. Morton.

HARRISBURG, PA.—Wheatland Street Railway Company, of Wheatland, Mercer county; to build a line one mile long through the streets of Wheatland; $6,000. Greensburg & Latrobe Street Railway Company; to construct a line ten miles long from Latrobe to Greensburg; $60,000.

CHICAGO, ILL.—Effingham & Olney Interurban Railroad. To be constructed from Effingham southeasterly through counties of Clay and Richmond to Olney. Principal office at Eberle, Ill. $2,500. Incorporators and first board of directors: R. S. Wishard, D. Wishard, G. M. Merry, Henry Richards, of Eberle, Ill., and Theron Gould, of Bible Grove, Ill.

SPRINGFIELD, ILL.—Carthage & Western Illinois Electric Railway Company, with principal office located at Chicago. To construct a line from Carthage, Hancock county, to points in the counties of Fulton, Cass and Adams. $2,500. Incorporators and first board of directors: W. M. R. Vose and F. P. Vose, both of Evanston; C. C. Breuer, Ralph A. Griffen and George A. Griffen, all of Chicago.

ELECTRICAL SECURITIES.

The first three days of August realized each a "million share day" in comparison to only two such days for the whole month of July. Sentiment continues bullishly inclined, and under the impetus given the market by the declaration of the dividend in United States Steel common the market advanced rather solidly, practically all of the leading stocks making rallies of from five to twenty points. An encouraging feature has been the publication of a large number of very favorable railroad earnings. One compilation of the reports so far made for the recently ended fiscal year shows a total gross increase of 11.68 per cent, while net increased 24.30 per cent. For the first six months this year the Pennsylvania Railroad system reported a gross gain of $13,521,000, while net increased $6,381,000. The Illinois Central's fiscal year showed a gross increase of $2,127,000, and net increased $801,000. Atchison in the fiscal year made a gross gain of $9,688,000, while net increased $6,564,000. The combined Rock Island-'Frisco system for the fiscal year made a gross increase of $10,799,000, and net increased $4,574,000. Southern Railway for the same period made a gross gain of $5,496,000, and in net of $805,000, and Canadian Pacific made a net gain of $7,498,000.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 4.

New York:	*Closing.*
Allis-Chalmers common	17½
Allis-Chalmers preferred	49
Brooklyn Rapid Transit	80⅜
Consolidated Gas	137⅛
General Electric	168½
Interborough-Metropolitan common	38¼
Interborough-Metropolitan preferred	77½
Kings County Electric	160
Mackay Companies (Postal Telegraph and Cables) common	74½
Mackay Companies (Postal Telegraph and Cables) preferred	72¾
Manhattan Elevated	147⅜
Metropolitan Street Railway	107½
New York & New Jersey Telephone	127½
Western Union	91⅝
Westinghouse Manufacturing Company	151

The rapid advance in Brooklyn Rapid Transit has attracted considerable attention, and if the report is true that a considerable effort has been made to bear the stock the shorts must have suffered financially. Notwithstanding the fact that approximately four out of every five days during July witnessed rain, earnings of the Brooklyn Rapid Transit system increased on an average $2,000 per day, or about $60,000 for the month. This increase in traffic through the borough of Brooklyn in July was above a $250,000 gain made in July, 1905, and evidences greater general traveling.

Boston:	*Closing.*
American Telephone and Telegraph	133½
Edison Electric Illuminating	235
Massachusetts Electric	69½
New England Telephone	131¾
Western Telephone and Telegraph preferred	90

Massachusetts Electric and Western Telephone made substantial gains with the other stocks irregular.

Philadelphia:	*Closing.*
Electric Company of America	11⅛
Electric Storage Battery common	70
Electric Storage Battery preferred	70
Philadelphia Electric	7 15-16
Philadelphia Rapid Transit	30¼
United Gas Improvement	84½

The gross earnings of the Philadelphia Rapid Transit Company for July will show an increase over last year of approximately $80,000. The last few days are estimated, but the amount mentioned is a director's view. The earnings for the year will show an increase in gross of close to $1,250,000. United Gas Improvement was in the eyes of the speculator, considerable movement taking place. The stock was off several points during the week, but closed with a net gain of one-half point.

Chicago:	*Closing.*
Chicago Telephone	126
Chicago Edison Light	135
Metropolitan Elevated preferred	66½
National Carbon common	81¾
National Carbon preferred	120
Union Traction common	4
Union Traction preferred	14

The Metropolitan Elevated carried 123,370 passengers daily during July, an increase of 9,792 per day.

South Side Elevated stockholders are asking $120 for their stock in the new holding company's first preferred 5 per cent stock. One hundred and fifteen has been bid.

Negotiations to complete the merger with Metropolitan Elevated left out are expected to be resumed next week.

Digitized by Google

ELECTRIC LIGHTING.

MARQUETTE, MICH.—A second municipal electric plant is to be erected at a cost of $60,000.

McEWEN, TENN.—L. D. Baker will at once commence the erection of an electric light plant for McEwen.

FREDONIA, N. Y.—At a special election the taxpayers voted to expend $12,000 to extend the electric lighting plant.

PULASKI, N. Y.—The Pulaski Electric Light and Power Company's dam in the Salmon river at Pulaski has been rebuilt.

MANITOU, COL.—Colorado Springs capital this summer will erect a 300,000-horse-power electric power plant. at Manitou.

HUMBOLDT, KAN.—An electric lighting franchise has been granted to V. G. Shinkle. The plant will be installed at once.

NORTH ATTLEBORO, MASS.—North Attleboro's municipal electric light system is to be enlarged at an expense of $35,000.

PAW PAW, MICH.—Paw Paw has voted to issue bonds to the amount of $50,000 for improving the electric light and water plants.

LEHIGH, I. T.—The Twin City Electric Light Company has placed its plant in operation and is now lighting the streets of Lehigh.

EMINENCE, KY.—The Eminence electric light plant has been sold at auction, under order of the circuit court, to T. D. Cole. The price was $4,000.

LANSING, MICH.—Receipts of the Lansing municipal water and electric light system above operating expenses for the past fiscal year were $51,869.

EL RENO, OKLA.—The El Reno Electric Light and Power Company will expend from $30,000 to $40,000 in extending its service to all parts of the city.

LE ROY, N. Y.—The Le Roy board of aldermen has granted the Genesee County Electric Light, Power and Gas Company a permit to extend its line into Le Roy.

LITTLE FALLS, N. Y.—At a meeting of the Little Falls common council the Hudson River Electric Power Company was granted a franchise by a unanimous vote.

OTTAWA, KAN.—Contracts have been closed by the city of Ottawa for the remodeling and renewing of the water and light plants. The amount of the contracts is $48,931.

YOUNGSTOWN, OHIO—The Youngstown Consolidated Gas and Electric Company has secured a building permit for the erection of a $10,000 power plant adjoining its present plant.

KINGWOOD, W. VA.—The electric lighting plant of Kingwood was recently destroyed by fire. The citizens will vote on a proposition to bond the town for the establishment of a new plant.

WATERFORD, N. Y.—Waterford has signed a contract with the Beacon Electric Company for furnishing forty or more arc lights to the village at $94.90 per light per year for a term of five years.

CUMBERLAND, MD.—The Edison Electric Illuminating Company is remodeling and improving its plant, installing additional machinery so as to increase the capacity of the plant to 1,000 kilowatts.

ERIE, PA.—The Union City borough council has accepted the bid of the Union City Electric Light Company, to light the streets of the borough for a term of five years at practically the old contract price.

IDAHO FALLS, IDA.—By a vote of four to one the taxpayers of Idaho Falls decided to issue bonds to the amount of $47,000 for the purpose of building a municipal electric light plant and a city water plant.

FREMONT, OHIO—The Logan Gas Company, operating the Fremont Electric Light Company, and owning the street-lighting franchise, has sold the lighting plant to the Fremont Yarian Company for $35,000.

MEMPHIS, TENN.—Work has been commenced on the powerhouse of the Electric Light and Power Company, financed by the Laclede Gas Light Company, of St. Louis. The new company is capitalized at $1,000,000.

BOSTON, MASS.—A reduction in its charges for electricity to non-contract customers of from eight to seventeen and one-half per cent, according to the hours of burning, is announced by the Edison Electric Illuminating Company.

KENOSHA, WIS.—The city of Kenosha is having plans prepared by the Milwaukee Engineering Company for a municipal lighting plant of 300 to 400 arc light capacity, to be installed before the present contract for lighting the streets expires.

GRAND FORKS, N. D.—Ed Nealy, of Red Lake Falls, Minn., who recently secured the franchise for supplying light and power at Grand Forks and East Grand Forks, states that work will begin at once. There is a dam at Red Lake Falls with an eighteen-foot head.

MORGAN CITY, LA.—B. M. Young and Hugh Young have purchased the electric plant of the Morgan City Improvement Company. They have ordered a new and large first-class plant, complete in every respect, and expect to place it in operation in about four months.

HARRISON, N. J.—Plans are being prepared by the Public Service Corporation for a large electric light and power plant on the site of the old gas works on Passaic avenue, East Newark. The new station is needed to supply the increasing demand for current in West Hudson.

BRIGHTON, COL.—The Northern Colorado Power Company has been granted a franchise to operate an electric plant in Brighton for a period of twenty-five years. This is the initial step in the plans of the company to furnish all towns in northern Colorado with light and power.

GLEASON, TENN.—The stockholders of the Gleason Water and Light Company have elected officers as follows: W. B. Bynum, president; W. H. Williams, general manager, and J. C. Ammons, secretary and treasurer. The general manager was instructed to place an order for the machinery at once.

CANTON, OHIO—Announcement is made by Attorney Thomas F. Turner, president of the Merchants' Heat, Light and Power Company, that a deal has been practically closed by which a large interest in that corporation is to be acquired by capitalists interested in the Stark Electric Railway Company.

ORRVILLE, OHIO—Orrville is to have an all-night electric service in the future. The Orrville Light, Heat and Power Company, J. A. Wagner, of New Philadelphia, chief owner, has been granted a five-year renewal of franchise. The lights are to cost $58 per annum, and new arc lamps will be installed.

PHILADELPHIA, PA.—The electric lighting plants of Manheim and Mount Joy, two towns of 4,000 or 5,000 each, near Lancaster, Pa., have been purchased by C. T. Leland and H. V. H. Stoever, at sheriff's sale for $25,000. They are subject to $43,000 bonds. The companies will be reorganized and the plants improved.

EAST HAMPTON, N. Y.—Stockholders of the East Hampton Electric Light Company have elected directors as follows: Henry A. James, president; George E. Munroe, vice-president; Joseph S. Osborne, secretary and treasurer; Everett Herrick, C. L. W. Eidlitz, S. Minot Jones, B. H. Van Scoy and George A. Eldredge.

LOCKPORT, N. Y.—The town board of the town of Lockport has granted the Economy Light, Fuel and Power Company and the International Power and Transmission Company permission to construct, maintain and operate necessary poles, wires, cables, conduits and other appliances for a transmission line through the town.

PULASKI, N. Y.—The Pulaski board of village trustees has signed a five-year contract with the Pulaski Electric Light and Power Company, whereby the latter will light the streets of the village, providing not less than 121 incandescent lamps, and keep the same burning until 1 A. M., for a sum not exceeding 1,200 per year.

Digitized by Google

DANSVILLE, N. Y.—The Dansville Gas and Electric Light plant has been purchased by A. B. Beadle, of New York city; W. W. Levering, of Philadelphia, and M. A. Maxwell, of Easton, Pa., and they have taken possession. They purpose expending from $20,000 to $25,000 improving the property and installing new engines and dynamos.

ANNISTON, ALA.—The Coosa River Electric Power Company has closed a deal for the purchase of the Gray lands, which cover over a half-mile of water front on the east bank of the Coosa river in Calhoun county. The lands, with the Randolph lands already acquired, give the company all the property needed for the erection of its dam, power-house and tail-race.

STANDISH, MICH.—The Rifle River Improvement Company is a new corporation organized to furnish electric power for lighting and operating mills and factories at Standish, Bay City, Saginaw and other towns. The dams, it is claimed, will permit the company to generate enough power to operate a belt-line road encircling Arenac county, with headquarters at Standish.

PITTSBURG, PA.—The Kuhn interests, which own and control a number of electric companies and traction systems in Fayette and Westmoreland counties and the coke regions, are planning for the establishment of a central electric plant at New Haven, and will abandon a series of isolated plants in various locations. The company now supplies power and light to several traction systems and a score of small towns.

FOREST GROVE, ORE.—George Bagley, of Hillsboro, has purchased the Dudley mill, northeast of Forest Grove. His object in buying this property is to get possession of the falls on the north fork of Dairy creek. He will deepen the channel and repair the dam, which will furnish power sufficient to operate an electric light plant that he intends establishing to furnish lights for Greenville, Banks, Roy and the surrounding settlement.

SPOKANE, WASH.—The Inland Empire Railway Company has started the development of its power site at Nine Mile bridge on the Spokane river. Sanderson & Porter, of New York city, have been engaged as designing and constructing engineers. The Inland Empire company announces that it will develop 10,000 horse-power at once with facilities for increasing this amount later on to 20,000 horse-power. The plant will cost from $750,000 to $800,000.

CHATTANOOGA, TENN.—C. H. Fisk, manager of the Great Falls Power Company, states that work on his plant will commence not later than August, and when completed will represent an investment of $3,000,000, and develop about 50,000 horse-power. About half of this will be utilized by the electric road running to Nashville and the balance will be brought to Chattanooga for the use of manufacturing concerns which may desire electric power.

ROCHESTER, N. Y.—The board of contract and supply of the city of Rochester, N. Y., has advertised for bids for lighting the streets of the city and the furnishing of electric lamps, care, maintenance and operation of such lamps and appurtenances, including the necessary electricity therefor, for the periods of one, two and five years, respectively, beginning at twelve o'clock, noon, July 1, 1907. Bids must be received at the city hall, Rochester, N. Y., by ten o'clock, A. M., August 22, 1906.

ALBANY, N. Y.—The Port Henry Light and Power Company has been incorporated to carry on operations in the villages of Port Henry, Westport, Elizabethtown, Sand Point and Ticonderoga, and the towns of Moriah, Westport, Elizabethtown, Crown Point, Ticonderoga, North Hudson and Shroon. The capital stock is $100,000, and the directors are: D. A. Foote and John R. Sherman, of Port Henry, and Wallace Murray, T. A. Gould, William Winshull and C. F. Carpenter, of Saranac Lake.

COLORADO SPRINGS, COL.—The Colorado Springs city council has appointed Aldermen Hosman, Holden and Seldomridge, with City Attorney Robinson, a committee to investigate the electric light conditions in other cities, and also the prices charged for light, with a view to taking action on the resolution recently introduced by City Attorney Robinson calling for a reduction by the Colorado Springs Electric Company of its rates from twelve and one-half cents to six cents per kilowatt-hour.

NEWARK, N. J.—At the annual meeting of the Butte Electric and Power Company, held in Newark, N. J., the retiring board of directors was reelected, with the exception that F. Lothrop Ames, of Boston, was elected in place of E. W. Rollins. Copley Amory and S. Z. Mitchell, who were elected during the year past to fill vacancies, were reelected. At the meeting of the stockholders of the four subsidiary companies of the Butte Electric and Power Company the retiring boards were also reelected.

COLORADO SPRINGS, COL.—According to a statement made by G. A. Taff, the first of a series of big power plants which are to be erected by the Empire Water and Power Company will be constructed in Manitou at once. Actual work will begin shortly, and the plant will be rushed to completion. As soon as the demand makes it necessary, a second plant will be installed. The company has almost completed surveys for the reservoirs on its holdings, which comprise 1,000 acres along Crystal and Catamount creeks.

FAYETTEVILLE, TENN.—The board of aldermen of Fayetteville has granted a twenty-year franchise to Fred Eslick, who owns the Brady mill property, near Kelso, and who proposes to cut a canal one-half mile long by which he will be enabled to secure water power sufficient to furnish electric power to illuminate Fayetteville. Work will begin at once, and the current is expected to be ready to be turned on by early fall. The city at present has a lighting contract with the Fayetteville Electric Light and Power Company.

MUNCIE, IND.—The city of Muncie, having definitely decided to abandon its municipal street-lighting plant because of the expense of operation, and to enter into a contract with a private company to furnish light for the streets, is now receiving bids from electric light companies. Two bids have been received thus far—one from the Muncie Electric Light Company, which agrees to light the entire city at the rate of $57.50 a year for each light for the first 260 lights and $45 a light in excess of 260; the other from the Indiana Traction Company for $65 a year for each light, not less than 260 lights to be used.

DEPEW, N. Y.—The Ontario Power Company has resumed work upon its transmission line in the vicinity of Depew, the work upon which has been at a standstill for several months. The towers are now being erected upon the foundations, which were laid last fall. This is the line which is to supply power to the Lackawanna steel plant. It runs on a line north and south, about half way between the eastern city line of Buffalo and Depew, connecting with the main line, now completed, west of Lockport. It is expected that a wire will be run to Depew and Lancaster to supply power to the various industries at these places.

ALEXANDRIA, VA.—Alexandria, after many years' trial of its municipal electric lighting plant, has finally leased the plant to a private corporation for a term of thirty years. The leasing firm is headed by Edward E. Mandeville, of New York. Mr. Mandeville's contract with the city calls for the payment of $8,500 for the plant and franchise and the furnishing of not less than eighty-five arc lights at an annual cost of $75. This contract calls for a payment to the city of five per cent of the gross receipts instead of taxes. Under the contract Alexandria will pay $20.75 a year more for arc lights than Richmond, which city, under its present contract, pays $54.75 for each lamp. Charlottesville, under the new arrangement with the electric lighting company in that city, is paying $60 a year for each arc light, or $5.25 a year more than Richmond.

ROCKVILLE, CT.—The plant of the Rockville Gas and Electric Company, Prescott Block, Rockville, Ct., has been entirely rebuilt and is operating now under very favorable conditions. There have been installed three thirty-five-light current transformers and a new 150-kilowatt, three-phase, sixty-cycle, 2,300-volt generator. It is expected that by the middle of August the high-tension electric line will be completed from Hartford to Rockville. Over this line the Hartford Electric Light Company is to deliver current to Rockville for lighting the streets, and also for lighting in Stafford Springs. The high-tension current will be transformed at the Rockville plant. When the transmission line is completed the Rockville plant will be held in reserve in case of accident. William M. Lewis is manager of the Rockville Gas and Electric Company.

Digitized by Google

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1505 describes and illustrates Allis-Chalmers heavy-duty engines, belted type.

JAMES LEFFEL & COMPANY, Springfield, Ohio, have issued a handsome catalogue illustrating and describing their lines of steam engines and boilers. The details of construction are plainly shown and fully explained. This catalogue will be mailed free to those interested, upon request.

THE LINK BELT MACHINERY COMPANY, Chicago, Ill., under its new name, the Link Belt Company, has purchased the plants and all other assets of its associated companies, the Link Belt Engineering Company, Philadelphia, Pa., and the Ewart Manufacturing Company, Indianapolis, Ind.

THE NATIONAL INDIA RUBBER COMPANY, New York city, is now located at 42 Broadway, Le Baron C. Colt, agent. The company is represented by Henry D. Stanley in the rubber-insulated wire and cable department, and by Henry D. Archer in the department for druggists' sundries, hose, packing and clothing.

THE A. L. SWETT ELECTRIC LIGHT AND POWER COMPANY, Medina, N. Y., has published an illustrated description of the power equipment at Medina. This is a very interesting story, and is devoted principally to calling the attention of business men to this enterprise and to the advantages of Medina as a location for manufacturing industries.

THE ARROWSMITH ELECTRIC COMPANY, 434 Market street, Harrisburg, Pa., announces the withdrawal from the company of A. V. Arrowsmith, formerly vice-president and general manager. The company will continue in business at Harrisburg and Reading, under the management of John S. Musser, who reports a very satisfactory state of trade.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY, Syracuse, N. Y., is making use of an elaborate automatic telephone card index as a business souvenir. This card index contains sufficient space to insert 170 names, alphabetically arranged. The index case is made of aluminum and weighs, with the cards, about four ounces. The index is made by the Automatic Card Index Company, Utica, N. Y.

THE HOLSCHER ELECTRIC MANUFACTURING COMPANY, Warren, Ohio, is now under the management of M. Kecklinger, who has taken charge since the death of C. Holscher, some sixty days ago. The company manufactures incandescent lamps, and advises that it is operating entirely independent of any organization agreements. Manager Kecklinger mentioned that the company is looking for larger quarters and may move later in the season.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., will be pleased to send the August issue of "Graphite" to any one interested in this material. This issue contains the usual interesting literature pertaining to the applications of graphite. The company will be pleased to send to any one interested, upon request, a folder describing Dixon's graphite brushes. In addition to the descriptive matter there is a report of tests made upon these brushes.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York, N. Y., will shortly issue an attractive catalogue showing a complete line of "J.M." asbestos packings, copies of which will be mailed upon request. These packings do not contain rubber or organic material, will withstand any temperature or pressure, are pliable and readily conform to irregular surfaces. The company has achieved great success with this line of steam packings.

THE C. W. HUNT COMPANY, West New Brighton, Staten Island, N. Y., will be pleased to send its new bulletin descriptive of Hunt industrial railways to any one interested, upon request. The company announces that for repairs required or for emergencies arising after business hours or on holidays, the following may be called up on the local or long-distance telephone at any hour: D. H. Gildersleeve, sales manager, telephone number 134 L. West New Brighton, N. Y.; J. W. Eckert, superintendent, telephone number 64 J. West New Brighton, N. Y.; C. M. Steinrock, traffic manager, telephone number 89 J. West New Brighton, N. Y.

THE DE LA VERGNE MACHINE COMPANY, New York, N. Y., reports the following recent orders for "Hornsby-Akroyd" oil engines: Wheaton Seminary, Norton, Mass., thirteen horse-power; Rahr Brewing Company, Oshkosh, Wis., thirty-two horse-power; Vitagraph Company, Brooklyn, twenty-five horse-power; Regal Oil and Gas Company, Chicago, Ill., sixty-five horse-power; L. R. Wright, Pecos, Tex., thirteen horse-power; Jas. H. Holden, Fall River, Mass., seventy-five horse-power; borough of Souderton, Souderton, Pa., fifty horse-power; James L. Breeze, Southampton, L. I., thirty-five horse-power, direct-connected to twenty-five-kilowatt generator.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., announces that Captain I. N. Lewis, Artillery Corps, U. S. A., will call at its factory during August "on official business pertaining to the installation and operation of electrical machines, tools and power transmission machinery, and for the purpose of securing special information concerning electrical and laboratory apparatus and power-plant equipment." This unsolicited call upon the Crocker-Wheeler Company indicates the government's high opinion of the company's electrical engineers, whose skill in laying out for the government systems for generating and supplying electrical power is constantly in demand.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a new series of literature. An attractive blotter calls attention to mercury arc rectifiers for battery-charging panels. Flier No. 2192 describes and illustrates motor-starting rheostats with no-voltage release, type SA. A new folder calls attention to the many types of bases for Edison standard lamps. Bulletins Nos. 4443, 4446, 4447, 4449 and 4450 describe and illustrate, respectively, the following apparatus: Sprague-General Electric multiple-unit control for alternating and direct-current operation; starting compensators for alternating-current motors; low-voltage, three-phase generator and feeder panels; potential and synchronizing plug switches; parts of GE-80-A railway motors.

THE BRILLIANT ELECTRIC COMPANY, Cleveland, Ohio, has opened a special department to take care of the demand for Brilliant "Gem" and Brilliant tantalum lamps. While this department will be under the management of E. J. Kulas, the general manager of the company, it will be submanaged by E. V. Hennecke, who will cover a large part of the country exploiting these lamps. An illuminating engineering department has been installed for the purpose of assisting patrons in the design and construction of illuminating schemes. This service is entirely free, and the company invites requests for suggestions. The demand for the Brilliant tantalum lamp, the company announces, has been beyond all expectations, and it is in view of this demand and the desire to handle its customers' wants to the best advantage that the company has opened this department, at a considerable outlay.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburg, Pa., announces that the recent fire at its Oakland (Cal.) factory did not affect the engine and boiler house, and that the insulating tanks and drying ovens are intact. The company was fortunate in having a new lead press and steam pump *en route* from the East, and it is expected that temporary repairs will be made at once and that the lead-covering department will be in operation within about a week. Meanwhile temporary buildings are being erected for the storage of new stock, and the company is prepared to handle orders practically without delay, as a large shipment of new stock has been made to Oakland. The company will reestablish a San Francisco office at 332 Bush street for the convenience of its San Francisco patrons. At the present time, however, the main Pacific coast office will be continued in the Bacon Block, Oakland, Cal.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 7. NEW YORK, SATURDAY, AUGUST 18, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Manhattan Bldg., Chicago, Ill., L. W. MARSHALL, Manager
BOSTON OFFICE: Delta Bldg., 10 Post Office Square, M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad St., London, E. C., HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.
Copyright, 1906, by Electrical Review Publishing Co.
Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

CONTENTS.

EDITORIAL:
An Interesting Use of a Portable Motor . . . 241
A Feature of Municipal Ownership . . . 241
Nitrates from Power Gas . . . 242
Exhausting Our Power Supplies . . . 242
The Present Standing of the Gas Turbine . . . 243
The Gymnotus Electricus as a Source of Power . . . 243
The Advance of Science, by E. Ray Lankester . . . 244
Guayule Rubber Development . . . 246
The Rejuvenated Sons of Jove . . . 246
Foreign Trade Opportunities . . . 246
Municipal Electric Railways at Wellington, New Zealand, by Frank C. Perkins . . . 247
Telephone and Telegraph . . . 250
An Electrically Driven Tin-Plate Mill . . . 251
Electricity in Mines . . . 251
London Underground Electric Railways . . . 251
Test of a Small Gasolene Electric Light Plant . . . 252
Suburban Electrification at Boston, by Howard S. Knowlton . . . 252
Some Notes on the Mechanical Design of Electrical Generators, by R. Livingstone . . . 253
The Twelfth Annual Convention of the Ohio Electric Light Association. 254
Electric Railway Statistics for Greater New York . . . 255
A New South American Power Plant . . . 255
Remote Control of Electric Motors . . . 255
All-Steel Cars Adopted for the New York City Tunnel of the Pennsylvania Railroad . . . 256
A Report on the Moore Tube Lamp . . . 257
Blow to Baggage Men . . . 258
Aluminum . . . 258
Efficiency of Steam Plant, by Walter A. Vignoles . . . 259
ELECTRICAL PATENTS . . . 263
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 264
The Valle Maggia Single-Phase Railway . . . 265
METHODS OF GETTING NEW BUSINESS . . . 266
INDUSTRIAL SECTION:
The "Victor" Combination Meter . . . 267
The San Francisco Office of the Shelby Electric Company . . . 267
Electric Railway Building in Oregon . . . 267
High-Speed, High-Overload-Capacity Motors for Testing Purposes. 268
Water-tight Floor Outlets . . . 268
A New Gasolene Torch . . . 268
A Large Shipment from the Westinghouse Company . . . 269
Motor Drive for Coal-Crushing Rolls . . . 269
The Growth of the Automatic Electric Company . . . 270
The Link-Belt Company . . . 270
A Tungsten Filament Lamp . . . 270
CURRENT ELECTRICAL NEWS . . . 271

AN INTERESTING USE OF A PORTABLE MOTOR.

An interesting use of a portable electric motor has been made at the new power-house of the London County Council. This recent addition to the British metropolis's power plants is undoubtedly one of the finest and best equipped in that city. It is located at Greenwich, where ample water was available for condensing purposes. The condenser pumps are driven by three-phase motors, which, of course, run at a constant speed, and the control of the water delivered by them is by means of valves operated by a worm and wheel. The power to drive the worms is obtained from a small portable motor fitted with back gears and a flexible shaft. The motor can be wheeled to the point desired, the flexible shaft connected to the worm, and the valve is thus put under electrical control.

The ease with which the electric motor is controlled is largely responsible for the increasing use being made of it for driving the power-house auxiliaries. The instance referred to above is another of this kind which is of particular interest, as but one motor is required to control the entire set of valves, and because it makes possible the controlling of the valve from a distance, which is of particular interest in this case since the method of driving the pumps makes frequent movement of the valves necessary.

A FEATURE OF MUNICIPAL OWNERSHIP.

At the time when advocates of municipal ownership in this country are making the most noise, in England, to which country they are accustomed to point for shining examples of the benefits of this system, the opponents of what they call municipal trading are making a strong fight. At a recent meeting of the Industrial Freedom League, Lord Avebury made an address in seconding the movement to adopt a report to the league on this subject. Many of the points made by the speaker against this practice have been stated again and again. One of them, however, does not seem to have received the attention it deserves. This is the danger that the question of municipal operation may become political, for in that case both the good of the public and the success of the undertaking become secondary matters to party success. At the present time in this country it is being urged as an economic question, the object being to reduce the cost of the service, first to the city itself for public uses, and then to the citizens. Such arguments are, of course, entirely proper and should be viewed upon their merits, but if any party gets into power mainly because it advocated such policy, it is pretty sure to make it a party policy, in which case the economic side is lost sight of and men vote for or against it because of their belief on other questions.

Another point made by the same speaker is frequently overlooked. Those who attack the public utility companies are fond of pointing out the large profits made, but they lose sight of the fact that during the early years in which the industry was established the profits were very small, or in some cases undiscoverable. It is not unusual, when introducing a new business, to expect a loss for the first few years, which will be made up by the profits that follow. Where such conditions have prevailed, it is unjust to expect the company to be satisfied with the small profit which would have sufficed had the business been a paying one from the start.

Digitized by Google

NITRATES FROM POWER GAS.

Evidences of the interest in the problem of fixing atmospheric nitrogen, so as to make it available for plant food, have been numerous of late. Only a short time ago we commented upon the group of excellent papers on the subject read before the Bunsen Society at its Dresden meeting, and now another process is put forward which is entirely new and possesses some features of peculiar interest. This problem was first of all chemical, then became electrical, and in this stage progress was made to such an extent that it becomes merely a question of the cost of power. Now another step has been taken, whether backward or forward remains to be seen; but it carries the problem over into the field of gas engineering.

The new process is due to a German engineer named Häusser, and is described in a paper presented by him at a recent meeting of the Society of German Engineers. An interesting discussion of this paper is contributed by F. E. Junge to *Cassier's Magazine* for August. It has been noticed frequently that the exhaust gases from gas engines, if running hot, seems, from the odor, to contain nitric oxide, and this has suggested that it might be commercially feasible to bring about the combination of nitrogen and oxygen in such a device. The process, as described, contemplates the use of so-called producer gas. To bring about the reaction it is necessary to raise the gas to a comparatively high temperature, which temperature must be under control; and the gases must be cooled down immediately after the reaction has taken place. The heating may be brought about by compressing and igniting a mixture of gas and air as is done in gas engines. Häusser's plan is to compress the mixture of producer gas and air in a gas engine. At a certain point during compression ignition is brought about, and the combustion raises the pressure and the temperature to a point high enough to bring about the reaction. To prevent the decomposition which would follow, water is injected into the cylinder at the end of the stroke, thus quickly lowering the temperature to a point where decomposition will not occur. The gases may then be expelled from the cylinder and the nitric oxide allowed to form nitrogen peroxide, which is then abstracted in the usual way. But, since the gases are still hot and still under pressure when the temperature has been lowered to a safe point, they may be expanded in the engine and thus convert a certain portion of their heat into useful work. In other words, by carrying the temperature high enough and then suddenly cooling the gases, nitric acid is secured as a by-product from the gas engine, though, of course, at the expense of a certain loss of heat, due to the cooling.

This loss of heat, which under ordinary operation would be converted into work, represents the energy which is paid for the acid, for, while it does include energy absorbed by the gases which combine, the percentage of gases which take part in the reaction is so small that the absorption of energy thereby is practically negligible. Leaving out other considerations, such as the cost of the water and collecting devices, the cost of the process may be estimated by the cost of this lost work. Figuring on this basis it is estimated that nitric acid, prepared in this way, would cost about one cent per pound, the price of gas being 0.015 cent per thousand British thermal units. This may be compared with the present price of raw nitric acid in Germany, which is about 7.6 cents per pound.

This process of manufacturing nitric acid is interesting, because, while it depends upon a source of cheap energy, it must turn to the mine, and not to the waterfall. Moreover, the nitric acid produced will be of small value compared with that of the mechanical power produced by the engine. In other words, the acid will be the by-product rather than the power, so that to carry on the process commercially will require the disposal of large quantities of mechanical energy. It should be noted that this process puts a further drain on our fuel supplies, though it would undoubtedly be first put into use at the blast furnaces, where gas fuel is now being wasted; so that, in this sense, it offers us a means of saving. Further information regarding this new process will be awaited with interest. If it can be shown to be better than the electrical methods the latter will be forced to the wall, and those who have cheap water-power for sale must turn their attention in other directions.

While on this subject it is interesting to note a suggestion made by one of our contemporaries, that the fixation of atmospheric nitrogen can not be allowed to go on indefinitely for the replenishment of the soil, and that we should pay more attention to saving our wastes, and not call upon the atmosphere for what we need. It has been estimated that in France alone the amount of nitrogen yearly taken from the soil is about 600,000 tons, and not much more than one-half of this is returned to the soil in stable manure. Let us assume, for the purpose of argument, that those countries employing nitrogenous fertilizers use during each year 5,000,000 tons of nitrogen. This seems to be a fairly liberal estimate, judging from the above figure regarding France, and the fact that during 1905 1,500,000 tons of nitrate of soda were employed throughout the world. On this basis it is easily seen that there is no danger of impoverishing the atmosphere, for the atmospheric pressure at sea level corresponds to about eleven pounds of nitrogen per square inch, or, say, 1,500 pounds per square foot, or 20,000,000 tons per square mile. Each square mile of the earth's surface has above it enough nitrogen to supply the entire world for five years, on the basis assumed above; and since the entire surface of the earth is not much short of 200,000,000 square miles, we can go on abstracting nitrogen at this rate for about a million years before reducing the quantity in the atmosphere one-tenth per cent.

EXHAUSTING OUR SUPPLIES.

From time to time, attention is directed to the rate at which we are burning coal and the probable giving out of this necessity, but, until recently, no one pointed out the possible danger that our resources of iron ore are comparatively small. At a recent meeting of the Iron and Steel Institute in London, President R. A. Hedfield said that he had computed that by the year 1950 300,000,000,000 tons of iron ore would be needed

Digitized by Google

annually. According to trustworthy authorities, only about 10,000,000,000 tons of ore are available in known workable iron fields. By the end of the century, it is probable that the tons of ore which will have been required, allowing for ordinary growth, would be 45,000,000,000, or four and one-half times that now known available.

To offset the exhaustion of our fuel supplies, we have waterfalls and, possibly, heat from the sun. To make up for the lack of iron, we will have to turn to other metals. Since there is no simple metal which we can call to mind at the present moment that is altogether suitable, possibly some alloy will have to be adopted, using perhaps aluminum as a basis.

Assuming that no great revolutionary development in the electrical industries takes place, an assumption which is not warranted, the dynamo builder of 100 years hence will have to do without iron. This would seem to be fatal, but, fortunately, magnetic metals are now known which contain no iron, and these hold out the hope that, even should the worst come, a workable dynamo could be built in which no iron would be used.

By the way, what is the extent of our copper resources, and are they likely to run short during the present century? A lack of copper would be almost as hard to endure in the electrical field as a scarcity of iron.

THE PRESENT STANDING OF THE GAS TURBINE.

To step from the steam turbine to a gas turbine seems at first thought not too dificult, and to offer possibilities of economy in fuel and investment. A closer examination reveals difficulties, both theoretical and practical, though mainly the latter, so that an experimental investigation seems worth while. So far practically no success has been reported. The latest contribution to this subject is an article by Dr. C. E. Lucke in the *Engineering Magazine* for August. Dr. Lucke has studied the possibilities of the gas turbine for some years past, and in this article not only gives the results of certain experiments conducted by himself and the conclusions which he draws therefrom, but he presents, as well, the opinions of a number of other eminent mechanical engineers on the same subject.

The experiments were conducted with a De Laval steam turbine and compressed air, the latter being the most convenient substitute available for the hot gases. This arrangement, of course, has some bearing on the value of the experiment, but the results are nevertheless significant. It was found that the drop in temperature taking place when the gases are expanded in a diverging nozzle is only from four to eighteen per cent of the theoretical, or adiabatic, drop. This drop is influenced by the shape of the nozzle and the speed of the turbine wheel, although the latter seems to act somewhat erratically; but, in any case, the amount of energy which is thus made available is disappointingly low. In fact, the conclusion drawn is that the temperature drop in free expansion with such nozzles indicates very small conversion of heat into work—that is to say, these nozzles are an inefficient means of transforming heat into work. Out of seven opinions given to Dr. Lucke four express disbelief in the success of the gas turbine; two think that there is but little hope for it at the present time, but that eventually we may succeed; and but one takes a hopeful view. Dr. Lucke's summation is that the difficulties encountered by those who have experimented and those that are foreseen by practical men make it almost certain that efforts to produce a successful gas turbine will be fruitless for a long time to come.

THE GYMNOTUS ELECTRICUS AS A SOURCE OF POWER.

An amusing suggestion has appeared recently in the daily papers which, from its novelty, will bear examination. This is nothing more than the idea that we harness for useful purposes the power of the electric eel, or gymnotus electricus, as it is known to naturalists. According to this story, 100 of these eels placed in a zinc tank would give off enough electricity to run an automobile for twenty-four hours. Ten thousand of them distributed about in suitable jars would generate enough power to run a three-car train, and 300,000 would be an ample supply for the largest ocean liner.

If one may work backward from these figures, it would seem that one of these eels has an average power of about one-tenth of a kilowatt, or, say, one-tenth of a horse-power, and this figure would seem to agree fairly with our memory of pictures that used to be given in the old school geographies. We have a very vivid recollection of a picture showing a number of frantic horses driven into a pool of water by a band of Indians and there attacked by these electric eels. In those pictures, there were at least ten eels to every horse.

Figuring on this basis, the gymnotus does not seem to be a very compact generator of electrical energy. These eels grow to considerable size, often five or six feet long, but assuming as a fair figure an average length of three feet and a diameter of two and one-half inches, each eel would occupy a space of about one-eighth of a cubic foot. Our 300,000 eels for the ocean liner would therefore fill a space of twenty feet deep, forty feet wide and sixty feet long solidly with eel flesh, and since each eel would require considerable space for elbow or tail room, there would not be much space left within the vessel for cargo. Moreover, since these eels only constitute the generating part of the equipment, space would have to be found for the motors. It would seem to be a better plan to break the eels to the bridle and teach them to tow the vessel, using them thus as motors rather than generators. This would save all space within the vessel for cargo. It would save the motors and propellers, and in these two respects alone would largely offset any smaller rating we might have to give the gymnotus when employed as a motor rather than as a generator. Moreover, if more power were needed, more eels could be hitched up, and by making the traces long enough they could probably forage while at work, thus saving the vessel the expense of feeding them.

The conditions, unfortunately, are not so favorable for their use on land, for the 5,000 eels estimated to be necessary to run an interurban car would fill a space of 600 cubic feet without allowing any room for wriggling. It is interesting to note that these eels are capable of giving a most terrible shock. The voltage generated in their organs is therefore undoubtedly high, but the quantity involved in the discharge is probably small. Moreover, it seems to be quickly exhausted. The eel is capable of a violent, but short-lived, action.

Digitized by Google

THE ADVANCE OF SCIENCE.[1]

BY E. RAY LANKESTER.

If I venture on the present occasion to say a few words as to the great features in the progress of our knowledge of Nature during the last twenty-five years, it will be readily understood that the mere volume of new knowledge to be surveyed has become so vast that a full and detailed statement such as that which Lord Avebury placed before the association at its jubilee is no longer possible in a single address delivered from the president's chair.

In attempting to give an outline of the advancement of science in the past twenty-five years I think it is necessary to distinguish two main kinds of advancement, both of which our founders had in view. Francis Bacon gave the title "Advancement of Learning" to that book in which he explained not merely the methods by which the increase of knowledge was possible, but advocated the promotion of knowledge to a new and influential position in the organization of human society. His purpose, says Dean Church, was "to make knowledge really and intelligently the interest, not of the school or the study or the laboratory only, but of society at large." This is what our founders also intended by their use of the word "advancement." So that, in surveying the advancement of science in the past quarter of a century, we of the British Association must ask not only what are the new facts discovered, the new ideas and conceptions which have come into activity, but what progress has science made in becoming really and intelligently the interest of society at large. Is there evidence that there is an increase in the influence of science on the lives of our fellow citizens and in the great affairs of the state? Is there an increased provision for securing the progress of scientific investigation in proportion to the urgency of its need, or an increased disposition to secure the employment of really competent men trained in scientific investigation for the public service?

As one might expect, the progress of the knowledge of Nature (for it is to that rather than to the historical, moral and mental sciences that English-speaking people refer when they use the word "science") has consisted, in the last twenty-five years, in the amplification and fuller verification of principles and theories already accepted, and in the discovery of hitherto unknown things which either have fallen into place in the existing scheme of each science or have necessitated new views, some not very disturbing to existing general conceptions, others of a more startling and, at first sight, disconcerting character. Nevertheless, I think I am justified in saying that, exciting and of entrancing interest as have been some of the discoveries of the past few years, there has been nothing to lead us to conclude that we have been on the wrong path—nothing which is really revolutionary; that is to say, nothing which can not be accepted by an intelligible modification of previous conceptions. There is, in fact, continuity and healthy evolution in the realm of science. While some onlookers have declared to the public that science is at an end, its possibilities exhausted, and but little of the hopes it raised realized, others have asserted, on the contrary, that the new discoveries—such as those relating to the X-rays and to radium—are so inconsistent with previous knowledge as to shake the foundations of science, and to justify a belief in any and every absurdity of an unrestrained fancy. These two reciprocally destructive accusations are due to a class of persons who must be described as the enemies of science. Whether their attitude is due to ignorance or traditions of self-interest, such persons exist; and it is one of the objects of this association to combat their assertions and to demonstrate, by the discoveries announced at its meetings and the consequent orderly building up of the great fabric of "natural knowledge," that Science has not come to the end of her work—has, indeed, only as yet given mankind a foretaste of what she has in store for it—that her methods and her accomplished results are sound and trustworthy, serving with perfect adaptability for the increase of true discovery and the expansion and development of those general conceptions of the processes of Nature at which she aims.

There can be no doubt that the past quarter of a century will stand out forever in human history as that in which new chemical elements, not of an ordinary type, but possessed of truly astounding properties, were made known with extraordinary rapidity and sureness of demonstration. Interesting as the others are, it is the discovery of radioactivity and of the element radium which so far exceeds all others in importance that we may well account it a supreme privilege that it has fallen to our lot to live in the days of this discovery. No single discovery ever made by the searchers of nature even approaches that of radioactivity in respect of the novelty of the properties of matter suddenly revealed by it. A new conception of the structure of matter is necessitated and demonstrated by it, and yet, so far from being destructive and disconcerting, the new conception fits in with, grows out of, and justifies the older schemes which our previous knowledge has formulated.

The delicate electric test for radioactivity has been largely applied in the last few years to all sorts and conditions of matter. As a result it appears that the radium emanation is always present in our atmosphere; that the air in caves is especially rich in it, as are underground waters. Tin-foil, glass, silver, zinc, lead, copper, platinum and aluminum are, all of them, slightly radioactive. The question has been raised whether this widespread radioactivity is due to the wide dissemination of infinitesimal quantities of strong radioactive elements, or whether it is the natural intrinsic property of all matter to emit Becquerel rays. This is the immediate subject of research.

Over and above the more simply appreciable facts of radioactivity, there comes the necessary and difficult enquiry: What does it all mean? What are the Becquerel rays of radioactivity? What must we conceive to be the structure and mechanism of the atoms of radium and allied elements, which can not only pour forth ceaseless streams of intrinsic energy from their own isolated substance, but are perpetually, though in infinitesimal proportions, changing their elemental nature spontaneously, so as to give rise to other atoms which we recognize as other elements?

The kind of conceptions to which these and like discoveries have led the modern physicist in regard to the character of that supposed unbreakable body—the chemical atom—the simple and unaffected friend of our youth—are truly astounding. But I would have you notice that they are not destructive of our previous conceptions, but rather elaborations and developments of the simpler views, introducing the notion of structure and mechanism, agitated and whirling with tremendous force, into what we formerly conceived of as homogeneous or simply built-up particles, the earlier conception being not so much a positive assertion of simplicity as a non-committal expectant formula awaiting the progress of knowledge and the revelations which are now in our hands.

Intimately connected with all the work which has been done in the past twenty-five years in the nature and possible transformations of atoms is the great series of investigations and speculations on astral

[1] Abstracted from the address delivered to the British Association for the Advancement of Science, at York, England, August 1.

Digitized by Google

chemistry and the development of the chemical elements which we owe to the unremitting labor during this period of Sir Norman Lockyer.

Of great importance has been the whole progress in the theory and practical handling of electrical phenomena of late years. The discovery of the Hertzian waves and their application to wireless telegraphy is a feature of this period, though I may remind some of those who have been impressed by these discoveries that the mere fact of electrical action at a distance is that which hundreds of years ago gave to electricity its name. The power which we have gained of making an instrument oscillate in accordance with a predetermined code of signaling, although detached and a thousand miles distant, does not really lend any new support to the notion that the old-time beliefs of thought transference and second sight are more than illusions based on incomplete observation and imperfect reasoning. For the important factors in such human intercourse—namely, a signaling instrument and a code of signals—have not been discovered, as yet, in the structure of the human body, and have to be consciously devised and manufactured by man in the only examples of thought-transference over long distances at present discovered or laid bare to experiment and observation.

The past quarter of a century has witnessed a great development and application of the methods of producing both very low and very high temperatures. Sir James Dewar, by improved apparatus, has produced liquid hydrogen and a fall of temperature probably reaching to the absolute zero.

In chemistry generally the theoretical tendency guiding a great deal of work has been the completion and verification of the "periodic law" of Mendeléeff; and, on the other hand, the search by physical agents, such as light and electricity, for evidence as to the arrangement of atoms in the molecules of the most diverse chemical compounds. The study of "valency" and its outcome, stereo-chemistry, have been the special lines in which chemistry has advanced. As a matter of course, hundreds, if not thousands, of new chemical bodies have been produced in the laboratory of greater or less theoretical interest. The discovery of the greatest practical and industrial importance in this connection is the production of indigo by synthetical processes, first by laboratory and then by factory methods, so as to compete successfully with the natural product. Von Baeyer and Heumann are the names associated with this remarkable achievement, which has necessarily dislocated a large industry which derived its raw material from British India.

There is no doubt that there has been an immense "revival" in astronomy since 1881; it has developed in every direction. The invention of the "dry plate," which has made it possible to apply photography freely in all astronomical work, is the chief cause of its great expansion. Photography was applied to astronomical work before 1881, but only with difficulty and haltingly. It was the dry plate which made long exposures possible, and thus enabled astronomers to obtain regular records of faintly luminous objects such as nebulæ and star-spectra. Roughly speaking, the number of stars visible to the naked eye may be stated as 8,000; this is raised by the use of our best telescopes to 100,000,000. But the number which can be photographed is indefinite and depends on length of exposure; 1,000,000,000 can certainly be so recorded.

While I have been able, though in a very fragmentary and incomplete way, to indicate the satisfactory and, indeed, the wonderful progress of science since this association last met in York, so far as the making of new knowledge is concerned, I am sorry to say that there is by no means a corresponding "advancement" of science in that signification of the word which implies the increase of the influence of science in the life of the community, the increase of the support given to it, and of the desire to aid in its progress, to discover and then to encourage and reward those who are specially fitted to increase scientific knowledge, and to bring it to bear so as to promote the welfare of the community. I am speaking on a privileged occasion to a body of men who are met together for the advancement of science, and I claim the right to say to them, without offense to the representatives of institutions which I criticize, what is in my mind.

It is, unfortunately, true that the successive political administrators of the affairs of this country, as well as the permanent officials, are altogether unaware to-day, as they were twenty-five years ago, of the vital importance of that knowledge which we call science, and of the urgent need for making use of it in a variety of public affairs. Whole departments of government in which scientific knowledge is the one thing needful are carried on by ministers, permanent secretaries, assistant secretaries and clerks who are wholly ignorant of science, and, naturally enough, dislike it, since it can not be used by them, and is in many instances the condemnation of their official employment. Such officials are, of course, not to be blamed, but rather the general indifference of the public to the unreasonable way in which its interests are neglected.

A difficult feature in treating of this subject is that when one mentions the fact that ministers of state and the officials of the public service are not acquainted with science, and do not even profess to understand its results or their importance, one's statement of this very obvious and notorious fact is apt to be regarded as a personal offense. It is difficult to see wherein the offense lies, for no one seeks to blame these officials for a condition of things which is traditional and frankly admitted.

This is really a very serious matter for the British Association for the Advancement of Science to consider and deal with. We represent a line of activity, a group of professions which are in our opinion of vital importance to the well-being of the nation. We know that those interests which we value so highly are not merely ignored and neglected, but are actually treated as of no account or as non-existent by the old-fashioned class of politicians and administrators. It is not too much to say that there is a natural fear and dislike of scientific knowledge on the part of a large proportion of the persons who are devoid of it, and who would cease to hold, or never have held, the positions of authority or emolument which they now occupy, were scientific knowledge of the matters with which they undertake to deal required of them. This is a thorny subject, and one in which, however much one may endeavor to speak in general terms, it is difficult to avoid causing personal annoyance. Yet it seems to me one which, believing as I do that it is of most urgent importance, it is my duty as your president to press upon the attention of the members of the British Association. Probably an enquiry into and discussion of the neglect of science and the questionable treatment of scientific men by the administrative departments of government would be more appropriate to a committee appointed by the council of the association for this purpose than to the presidential address.

At the same time, I think the present occasion is one on which attention should be drawn in general terms to the fact that science is not gaining "advancement" in public and official consideration and support. The reason is, I think, to be found in the defective education, both at school and university, of our governing class, as well as in a racial dislike among all classes to the establishment and support by public

Digitized by Google

funds of posts which the average man many not expect to succeed by popular clamor or class privilege in gaining for himself—posts which must be held by men of special training and mental gifts. Whatever the reason for the neglect, the only remedy which we can possibly apply is that of improved education for the upper classes, and the continued effort to spread a knowledge of the results of science and a love for it amongst all members of the community. If members of the British Association took this matter seriously to heart they might do a great deal by insisting that their sons, and their daughters, too, should have reasonable instruction in science both at school and college. They could, by their own initiative and example, do a good deal to put an end to the trifling with classical literature and the absorption in athletics which is considered by too many schoolmasters as that which the British parent desires as the education of his children.

One of the most solid tests of the esteem and value attached to scientific progress by the community is the dedication of large sums of money to scientific purposes by its wealthier members. We know that in the United States such gifts are not infrequent; they are rare in this country. It is, therefore, with especial pleasure that I call your attention to a great gift to science in this country made only a few years ago. Lord Iveagh has endowed the Lister Institute, for researches in connection with the prevention of disease, with no less a sum than a quarter of a million pounds sterling.

Many other noble gifts to scientific research have been made in this country during the period on which we are looking back. Let us be thankful for them, and admire the wise munificence of the donors. But none the less we must refuse to rely entirely on such liberality for the development of the army of science, which has to do battle for mankind against the obvious disabilities and sufferings which afflict us and can be removed by knowledge. The organization and finance of this army should be the care of the state.

It is a fact which many of us who have observed it regret very keenly, that there is to-day a less widespread interest than formerly in natural history and general science, outside the strictly professional arena of the school and the university. The field naturalists among the squires and the country parsons seem nowadays not to be so numerous and active in their delightful pursuits as formerly, and the mechanic's institutes and lecture societies of the days of Lord Brougham have given place, to a very large extent, to musical performances, bioscopes and other entertainments more diverting, but not really more capable of giving pleasure than those in which science was popularized. No doubt the organization and professional character of scientific work are to a large extent the cause of this falling-off in its attraction for amateurs.

In conclusion, I would say a word in reference to the associations of our place of meeting, the birthplace of our society. It seems to me not inappropriate that a society for the advancement of science should have taken its origin under the walls of York Minster, and that the clergy of the great cathedral should have stood by its cradle. It is not true that there is an essential antagonism between the scientific spirit and what is called the religious sentiment. "Religion," says Bishop Creighton, "means the knowledge of our destiny and of the means of fulfilling it." We can say no more and no less of science. Men of science seek, in all reverence, to discover the Almighty, the Everlasting. They claim sympathy and friendship with those who, like themselves, have turned away from the more material struggles of human life, and have set their hearts and minds on the knowledge of the Eternal.

Guayule Rubber Development.

Consul V. L. Duhaime, of Saltillo, writes that the guayule shrub two years ago was not only regarded as worthless, but was considered as a nuisance by the Mexican land owners. In fact, lands thick with this brush, which could have then been bought for a nominal sum, are now difficult to secure, the price being from five to ten times higher.

Many sales of guayule on the ground have been reported at over five times the price at which the land itself was held at previous to this boom. The buying up of this shrub began about the latter part of the year 1904, at $15 Mexican currency per ton. But, owing to the numerous parties anxious to secure quantities large enough to justify them in erecting factories for the extraction of the gum, buyers now find it very difficult to arrange deals. Recently, contracts for large lots have been reported at as high as $100 Mexican currency per ton. For many years guayule was known to contain rubber, but it is only within a short time since that a process has been invented for the extraction of the gum for commercial use. Although the product was of an inferior quality and of little value, it was enough to set chemists and inventors to work on the problem; so much so that many extraction processes are being registered at the Mexican patent office. However, none of the methods have yet attained a degree of perfection, as the known results vary from ten to twelve per cent, whereas the quantity of gum contained in the shrub is known to be approximately eighteen per cent. The quality attained can better be judged by the price realized for the product of the different processes, which varies from twenty-eight to fifty cents, gold, per pound on the New York market. However, men engaged in the new industry are learning to produce a better finished product. A sample lot of such excellent quality, extracted with a process in the experimental stage and not yet patented, brought $1, gold, per pound.

No claim is made that the gum extracted from the guayule will ever take the place of rubber, but it can be made a substitute in many forms of manufacture. This industry has now passed from the experimental to the practical stage, and is destined to become a very important one in northern Mexico, especially in the state of Coahuila. Factories which are already working and those now under construction within a small radius of Saltillo will represent an outlay in buildings and machinery alone of several millions of dollars. Large quantities of the gum extracted are now being exported from this district.

The Rejuvenated Sons of Jove.

The Order of Rejuvenated Sons of Jove will have a meeting at Niagara Falls, N. Y., on Tuesday, September 11, 1906, which promises to be largely attended.

This order, as mentioned some weeks ago in the ELECTRICAL REVIEW, is a secret one which has been organized in the electrical industries. It already has a large membership, which is being rapidly increased.

The forthcoming meeting will be largely attended by the present membership, and an initiation of new members will also be held at that time.

Foreign Trade Opportunities.

The government of Ecuador invites bids for the construction of a railway (steam or electric traction) from Ambato to the river Arajuno. Free importation of materials. Apply, Subsecretario del Ministrio de Obras Publicos, Quito, Ecuador. The file number of the enquiry at the Bureau of Manufactures, Washington, D. C., is 275.

The town of Lujan, Argentina, has decided to erect an electric light plant. The file number of the enquiry is 280.

Digitized by Google

Municipal Electric Railways at Wellington, New Zealand.

By Frank C. Perkins.

THERE has recently been placed in operation at Wellington, New Zealand, an up-to-date railway power plant and an electric railway system operated by the municipality. This city has a population of 57,663, and during the past year 13,574,223 passengers were carried, with a total car-mileage of 1,471,913. The total length of track is 21.5 miles, a four-foot gauge being used.

The total revenue during the past year was $374,531, while the working expenses were $262,440, the ratio of revenue to working expenses being 70.07 per cent. The working expenses per car-mile were 17.16 cents, and the number of units per car-mile was 1.51. The total number of units used was 2,228,313, and the whole cost per unit was 1.54 cents.

The price of coal per ton employed at this station is $4.25. The total cost of the Wellington Electric Railway system, including the power station, was $1,555,200.

It is maintained that in the movement of municipalization of public works Wellington lays claims to her own fire brigade, water, drainage and tramways systems, and lighting is to be added to the list in the near future. The electric tramways provide a good example of what may be attained in affairs having the direct control of the people. The system has now been running two years, and the following is a brief outline of this system:

Overhead trolley construction is used, and there are over twenty-one miles of single and double track open for traffic. The whole of the city track has been laid on a solid concrete foundation. The rails are of the British standard section No. 2, ninety-five pounds per yard, forty feet long and bonded with No. 0000 stranded copper bonds. The overhead wires are suspended from welded-steel tubular poles, the latter being fitted with artistic bases and scrollwork; the trolley wire is No. 0000 gauge, hard-drawn copper, fixed with sweated ears and flexible suspension.

The accompanying illustration, Fig. 1, shows the interior of the power station, which is situated on reclaimed land near the harbor and close to the new coal wharf in course of erection for the harbor board—a site which has proved of great convenience. It is a handsome structure, built of the best quality pressed brick, relieved with moulded blue Staffordshire bricks. The chimney is the largest in Wellington, being 130 feet high, with an internal diameter of ten feet; thus providing flue capacity for fully 7,000 horsepower, or four times the output of the existing station. The fear of earthquakes, which still visit the city, has made it necessary to build the stack in the most substantial manner. During an earthquake which occurred about twelve months ago the stack was subjected to a severe test and stood it well.

The boiler house, fronting on Victoria street, is a spacious room, seventy feet by eighty-one feet, lofty and well lit and with ample windows and skylights. There are at present three boilers, of the

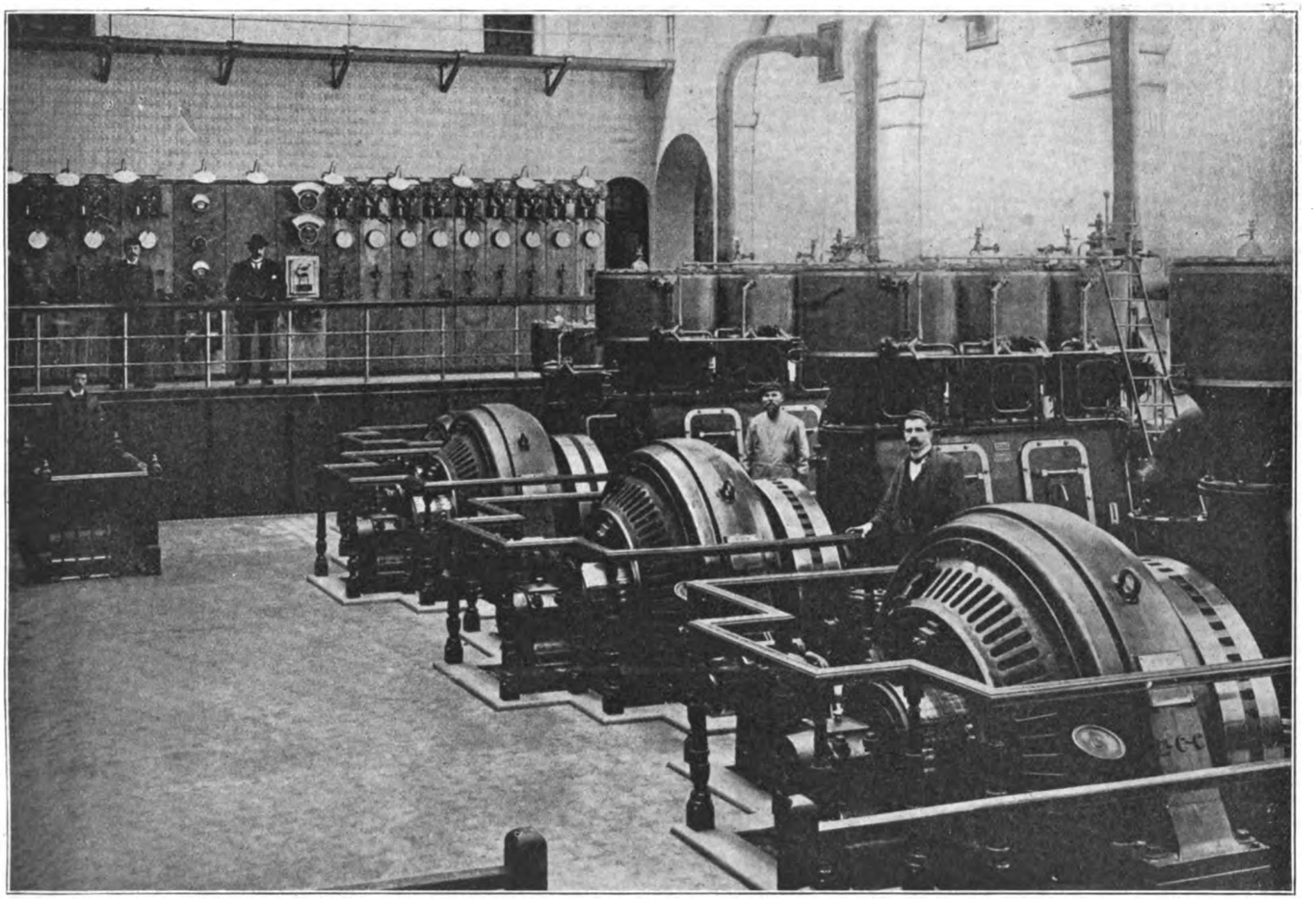


FIG. 1.—INTERIOR VIEW OF POWER STATION, CORPORATION TRAMWAYS, WELLINGTON, NEW ZEALAND.

Digitized by Google

Lancashire type, eight feet by thirty feet, working at a pressure of 160 pounds per square inch, made by Daniel Adamson & Son, to withstand a test pressure of 320 pounds per square inch. This was necessary in order to conform with the government regulations, which provide for a test at double the working pressure. Space has also been provided for four more boilers, two of which are now on order. The labor of stoking has been brought to a minimum because the coal, once tipped into the bunker, is fed by means of a series of motor-driven conveyers, made by the New Conveyer Company, into the hoppers of the mechanical stokers. The coal is forced with the simple ram action below the fire line, and as the fresh coal rises it is brought to the coking stage at which the gases are liberated to pass upward through the fire, thus ensuring utilization of the maximum amount of calorific value in the coal. Forced draught is provided by means of motor-driven rotary blower fans of the Cyclone Fan Company's manufacture, which maintain a high furnace temperature. Two Weir gun-metal pumps, with seven-inch-diameter piston, nine and one-half-inch cylinder, twenty-one-inch stroke, represent the boiler feed plant, each with a capacity of 4,000 gallons per hour. The feed-water passes through a large Green economizer having 640 iron pipes set vertically in the flue. The pipes are nine feet long and are provided with scrapers worked by a small enclosed type motor. An auxiliary by-pass flue is also provided as a standby during overhaul. The flues are ten feet by six feet. There are two steam mains from each boiler, one leading direct to a ten-inch range, the other to a Bolton superheater with a heating surface of 190 square feet, set at the end of each boiler. Suitable valves of the Hopkinson pattern are provided, admitting of the utmost flexibility of manipulation.

The steam superheat is about 100 degrees Fahrenheit. Geipel steam traps, placed in suitable positions, prevent any water likely to condense in the pipes from getting across to the engines. The type of engine used is the Belliss & Morcom triple-expansion, high-speed, self-lubricating machine, direct-coupled to Electric Construction Company six-pole direct-current generators. Four units are installed, one of 250 horse-power and three of 500 horse-power. The foundations are in place, however, for two additional machines, one of which, of 1,000-horse-power capacity, is under order.

For municipal lighting the 250-horse-power set is used, supplying current at 220 volts. This set, however, is also used from midnight to morning as a traction unit, delivering 550 volts, to keep the current on the lines for the ordinary work of cleaning and repairing the cars, etc. Of the three 500-horse-power sets one is always standing by, while the other two take the traction load all day. The speed of the small set is 500 revolutions per minute, and of the others 375 revolutions per minute. There are now being installed in the power station two more boilers of the same size and class and a 1,000-horse-power Belliss & Morcom engine direct-coupled to an Electric Construction Company dynamo. There are also two small motor-generators.

The switchboard is set on a raised platform at the end of the engine room, and is composed of handsome gray-blue mar-

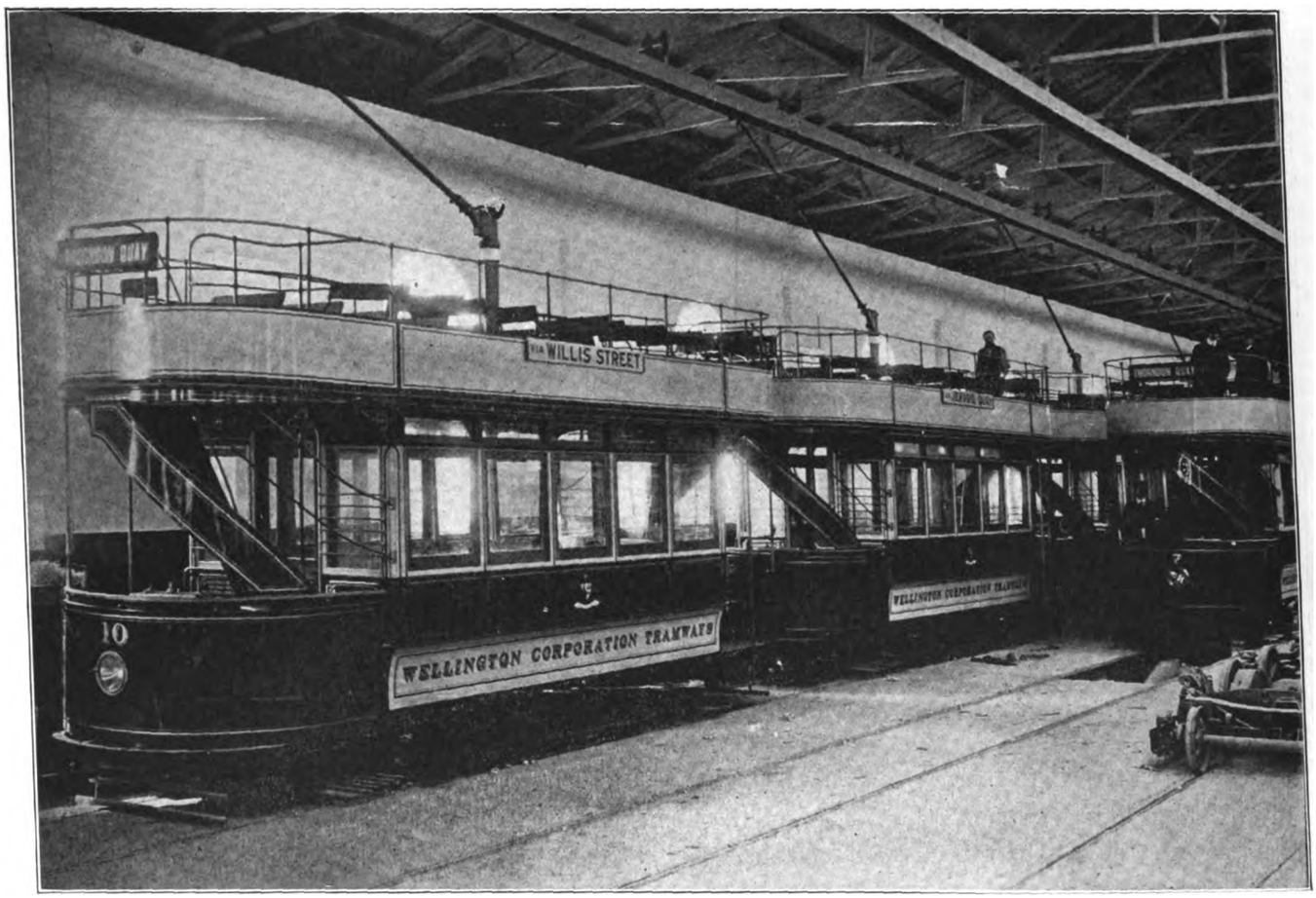


FIG. 2.—CAR EQUIPMENT OF CORPORATION TRAMWAYS, WELLINGTON, NEW ZEALAND.

Digitized by Google

ble. There are four machines, one Board of Trade, one summation and nine feeder panels all provided with the necessary indicating and integrating instruments, switches and circuit-breakers. The engine room is traversed by a motor-driven overhead crane, capable of lifting fifteen tons, made by Jessop & Appleby.

As noted in the accompanying illustration, the general appearance of the engine room, which is eighty-five feet by thirty-five feet, is very neat and attractive. The walls are sheathed with Wunderlich stamped-steel facings and painted in green shades and cream, while the floor is suitably laid out with terra-cotta tiles.

The condensing plant, which is of a type lately finding great favor, is particularly adapted to the requirements of the power station, situated close to the harbor, with a plentiful supply of sea water for condensing purposes. The plant consists of three motor-driven centrifugal pumps which pump the sea water from a well fed by a large culvert into an overhead tank. The water then gravitates to jet condensers on the "Korting" ejector principle fixed to each individual engine. An average vacuum of twenty-seven inches is maintained. Over the pump room are the offices of the chief engineer, the lines superintendent and also the testing laboratory.

The engines are now working on a very small coal consumption and require a minimum of attention. This fact, together with the economy of management of the works, results in the production of power at well under one cent per unit.

The accompanying illustrations, Figs. 2 and 3, show the car shed, situated at the southern end of Newtown, which is a fine building in picked brick, 384 feet long by 101 feet wide; the steel-trussed roof being divided into two bays provided with ample skylights. Forty feet of one end of the shed is used as a workshop, paintshop and smithy. The workshop is provided with up-to-date motor-driven machine tools, including a heavy turning lathe, wheel lathe and press. It is provided with eight tracks and has large sliding entrance doors.

The rolling stock consists of forty-six cars, and comprises box cars, double-deck cars, combination cars, side-door cars and the open-sided Hong Kong type—all of which are painted in Indian red picked out with pale canary-yellow. They look well and are in every way suitable for their particular class of work. All the cars, with the exception of the combination type, are mounted on Brill trucks with two General Electric motors of twenty-five horse-power each.

A new type of trolley head (Figs. 4 and 5) designed by Messrs. Holmes and Allen, about to be used, is a distinct departure from the usual design and embodies several novel features introduced with the aim of preventing accidents now possible with the overhead system.

In the normal riding position the head resembles closely those now used on all side-running systems. If the wheel jumps, however, a concealed spring causes the head to collapse and automatically rings a bell placed close to the motorman. In this position it is impossible for accidents to happen, since the head can not foul and catch the overhead span wires. The usual pull on the rope necessary to replace the wheel on the wire resets the head.

It is claimed that the spring has a

FIG. 3.—CAR BARN OF THE CORPORATION TRAMWAYS, WELLINGTON, NEW ZEALAND.

Digitized by Google

double importance, since, due to its cushioning action, the wheel is actually prevented from leaving the wire.

It is stated that since the completion of the city tracks, a year ago, considerable progress has been made in extending the lines to Greater Wellington. The Island Bay section is now open right down to the water. Kilbirnie tunnel (one-quarter mile long) is in the hands of the contractor,

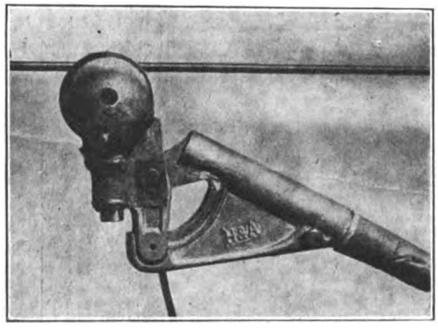


FIG. 4.—NEW FORM OF TROLLEY HEAD, WELLINGTON CORPORATION TRAMWAYS.

and is steadily moving on to completion. As this work is nearing completion a start will be made with the track on each side of the tunnel. The full length of this extension is to be one and three-quarter miles and in the near future will be continued for a distance of two miles out to Seatoun and Miramar.

It is said that the Brooklyn section is now completed. The latter work has entailed heavy cutting and embankments. This section will be one-twelfth mile in length.

On account of the fact that traffic on these suburban extensions will not be as

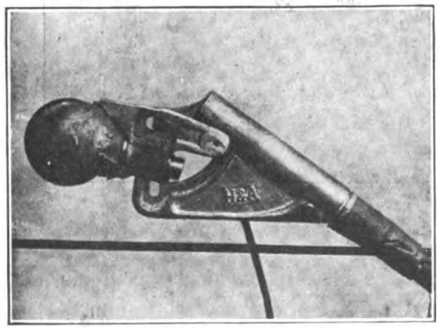


FIG. 5.—NEW FORM OF TROLLEY HEAD, WELLINGTON CORPORATION TRAMWAYS.

heavy as that dealt with in the city, sleeper construction has been adopted. The chief objection to this type of construction—namely, the springing at joints—has been nullified by using the same anchor joints as have been used on the city tracks.

The Kilbirnie line will eventually be extended to Miramar and Seatoun. This will entail two and three-quarter miles of single track and is mostly on the level skirting the harbor edge; a short tunnel, however, will be necessary before Seatoun is reached.

The extension to Karori is about two miles in length. It will wind up a tortuous road, passing through a short road tunnel before the cemetery gates are reached, which will be the terminus for the next few years.

The Wadestown borough council has investigated proposals to determine the best way to serve that borough with a tramway. It has proved a difficult task and had called forth proposals of all descriptions, including a cable system. This district is about 600 feet above sea level, and if electric tramways are adapted some heavy grades will have to be negotiated.

All these schemes are to be run in conjunction with the city tramways—the same gauge and characteristics being adhered to.

This tramway system for its size deals with a very large passenger traffic, the volume of which is steadily on the increase, carrying annually about 15,000,000 passengers, while a glance at the returns of British systems will show that this is 100 per cent better than that accomplished in any town of similar size.

The permanent way and overhead construction were carried out by MacArtney, McElroy & Company, of London, and the plant was installed by the Electric Construction Company, of Wolverhampton, England.

The future before the tramways is full of questions of suburban extensions. The surrounding boroughs have all passed resolutions assenting to the proposals formulated by their governing bodies. The roads will be built at the borough's expense by the Wellington Corporation, who will also supply power and cars at a fixed charge per car-mile.

Telephone and Telegraph.

A Western Union official, says the *Wall Street Journal,* recently stated that the rapid development of the telephone industry was cutting into the business of the telegraphic companies, particularly the Western Union. So far as exchange service is concerned, the Western Union and the American Telephone sub-companies can not be considered. In the long-distance service of the American Telephone Company and the toll service of the thirty-four sub-companies, the two industries are more or less competitors, and an analysis of the development of these two competing lines of business in the past ten years reveals the truth of the admission made by the Western Union official.

In the ten years ended December 31 last, the toll and long-distance service of the American Telephone Company and its sub-companies increased from $4,000,000 gross to $30,000,000, a gain of $26,000,000, or 650 per cent. In the same period the gross business of the Western Union increased only $6,815,626 or 30.6 per cent. During these ten years, however, the Western Union has had to meet the sharp rivalry of the Postal Telegraph Company, practically all of the growth of which has been crowded into the past five or six years and the bulk of which has been at the expense of the Western Union.

The following table shows the rapid growth in the toll-line telephone business:

Gross.	Toll and Long Distance.	Western Union.
1905	$30,000,000	$29,033,635
1895	4,000,000	22,218,019
Increase	26,000,000	6,815,626
Per cent increase	650	30.6

In 1895 the number of telephone toll and long-distance calls per annum was three and one-half times smaller than the total number of messages handled annually by the Western Union. To-day the tables have been reversed and during 1905 the number of toll calls was nearly double the messages handled by the Western Union. The following table outlines this growth:

No. Calls.	Toll and Long Distance.	Western Union.
1905	118,522,000	67,477,320
1895	16,400,000	58,307,315
Increase	102,122,000	9,170,005
Per cent increase.	622.5	15.7

Further evidence of the growth in the capacity of the telephone toll business to compete with the Western Union is found in the rapid increase in toll wire mileage. In 1905 for the first time in the history of the telephone industry, the number of mile of toll wire passed the wire mileage of the Western Union. The expansion of the past ten years is shown as follows:

Miles Wire.	Toll and Long Distance.	Western Union.
1905	1,265,236	1,184,557
1895	305,938	802,651
Increase	959,298	381,906
Per cent increase	313	47

The gross receipts per message have shown little fluctuation in the case of either the telephone or telegraph services. The gross per toll call for 1905 was 25.3 cents and per telegraph message, eliminating "dead-heads," was 31.6 cents, an increase of about one cent per message in ten years for each service.

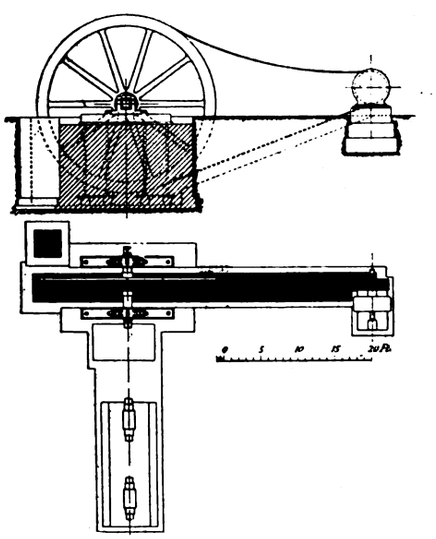
The record indicated sufficiently marked to show a steady trend in public sentiment toward the more extended use of the telephone for purposes for which the telegraph only was considered available a few years ago.

Digitized by Google

An Electrically Driven Tin-Plate Mill.

The few particulars respecting electrically driven tin-plate mills which follow were given in a paper entitled "The Manufacture of Tin Plates," which was read by R. B. Thomas before the Institution of Mechanical Engineers of Great Britain during the recent meeting at Cardiff:

The figure illustrates a tin-plate mill recently put down by the Redbrook Tin Plate Company, Tynewydd works, Wales. The motor is a Siemens Brothers, three-phase induction motor, which takes current from the South Wales Electrical Power Distribution Company's system at 2,200 volts pressure, and a frequency of twenty-five cycles. It is rated at 100 brake-horse-power and has a synchronous speed of 250 revolutions per minute. The load in tin-plate rolling is very variable. Siemens Brothers estimate that, in this



ELECTRICALLY DRIVEN TIN-PLATE MILL.

case, the maximum load reaches two and one-quarter times the normal; that is, when the piece passes into the rolls. At this overload, they state, the motor shows no tendency to fall out of step or to overheat.

The Redbrook company has also put in a cold-roll drive on the same lines. Five pairs of cold rolls are driven through rope gearing, the motor being of the same type and speed, but rated at 125 brake-horse-power. This is stated to be giving every satisfaction.

Switchboard readings for these two motors give the following results: in the case of the mill, on the first and last heat the maximum reading is 180 horse-power and on the second, third and fourth heats the maximum reading gives 120 horse-power to 150 horse-power; in the case of the cold rolls, starting up in the morning, the maximum reading gives 280 horse-power and the normal reading for the five pairs of cold rolls after starting up gives ninety horse-power.

A still more extensive electrical drive for cold rolls has been put in by Messrs. Lewis, of Gorseinon.

For illuminating, electric light is in general use in the tin-plate works in South Wales. The Melingriffith Tin Plate Company, and some others, use electric power to drive the tin house, fitting shop and other light work, and probably for this purpose it will come into general use in the future.

Electricity in Mines.

A very great development has taken place during the past two years in electrical machinery and apparatus for working colliery plant, says *Nature*. Manufacturers seem at last to have realized that machines and accessories must be adapted and made to suit the conditions existing in collieries, and that the collieries can not be adapted to suit their standard machines. Consequently, in the colliery exhibition which has just taken place in London, the result of experience in colliery work was clearly put before us in entirely new designs of motors and switch gear specially adapted for this work.

The details of colliery requirements have been most carefully studied and gone into, and the designs prove the tremendous development that has taken place. Whereas a few years ago contractors simply attached their standard machine to a haulage gear or coal cutter, and supplied the ordinary switch gear as for everyday use, to-day we find that it is the general rule for motors to be designed and built for the particular work for which they are intended, and to be made part and parcel of the machine they have to drive. The same applies to the switch gear, and a large supply of different forms of specially enclosed switches for use in very fiery mines proves how thoroughly the manufacturers have interested themselves in the matter.

The automatic and electrical devices for regulating and signaling in connection with electrically driven winding engines were quite the most interesting and valuable introduction in this year's exhibition, and the fact that by far the greater number of coal cutters and drills which were exhibited were fitted with electric motors should go far to prove that electricity is fighting its way successfully against the older established methods of colliery procedure.

Other arrangements of colliery machinery showing the adaptability of electric motors were well represented by motor-driven pumps, fans, hoists, heading machines and elevators, and among interesting signs of the times were the electrically driven air-compressors.

This development in colliery work is quite in keeping with the expansion of the use of electricity for power purposes which is taking place at the present time. The many power schemes now in hand or being brought before Parliament also show that, although it has been a long time coming, electricity as a motive power for general use may now be said to have "arrived."

London Underground Electric Railways.

Considerable progress has now been made with the new tube railways under construction and the extensions to the existing lines. The Great Northern, Piccadilly & Brompton Railway is approaching completion and it is expected to be ready for opening by the end of the present year. The large accumulator locomotives used for hauling material and construction trains have for some months been a familiar sight along the above-ground portion of the route between West Kensington and Hammersmith, and many of the station buildings are practically complete. The Charing Cross, Euston & Hampstead Railway is also in a forward condition. The tunnels are through almost entirely, the rails are laid and a large portion of cables have been already put in. The dimensions of the tunnels and details of the track work are in all respects similar to those of the Baker Street & Waterloo line, except that the running rails are being laid in forty-five-foot lengths as against the thirty-five-foot lengths of the Baker Street & Waterloo. A large depot, including car shed, stores and repair shops, has been erected at Golder's Green, Hampstead, where the line emerges to the surface, and where one of the largest substations is situated. Construction of the Edgware & Hampstead Railway and of the Edgware & Watford Railway, both of which are authorized and which will form extensions of the Charing Cross, Euston & Hampstead line, has not yet been commenced. The extension of the City & South London Railway to Euston is expected to be ready for traffic in about three months. The two remaining new London electric railways authorized—*viz.*, the North-West London and the North-East London lines, have not yet been commenced.—*Electrician (London), July 27.*

Digitized by Google

Test of a Small Gasolene Electric Light Plant.

The adaptability of the small gasolene engine to drive an electric generator for lighting purposes has raised a number of enquiries among farmers and others as to the practicability of lighting their residences, barns and other buildings with the electric incandescent light, produced by an electric generator driven by a gasolene engine, the engine being used for other purposes also.

With the above enquiry in view a test was made of a small unit, consisting of a two-horse-power, vertical, Fairbanks-Morse Company's throttling-governor gasolene engine, belted to their one-and-one-half-kilowatt electric generator. This unit was installed in the electrical engineering laboratory of the Kansas State Agricultural College, and the data obtained by Messrs. Dow, Carlson and Stoddard, senior students in the electrical engineering course. The outfit was set up and the test started about March 23, and was continued up to June 5. The tests were made for five and ten-hour continuous runs.

The generator was first calibrated or tested for efficiency, which at full load was found to be seventy-one per cent.

The gasolene tank from which gasolene was supplied to the engine was carefully calibrated or gauged, so that at any time the amount of gasolene consumed for a given period could be easily read. Readings were taken immediately after starting and stopping.

The average amount of gasolene consumed for a number of five and ten-hour runs was 1.35 quarts per hour on a full load of eighteen sixteen-candle-power, 110-volt incandescent lamps, which represents a two-horse-power output for the engine. The amount of gasolene consumed per hour when running light, *i. e.*, with no load on the engine, was 0.85 quart. The above figures are based on a grade of gasolene known as "Crown gasolene." Assuming this to cost fifteen cents per gallon, the cost per kilowatt-hour is approximately five cents. (Seven hundred and forty-six watts equals one horse-power, 1,000 watts equals one kilowatt.)

A higher grade of gasolene was tested, but with no better results as to cost.

The average results are shown by the following tabulated data:

Time.	Generator.			Gasolene Qts. per Hr.	Engine H. P.	Cost H. P.-Hour.	Cost K. W.-Hour.
	Volts.	Amp.	Watts.				
10 hours.....	110	9.3	1,023	1.35	2	$0.0253	$0.0495

The generator was operated at its rated speed, 1,850 revolutions per minute, and a test made for voltage regulation. This was done by means of a voltmeter placed across the generator terminals and its fluctuations observed.

With any given load the voltage did not vary to exceed one volt. This is less than one per cent when operating the lamps at their normal voltage, 110 volts. This variation is more rapid than in the case of a steam-driven unit with equal variation, and hence is likely to be more noticeable. A comparative test, however, was made to determine the difference between the incandescent lamps operated by the College steam-driven generator and those operated by the gasolene engine, with the result that little difference could be detected—the casual observer would not distinguish between them.

No attention was required by either the engine or generator after starting on a ten-hour run except to supply water to the cooling tank. The highest temperature of the water in the cooling tank was 185 degrees Fahrenheit.—B. F. EYER, in the *Industrialist*.

SUBURBAN ELECTRIFICATION AT BOSTON.

BY HOWARD S. KNOWLTON.

The statement of Vice-President Van Etten that there is no likelihood of the installation of electricity on the suburban service of the Boston & Albany in the near future is not surprising in view of the conservative attitude which has long characterized the officials of the steam roads terminating at the Hub, in regard to electrification. Then, too, the conditions prevailing in the suburban service between the environs of Boston and the city proper are, on the whole, about as satisfactory as could be expected under the régime of the steam locomotive. Trains are frequent, especially at morning and night; there are numerous expresses to important suburbs on the main lines; commutation rates do not greatly exceed one cent per mile, and the rolling stock is generally comfortable if not always attractive in appearance. Some 835 trains per day are handled in and out of the South Station alone, exclusive of dead mileage in the terminal and its yard.

Ten years ago it is understood that the completion of new electric lines between Boston and the Newton district cut down the passenger traffic on the suburban steam trains of the Boston & Albany Railroad about twenty-five per cent. The latter company has now not only recovered the twenty-five per cent of lost revenue, but has increased its revenues ten per cent above that of 1896. It therefore feels it unnecessary to expend $2,000,000 for the electrification of the Newton circuit line, although the vast terminal electrifications at New York are being carefully watched with an eye toward securing data applicable in some degree to Boston in the future.

Despite the obvious wisdom of drawing every possible lesson from the larger work at New York, it is certainly difficult to cite a suburban service outside the metropolis which offers better opportunity for electrification or a better field for its advantages than the Newton circuit line of the Boston & Albany road. Here we have a double-track loop about twenty miles in length, operating in some of the most beautiful residential districts in the world, stations seldom much over a mile apart, population steadily growing, practically no sharp curves or heavy grades in the track layout, and a volume of train movements each twenty-four hours which could be immeasurably better handled by electricity than by steam, all things considered. Every mile of the circuit is private right of way; there are no long tunnels, and the Charles river winds in its course most accommodatingly as regards desirable power-station sites. There are, of course, difficulties in the South Station yard and train shed which are not to be lightly swept aside, but it is likely that heavy electric railway engineering is equal to any problem of equipment which would be likely to present itself at Boston. The electrification of the Newton circuit line would unquestionably stimulate traffic and be warmly received by the public in Greater Boston if it were carried out, and, even though it be delayed for some years, the experience of the electrified roads at New York, including the New Haven's tentative and actual plans for New England, is likely to lead to an irresistible demand for the improved service in other large urban communities. The tendency of the times is away from the steam locomotive in great cities, and the problems of electrification are no longer as formidable as they were even two or three years ago.

Digitized by Google

SOME NOTES ON THE MECHANICAL DESIGN OF ELECTRICAL GENERATORS.[1]

BY R. LIVINGSTONE.

It is frequently stated that in many cases theory does not agree with practice. I do not altogether hold with this statement, but at the same time I have no doubt that many theories are of very little use in practical work; either because the theories are not far enough advanced, or because we have not sufficient knowledge of the practical conditions to be able to apply them accurately. For instance, in some forms of castings, subjected to a bending stress, we may be able to calculate the bending stress very accurately, yet find if we use a factor of safety of four or five, that the casting fails when put to use; failure being due to high initial contraction stresses. This certainly does not prove that the theory of bending was at fault, but it does show that experience is of the utmost value in its application. It is not sufficient to proportion a casting to suit its working stresses only: great care must be taken in design to avoid contraction stresses, and when it is impossible to do away altogether with them, to use such high factors of safety that the risk of failure will be small. It is certainly a mistake to depend solely on calculation for the design of electrical generators, but at the same time it is a much greater mistake to proportion the various parts of a machine only by their appearance or by intuition, as many draughtsmen do. The ideal designer is one who can judge correctly the relation between the calculated

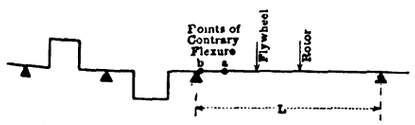


FIG. 1.—MECHANICAL DESIGN OF GENERATORS.

stresses and the actual stresses. In a few cases the calculated will be the actual stresses, and very low factors of safety can be used, but in the majority of cases the calculated will only be in proportion to the actual stresses and proportionately higher factors of safety must be used.

The following notes on the mechanical design of generators mostly relate to direct-coupled generators, and it is hoped they will serve as a safe guide in the design of such machines.

Shafts—In shafts for direct-connected generators the stresses due to bending are so high in comparison with the torsional stresses that the latter may be neglected. The twisting moment, taking the average of a number of direct-coupled machines, may be approximately one-fourth of the bending moments. Then substituting this value in the equation for the torsional equivalent of the combined moments, $B + \sqrt{B^2 + T^2}$ (where B = bending moment and T = torsional moment), we get a value of 2.03 B instead of 2 B, when T is neglected, or an error of 1.5 per cent. This is clearly negligible when we con-

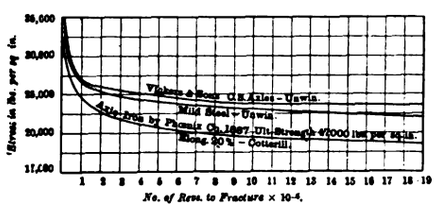

Wöhler & Spaeth's U.S. Axles - Unwin.
Mild Steel - Unwin.
Axle Tests by Francis Co. 1867 - Ultimate Strength 47000 lbs. per sq. in.
Bessemer Steel - Cotterill.
No. of Revs. to Fracture × 10⁻⁴.

FIG. 2.—MECHANICAL DESIGN OF GENERATORS.

sider that the error in calculating the weight of the rotor and flywheel might be as much as five per cent. Although the shaft is really a continuation of the engine shaft, and the point of contrary flexure changes from *a* to *b* (Fig. 1) once every revolution, due to the thrust from the piston being downward during one-half of a revolution and upward during the succeeding half, we are quite justified in assuming that the point of contrary flexure may be at the centre line of the engine bearing when calculating the generator shaft, and may calculate the shaft as a simple beam supported on two bearings, the engine bearing at one end and the outboard generator bearing at the other. The stresses obtained in this manner are due to dead loads only and a sufficiently high factor of safety should be used to take care of the increase of stress due to the eccentricity or out of balance of the rotor. As the stresses are alternating, the breaking load is a load which gives a much lower stress than the actual tensile strength of the material. A few results of tests by various authorities are shown plotted in Fig. 2. It is unfortunate that in the records of those tests the periodicities of alternation have not been given, as this is of even more importance than the number of alternations of stress before fracture. Also the chemical composition of the material, particularly the percentage of phosphorus, would have been a valuable addition to the data published. However, the stress in the shaft may, without fear of fracture, run up to one-quarter of the breaking stress given by an alternating test if the deflection of the shaft is not too high.

The unknown stresses are to such a large extent dependent on the stiffness of the shaft that the allowable deflection is of even more importance than the calculated stress in the material when determining the shaft diameter. This is especially the case in machines which have an unbalanced pull when the rotor is displaced from its central position. It is evident that in such machines the variations of deflection due to small out-of-balance forces cause unbalanced magnetic pulls, which increase the variations of deflection considerably and cause unsatisfactory running of the machine. For this reason the deflection should not exceed a proper proportion of the air-gap. A proportion which is found to give very satisfactory results in practice is ten per cent of the air-gap, in machines which have an unbalanced magnetic pull on the rotor when the rotor is displaced. Equalizing rings on direct-current armatures are said to do away to a great extent with the unbalanced magnetic pull, and on such machines a slightly higher shaft deflection can be allowed, though in no case should the deflection exceed twenty per cent of the air-gap.

Taking the average of a large number of generators, I find that the distribution of load on the generator shaft is such that

$$\delta = \frac{W L^3}{84.5 d^4 \times 10^6} \qquad (1)$$

when the shaft is proportioned to give a

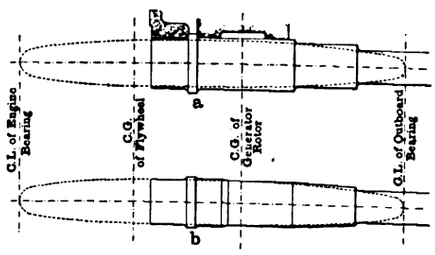


FIG. 3.—MECHANICAL DESIGN OF GENERATORS.

uniform stress throughout, where δ = deflection in inches at the centre line of armature or field, W = weight of flywheel, armature and commutator, shaft and unbalanced magnetic pull, L = length of span in inches (Fig. 1), and d = diameter of shaft at centre line of armature in inches.

Now, if the deflection is limited to ten per cent of the air-gap, taking average air-gaps will give the following allowable deflections:

0.0250 for generators of 100-kilowatt to 300-kilowatt capacity.
0.0375 for generators of 300-kilowatt to 750-kilowatt capacity.
0.0500 for generators of 750-kilowatt upward capacity.

Then, taking formula (1) and inserting

[1] Paper read before the Dick, Kerr Engineering Society. Abstracted in the *Electrician*, London, July 27.

Digitized by Google

the values of allowable deflection, we obtain the diameter of shaft:

$$d = \sqrt[4]{\frac{W L^3}{38.0}}$$ for generators 100 kilowatts to 300 kilowatts (2)

$$d = \sqrt[4]{\frac{W L^3}{42.2}}$$ for generators 300 kilowatts to 750 kilowatts (3)

and $$d = \sqrt[4]{\frac{W L^3}{45.4}}$$ for generators 750 kilowatts upward. (4)

The above will give the diameter of shaft which should be used in ordinary cases—that is, moderate speed machines which have an unbalanced magnetic pull when the rotor is displaced. The value of W should include the unbalanced magnetic pull when the rotor is displaced by an amount equal to the allowable shaft deflection. For high-speed machines the allowable deflection should be less than ten per cent of the air-gap, and for low-speed machines might be as high as twenty per cent. No definite rule can be put down, as each particular case must be decided on its merits. The following short table may serve as a guide for the deflection which can be allowed:

	With Unbalanced Pull. Per Cent of Air-Gap.	Without Unbalanced Pull. Per Cent of Air-Gap.
Low speed, 50 to 150 revolutions per minute.....	12	20
Ordinary speed, 150 to 650 revolutions per minute..	10	15
High speed, 650 to 1,000 revolutions per minute..	8	10

When the diameter at the centre line of the rotor has been obtained by this method the shaft should be checked to see that the stresses give a factor of safety of not less than four, and the shaft proportioned for a uniform bending stress throughout.

Any sudden change in diameter is bad, as where a shaft drops from one diameter to another, there is a break in the continuity of the metal fibre, and so a point is provided where fracture can commence. In fact, it is possible to weaken a shaft by increasing its diameter at a particular point above what is necessary for uniform stress. Changes in diameter then should be made as gradual as possible and the actual longitudinal section should follow as closely as possible the section calculated for uniform strength. Fillets should not be used if possible as changes in diameter are better made with tapers. Fig. 3 will help to illustrate my meaning. The dotted lines show the theoretical section, *a* shows an incorrect shaft and *b* shows the correct section.

THE TWELFTH ANNUAL CONVENTION OF THE OHIO ELECTRIC LIGHT ASSOCIATION.

HOTEL VICTORY, PUT-IN-BAY ISLAND, OHIO, AUGUST 21, 22 AND 23.

The twelfth annual convention of the Ohio Electric Light Association will be held at the Hotel Victory, Put-in-Bay Island, Ohio, August 21, 22 and 23. A fine programme has been arranged, the second day's session being devoted largely to the commercial end of central station work.

An elaborate programme of entertainment is being prepared, particular efforts being made to render these issues of especial enjoyment to the ladies. Through the courtesy of the manufacturers a number of valuable prizes will be awarded to the successful contestants in the games which will be conducted.

The following programme has been announced:

TUESDAY, AUGUST 21.

Meeting of all committees, 1.00 P. M.

FIRST SESSION, 1.30 P. M.

Address of acting-president, W. E. Russell, Massillon, Ohio.

Papers—"High-Efficiency Lighting Units in Ohio by Central Station Men," A. N. Cope, Public Service Company, Columbus, Ohio; T. D. Buckwell and J. W. Gilmartin, Toledo Railway and Light Company, Toledo, Ohio; C. C. Collins, Columbus Railway and Light Company, Columbus, Ohio.

Papers—"New Lamps and New Opportunities," F. W. Wilcox, General Electric Company, Harrison, N. J.

General talk on Nernst lamps, Max Harris, Nernst Lamp Company, Pittsburg, Pa.

Entertainment—Automobile ride around the island and visit to the caves for the ladies; prize contests and bathing; evening band concert and reception.

WEDNESDAY, AUGUST 22—FIRST SESSION, 9.30 A. M.

"Best Methods of Increasing Business"—Papers—"As Applied to Small Cities and Towns," Samuel M. Rust, Greenville Electric Light and Power Company, Greenville, Ohio. "As Applied to Cities," W. C. Anderson, Canton Light, Heat and Power Company, Canton, Ohio. "As Applied to Large Cities," Frank M. Tait, Dayton Lighting Company, Dayton, Ohio.

"Successful Ways of Increasing Business"—Papers—J. Kermode, Cleveland Illuminating Company, Cleveland, Ohio; J. H. Maxon, Gallipolis Light and Coke Company, Gallipolis, Ohio; D. W. Low, Alliance Gas and Electric Company, Alliance, Ohio; E. H. Beil, Youngstown Consolidated Gas and Electric Company, Youngstown, Ohio; M. E. Turner, Cleveland Illuminating Company, Cleveland, Ohio.

SECOND SESSION, 2.00 P. M.

Papers—"Gas Engines in Competition with Electric Motors," Wm. Wolls, Columbus Railway and Light Company, Columbus, Ohio.

"Advertising and New-Business Getting," Chas. A. Parker, Detroit, Mich.

"Wiring of a $3,500 Residence Scientifically Lighted," J. R. Cravath, Chicago, Ill.

"Series Luminous Arc Rectifier Systems," N. R. Birge, Schenectady, N. Y.

EVENING.

Rejuvenation of Sons of Jove.

Entertainments—Card party for ladies for prizes, forenoon; bowling contest and croquet for prizes; bathing and trolley ride; grand ball, evening.

THURSDAY, AUGUST 23—FIRST SESSION, 9.30 A. M.

Papers—"Report of Committee on Cost Determination," E. J. Bechtel, Toledo Railway and Light Company, Toledo, Ohio.

"Report of Committee on Publicity," B. S. Young, Ada Water, Heat and Light Company, Ada, Ohio.

"Legislation, Its Uses and Abuses and Report of Advisory Committee," D. L. Gaskill, Greenville Electric Light and Power Company, Greenville, Ohio.

"Report of Committee on Uniform Accounting and Records," F. E. Crawford, Library Bureau, Cleveland, Ohio.

SECOND SESSION, 2.00 P. M.

Paper—"Electric Heating Devices, their Latest Commercial Developments," H. J. Mauger, Schenectady, N. Y.

Report of secretary and treasurer.

Election of officers.

Question Box.

Executive session.

Entertainment—Finishing of contests for prizes; bathing and games.

Officers, 1905-1906—W. E. Russell, acting president, Massillon, Ohio; D. L. Gaskill, secretary-treasurer, Greenville, Ohio.

Committees for twelfth annual convention—reception committee—B. S. Young, Ada, Ohio; W. J. Hanley, Columbus, Ohio; George Dusenberre, Cleveland, Ohio; A. A. Serva, Ft. Wayne, Ind.; L. B. Hoit, Cleveland, Ohio; George Porter, Columbus, Ohio; N. C. Cotabish, Cleveland, Ohio; Elliot Reynolds, Pittsburg, Pa.

Entertainment committee—F. W. Wilcox, Harrison, N. J.; A. C. Robeson, Greenville, Ohio; Fred Bissell, Toledo, Ohio.

Committee on arrangements—E. J. Bechtel, Toledo, Ohio; M. C. Hull, Columbus, Ohio; E. F. Gwynn, Delaware, Ohio; E. H. Beil, Youngstown, Ohio.

Digitized by Google

Electric Railway Statistics for Greater New York.

A pamphlet has been issued by the board of railroad commissioners of the state of New York in which are given statistics of the electric railway operation in Greater New York for the months April, May and June of this year, and, for comparison, the corresponding figures for the same months in 1905. The statistics cover the surface, elevated and subway lines.

The Manhattan division (elevated) of the Interborough Rapid Transit Company took in, during the quarter considered, 69,164,266 cash fares, an increase of 4,612,563 over the corresponding quarter of 1905.

The heaviest day was in April, when 938,959 cash fares were received.

The car-mileage for the recent quarter was 15,412,742, a decrease, as compared with the same months in 1905, of 460,871.

The total number of passengers carried on the subway for the quarter was 37,161,607, and the car-mileage was 8,656,535. The increases as compared with last year were 10,219,312 passengers and 961,413 car-miles.

The New York City Railway Company (surface) took in during the last quarter 101,971,383 cash fares, an increase of 2,911,928.

The car-mileage was 14,897,170, a decrease of 787,561.

The greatest number of passengers carried on one day was in May, it being 1,846,538.

The total number of cash fares for the borough of Manhattan for the quarter under consideration was 208,297,256, an increase of 17,743,800 as compared with the corresponding quarter of 1905.

The total car-mileage was 38,966,447, a decrease of 287,019.

For the borough of Brooklyn the following statistics are given:

The Brooklyn Heights Railroad Company took in 96,275,361 cash fares, an increase of 7,700,572 over the corresponding quarter of 1905. The car-mileage was 16,970,757, an increase of 965,913. The heaviest day was in June, when 2,129,264 passengers were carried.

The Coney Island & Brooklyn Railroad Company took in 9,462,173 cash fares and made a mileage of 1,813,041. There was an increase over the 1905 quarter of 517,083 fares and 25,876 miles.

The Van Brunt Street & Erie Basin Railroad Company collected 512,793 cash fares and made a mileage of 54,176. The increase in fares over 1905 was 47,009 and the decrease in mileage 567.

Figures in detail are given for the other three boroughs. The following is the general recapitulation for the whole city:

GENERAL RECAPITULATION.

ALL BOROUGHS.

Cash Fares.

	1905.	1906.
Boro. of Manhattan.	190,553,453	208,297,256
Boro. of Bronx.....	6,019,861	8,923,465
Boro. of Brooklyn..	97,985,663	106,250,327
Boro. of Queens.....	5,756,034	6,364,443
Boro. of Richmond..	2,144,676	2,549,359
Total	302,459,687	332,384,850
Increase		29,925,163

Transfers.

	1905.	1906.
Boro. of Manhattan.	41,150,524	46,844,211
Boro. of Bronx.....	4,147,299	4,356,415
Boro. of Brooklyn..	22,085,667	34,817,773
Boro. of Queens.....	1,023,280	1,212,174
Boro. of Richmond..	209,139	288,700
Total	68,615,909	87,519,273
Increase		18,903,364

Car-Mileage.

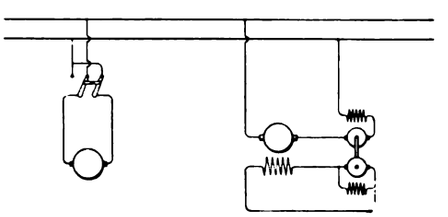
	1905.	1906.
Boro. of Manhattan.	39,253,466	38,966,447
Boro. of Bronx.....	1,656,516	2,025,433
Boro. of Brooklyn..	17,846,752	18,837,974
Boro. of Queens.....	1,168,947	1,256,711
Boro. of Richmond..	578,886	670,883
Total	60,504,567	61,757,448
Increase		1,252,881

A New South American Power Plant.

The city of Nichtheroy, some thirty miles north of Rio de Janeiro, Brazil, South America, has given its name to a new electric transmission system for supplying power and light to the towns of Cascatinha and Mage as well as the title city. Electricity is to be generated by water power and transmitted at 44,000 volts to substations at the cities mentioned. The installation is representative of the most modern engineering. At the main generating station the initial equipment will comprise three three-phase, revolving-field, 2,000-kilowatt generators, built by the General Electric Company. These machines, as well as two seventy-five-kilowatt exciter sets, will be driven by water-wheels made by J. M. Voith & Company, of Wurtemburg, Germany. The excitation current for the main governors will be furnished at 220 volts, the generator voltage being 2,300. This voltage will be stepped up to 44,000 volts in a bank of six water-cooled transformers, each having a capacity of 1,000 kilowatts and operating at sixty cycles. There is to be a spare 1,000-kilowatt transformer and a 3,000-kilowatt generator as a reserve. A very complete switchboard will be installed, all switches as well as rheostats being electrically operated from the board by remote control so that there will be no high-tension wiring at the switchboard. From the main generating station the power is to be delivered over a steel tower line to the three substations named in the foregoing. At the substations the transmission voltage is reduced to 6,600 volts for the local delivery. For this purpose there will be four 750-kilowatt transformers at Nichtheroy and four 350-kilowatt transformers at each of the other stations, Cascatinha and Mage. In each station one of the four transformers will be installed as a reserve. The complete electrical installation will be furnished by the General Electric Company through its representatives, Guinle & Company.

Distant Control of Electric Motors.

Horace F. Parshall, London, England, has obtained a patent (827,322, July 31) for an improved distant control electric motor, which he has assigned to the General Electric Company. The invention relates to systems of motor control of the type in which the motor is located at one point and its controlling mechanism at a point distant therefrom. Such systems are of particular application in the operation of electrically driven valves in ship-steering gear and the like. In systems of this type heretofore employed, in addition to the mains which supply the current to the motor other conductors are employed between the controlling point and the motor in order to control the direction of rotation of the motor. The principal object of the present invention



DISTANT CONTROL OF ELECTRIC MOTORS.

is to do away with these control wires and to provide means by which the direction of rotation of the motor may be reversed by simply reversing the direction of current in the supply mains. The invention consists in the combination of supply mains, a motor having one of its members connected to the mains and subjected to the same changes in direction of current as occur in the mains, and a motor-generator fed from said mains and operated to maintain the direction of current in the other member of the motor unchanged during changes in direction of current in the mains.

Digitized by Google

All-Steel Cars Adopted for the New York City Tunnel of the Pennsylvania Railroad.

The accompanying illustrations give an idea of the non-collapsible, fireproof passenger cars which have been adopted for the New York city tunnel of the Pennsylvania Railroad. This car, number 1651, has been placed temporarily on one of the company's regular local runs, and minute reports are being made as to its work.

The future passenger equipment is to be of steel, not only the frame and bodies, but of non-combustible material in every particular. The decision now definitely reached by the company will call for about 1,000 unburnable railroad cars to be ready when the New York tunnel is completed. It will also call for some 500 Pullman cars, which must also be of completely non-combustible construction. At the request of the Pennsylvania Railroad, the Pullman Company is now building the first all-steel sleeper ever constructed. It will be inspected by the Pennsylvania officials at an early date.

The new car weighs 103,550 pounds as against 84,900 pounds for the standard wooden coach. It is found that the added weight greatly reduces the vibration, adding to the comfort of the passengers. No inconsiderable part of the additional weight is due to the carrying of storage batteries and battery boxes. All the new cars are to be lighted by electricity, and the Pennsylvania company will carry no gas-illuminated cars of any kind into the New York tunnel. The electrical circuits of the new cars are all thoroughly insulated, and are placed in heavy metal conduits.

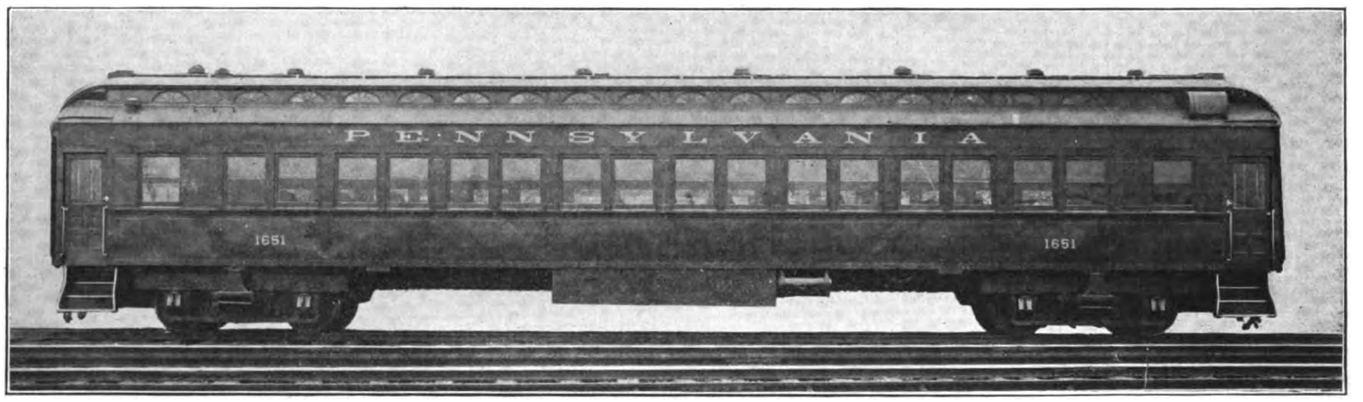
It is stated that the new car is absolutely non-collapsible. The concealed frame work is built on the cantilever principle, suspended upon the trucks as piers. Safety against telescoping is secured by the use of heavy steel girders, the principal feature in the body of the car being a central box girder twenty-four inches wide by nineteen inches deep, extending throughout the length of the coach.

An attempt has been made to overcome the tendency, when trains are in collision, of the first car to sweep the superstructure of the second car off its underframe. In the new equipment, this is prevented by extraordinary strength in the door and vestibule end posts, which are of heavy rolled steel.

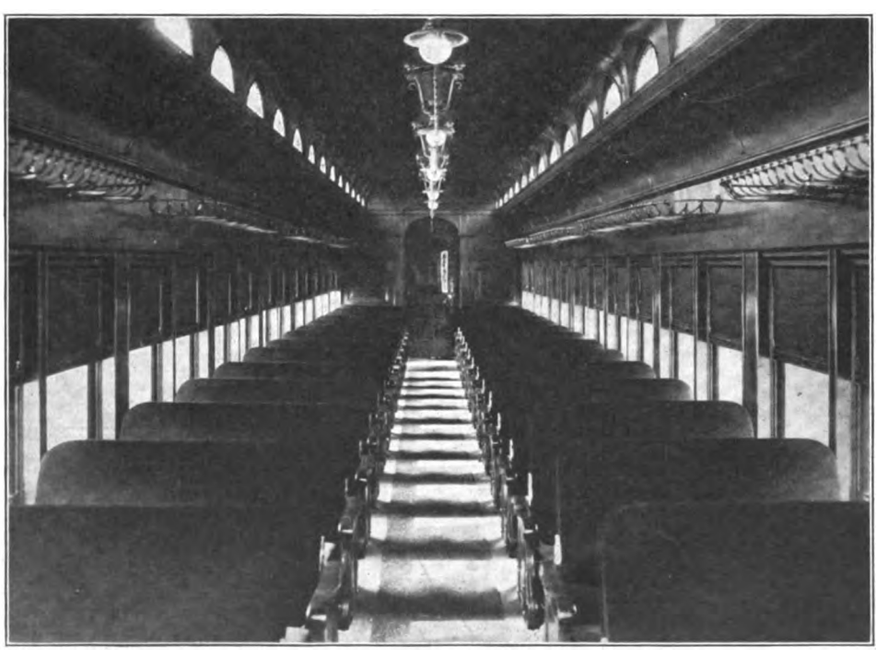
The flooring throughout the car and platform consists of an imitation of stone, spread, while in a plastic condition, over steel plates. The framing above the windows is composed of steel plates. The doors are composed of steel plates pressed into shape, imitating the wooden doors used in other cars and filled with cork to deaden the sound. The roof is constructed of composite boards covered with copper sheathing. The inside lining consists of composite boards covered with fireproof paint.

In the experimental car the seats are all of steel frame covered with fireproof plush. The foot-rests are also steel. For the present, the arm-rests are of wood, but experiments are now being made with various metals in the effort to secure a non-combustible material which will not be cold to the touch.

A coupler arrangement of a new type, said to be stronger than anything ever used before, has been designed for this car to avoid any possibility of breakage with the resultant parting of the train.



THE NEW FIREPROOF CAR FOR THE NEW YORK TUNNEL OF THE PENNSYLVANIA RAILROAD.

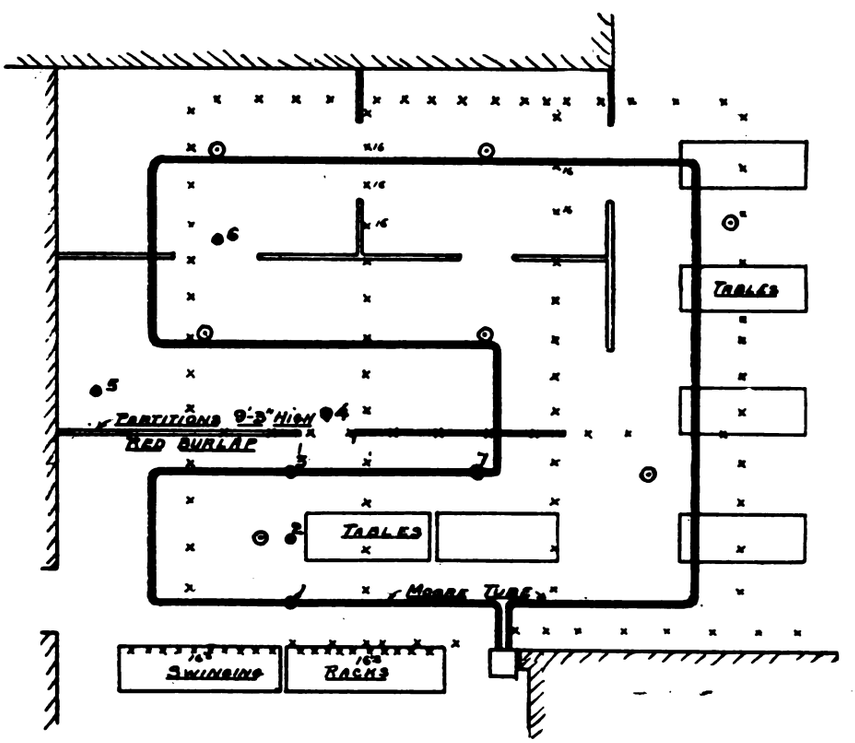


INTERIOR OF FIREPROOF CAR FOR THE NEW YORK TUNNEL OF THE PENNSYLVANIA RAILROAD.

Digitized by Google

A Report on the Moore Tube Lamp.

The following report is interesting, in view of the attention with which the subject of illumination by artificial means is being watched. The report has been made by the Electrical Testing Laboratories, New York city, and the tests were made for the Illuminating Engineering Publishing Company under the general direction of E. Leavenworth Elliott. The lamps were installed in the picture department of the store of L. Bamberger & Company, Market street, Newark, N. J. The general arrangement of the space illuminated and the location of the illuminants is indicated in the accompanying diagram.



LAYOUT OF ILLUMINATING UNITS.

Measurements of illumination of the Nernst, incandescent and Moore lamps were made at seven points in a horizontal plane thirty-four inches above the floor. These test points were located in the space between the exhibition racks, whose illumination constituted the chief object of the installations. They are indicated on the diagram already referred to.

The ceiling of the illuminated space was metallic, finished in cream color. The walls and partitions were covered with red burlap, upon most of which pictures were mounted.

The Moore tube was 179 feet in length and one and three-fourths inches in diameter. The light emitted by the tube was characterized by a representative of the Moore Electrical Company as of an "orange tint." The tube had been in service about 1,000 hours, having been installed March 16, 1906.

The Nernst lamps were of the six-glower, alternating-current type, with opalescent globes of bluish tint. Within twenty-four hours before the test they were equipped with new 250-volt glowers. All glowers were burning.

The incandescent lamps were wired to molding on the ceiling, with the exception of twenty sixteen-candle-power lamps used with opaque reflectors for the illumination of certain swinging racks. These latter were of practically no utility in illuminating any of the stations investigated. The total equipment included eighty-eight eight-candle-power lamps and twenty-five sixteen-candle-power lamps. The bulbs of all the lamps were of clear glass and were cleaned immediately before the test.

The intensity of illumination was determined by means of a Weber photometer especially arranged for work of this character. This instrument, together with the instruments used in determining electrical conditions, was carefully verified in the laboratory of the Electrical Testing Laboratories at New York on the day of the test and on the following day.

All electrical values in connection with the Moore tube and the Nernst lamps were determined by instruments belonging to the Electrical Testing Laboratories, placed in circuit upon the service during the test. Because of differences in wiring arrangements for the incandescent lamps similar values could not be determined without great difficulty. Consequently, it was decided to remove nineteen of the lamps from their positions and by supplementary test, considering these lamps as representative of all those installed, determine with sufficient accuracy the total energy consumed by the incandescent lamps as installed. With this end in view the voltage conditions were carefully determined during the test, and supplementary tests at the Electrical Testing Laboratories upon the incandescent lamps were made at voltages as determined.

All the illuminants were used without reflecting devices of any kind.

RESULTS OF TEST.

Height of ceiling, ten feet eleven inches. Plane investigated, horizontal, thirty-four inches above floor.

	Moore.	Nernst.	Incandescent.
Height of illuminant above floor	9 ft. 6 in.	8 ft. 10 in.	10 ft. 8 in.
Number of units	1 tube, 179 ft. long, 1¾ in. diam.	7 6-glower lamps (250-volt glowers)	88 8-C.-P., 25 16-C.-P. lamps, clear bulbs
System	60-cycle	60-cycle	60-cycle
Average voltage of circuits during test	243	244	117
Kilowatts	3.15	3.92	4.13 (est.)
Volt-amperes	56.40	88.90	....
Indicated power-factor	56%	Unity	....

INTENSITY OF HORIZONTAL ILLUMINATION.

Test Station No.	Moore.	Nernst.	Incandescent.
1	68 luces	41 luces	21 luces
2	68 "	67 "	16 "
3	76 "	52 "	16 "
4	77 "	39 "	19 "
5	18 "	17 "	3 "
6	68 "	78 "	12 "
7	63 "	15 "	17 "
Average	68 luces	44 luces	15 luces
Average variation from mean index of degree of uniformity	20.3%	41.7%	28.1%
Average luces per unit energy	20.0%	11.2%	3.6%

NOTE 1—As all instrument parts, as well as the operator, were below the plane in which measurements of illumination were made, low intensities, such as those found at Station 5, can not be ascribed to objective interference.

NOTE 2—The unit of illumination used in this report is known as the lux, and is equivalent to the illumination produced on a plain surface by a source of one-candle-power at a distance of one meter, the rays of light falling upon the surface perpendicularly. One foot-candle is equal to 10.76 luces.

NOTE 3—All figures setting forth consumption of energy by the Moore tubes are measures of total energy consumed by

Digitized by Google

the Moore tube system, including all auxiliaries.

SUPPLEMENTARY TEST ON INCANDESCENT LAMPS.

Lamp No.	Rated Volts.	Operating Volts Tested at	Candle-Power.	Watts.	Watts per Candle.
1	No rating	117	7.2	31.5	4.37
2	" "	117	6.4	30.9	4.82
3	115	117	6 3	32 9	5.22
4	115	117	8.0	33.1	4.14
5	115	117	8.1	33.5	4 13
6	114	117	6.5	33.2	5.11
7	No rating	117	8.1	34 5	4 26
8	" "	117	7.0	31.9	4.56
9	115	117	7.7	33.1	4 30
10	No rating	117	6.4	31.3	4.90
11	115	117	7.7	33.2	4.31
12	No rating	117	4.3	27.3	6 24
13	115	117	9.6	36 4	3.79
14	117	117	7.4	32.1	4.33
15	No rating	117	6.2	29.1	4.70
	Average.....		7.1	32.3	4.62
1	118	117	12.2	52.4	4.29
2	115	117	15.0	50 6	3.38
3	115	117	13 7	55.6	4.06
4	110	117	18.5	49.2	3 65
5	115	117	15.5	50 8	3 22
	Average.....		14.0	51.7	3.73

ELECTRICAL TESTING LABORATORIES.
PRESTON S. MILLAR.

Checked by E. FITZGERALD,
July 18, 1906.

BLOW TO BAGGAGE MEN.

TRAVELING MEN DO NOT CARRY AS MUCH BAGGAGE AS FORMERLY.

Has the newly inaugurated interurban system and the increased trains on the steam roads brought the existence of the transfer men to a close and diminished the number of commercial men to about one-half, especially in this part of the state? asks the Springfield (Ill.) *News*. This question was discussed in the passenger office of one of the railroads by a man from a transfer company and the railroad agent. The question came up after a remark by the agent of the road that he never sees the trucks of the baggage man laden with the number of trunks which he was in the habit of seeing some few years ago when many times the trucks would hardly be able to hold the trunks of one commercial man, so great was the amount of samples that he then carried. This brought out the statement that the baggage of the commercial men passing through Central Illinois had decreased twenty-five per cent of the original size, and where two men were on the road for the same house in this immediate vicinity one has been taken off. This condition has brought about less business in the way of passengers for the transfer company, and the man from that company gave his reasons for the outcome. He laid it all at the door of the new interurban railways scattered thickly in this district and spoke of the decrease in his business here in Springfield. The transfer man stated that it is noticeable to him that men whom he sees coming in on the early morning train he will find leaving in the afternoon on trains which have been added to the service of the railroads because of the universal demand for additional and better service. Sometimes this same traveling man, while he may have several trunks, he has discovered that he is able to get out again early in the afternoon if he can get through, so he will not burden himself with having his trunks taken to the hotel, but will have one taken down and the balance left at the depot, so in case he has no use for them he will be able to catch the first train out without any difficulty. He is aware that he can get them on a minute's notice, but he realizes to take them all to the hotel and have them opened and the contents properly arranged about the sample room would take up the greater part of the morning, and should he find there was "nothing doing" he would be unable to catch the first train in the afternoon.

"When a traveling man has discovered that he is through with a town, there is but one other thing troubling his mind," said the transfer man, "'How can I get to the next place and how quick?'" Right here is where the reduction in the force of men covering the territory comes in. One man was formerly unable to go over the ground the company had given to two men and this was due to the poor service of the steam roads and the lack of interurbans. Now this same territory may be covered by one man in less time than two formerly covered it, and instead of two men and two sets of trunks to handle the transfer man has but one. Here again the interurban plays an important part in the passing away of the profitable transfer business. The interurban, which, it must be admitted, secure their share of the patronage of the commercial men who make the local stops and who formed the bulk of the transfer companies' business, now carry their passengers into the business districts of the city, and in most cases drop them within a few doors of the hotel. Here there is no cab fare, and in some cities, although not here, the hotels have their patrons use their own truck and go to the interurban depot and secure the guest's baggage. By this method the transfer man has no chance at the change of the traveling man, but the poorly paid hotel employé is given the benefit. So with half the men covering the territory as formerly, and with the disappearance of the cab service, occasioned by the electric lines running close to the hotels, and the baggage and commercial men reduced to just one-half, the transfer man is beginning to feel inroads on his business. The question rises, how are the hotels and railroads affected by the reduction of the force. While the hotels may somewhat suffer, yet the railroads are hardly affected, as the same amount of territory to be covered is just the same and just as often, and it is immaterial if one man pays two fares to the company or two men pay one fare each; it is equivalent in the end. The steam roads, of course, see a falling off of their local business occasioned by the inauguration of the interurban service, but then it seems to have aroused the desire on the part of the people to move and a greater traffic to more distant points has been created. The hotel men are not badly hurt by this new condition. While they may not have the commercial men in their hotels as long as formerly, yet by the great amount of men who run to this city after supper on the interurbans, rather than stay in the country over night, they are given a new business which amounts to more than the loss occasioned by the reduction of men covering the territory, and a man may now be the guest of one of the hotels every night during the week, yet in the day be working hard in one of the small towns a few miles from here. This was formerly impossible, owing to the poor service at these small stations, and when a man was seen to leave the hotel with his grip it was generally for good, but today it is generally for only a few hours. Then, too, the hotels are benefited by the increased patronage of their dining rooms and cafés. People who come to town must eat, and when there is no particular hurry about getting back to their homes they will prefer a hotel where they may spend a comfortable hour and then return on the late train or cars. As a matter of fact, there appears to be but one man and one business which has been seriously injured by the inauguration of the new system, and that is the transfer man in the city who has depended on the business between the hotels and the depots for his subsistence.—*Interurban Railway Journal.*

Aluminum.

Of its yearly production, estimated at above 10,000,000 pounds, the Pittsburg Reduction Company apparently exports but little of its aluminum. For June there was shipped from the United States aluminum valued at $40,364, bringing the year's total up to $318,531. Estimating the average price of the metal at thirty-three cents a pound, we have exports of only 9,652 pounds.

Digitized by Google

EFFICIENCY OF STEAM PLANT.[1]

BY WALTER A. VIGNOLES.

PRELIMINARY.

A year or two ago, the author's attention was called to the amount of coal used in electricity works per unit generated, and to the statement made in certain quarters that, to do an equivalent amount of work, engineers on board ship used considerably less coal than electrical engineers in their central stations; this led to the investigation of the quantity of coal and water used in the electricity works at Grimsby, of which the author is the electrical engineer, in order to test the accuracy of this statement.

Last year the author wrote a paper, which was published in the *Electrician* (London), in which the coal consumption in electricity works was compared with the published results of the steam trials of warships. In this paper a table was given (table 1), comparing the result of the trials of a battleship and of a cruiser, with a test run at the Grimsby electricity works. For purposes of comparison the marine engines were considered as driving dynamos, the overall efficiency being taken at eighty-five per cent, and the coal per kilowatt-hour was worked out on that basis. The two ships taken were the best and worst in the steam trials made during 1904. It will be seen that the evaporation at Grimsby was in all probability as good as in the case of H.M.S. Diamond, as the latter was no doubt using Welsh coal, while the coal used at Grimsby is fine slack; but both the ships used considerably less steam per kilowatt-hour than the electricity works. The author has endeavored to analyze in the following paper the coal and steam consumption with a view to showing where the losses are incurred, and how they can best be avoided or reduced. Conditions in an electricity works are entirely different to those on shipboard, and it is doubtful if any electricity works can compete in steam consumption with the best results obtained in ships. In this connection the author thinks that one of the great disadvantages on board ship, want of space, is a blessing in disguise. Space is so valuable that the boilers are placed close to the engines, the length of steam pipes is reduced to a minimum, and everything possible is done to avoid complications which would take up room; in this way a great many losses are avoided.

TABLE 1.

COMPARISON OF COAL AND STEAM CONSUMPTION—WARSHIPS AND ELECTRICITY WORKS.

Name of Ship or Works.	I. H. P. or K. W. Full Power.	I. H. P. or K. W. of Test.	Coal per I. H. P.-Hour.	Water per I. H. P.-Hour.	Water per Pound of Coal.	Assumed Overall Efficiency.	Equivalent Coal per K. W. Hour	Equivalent Water per K. W. Hour.
Battleship Commonwealth.....	18,562 I. H. P	12,797	1.67	16.77	10.0	85%	2.66	26.6
Third-class cruiser Diamond.....	10,666 I. H. P.	10,066	2.98	21.6	7.25	85%	4.7	34.1
Grimsby electricity works, test peak, February 10, 1904.....	900 K. W.	211	....	.....[1]	6.57	....	7.1	46.6[1]

[1] Excluding stand-by coal.

In considering the coal consumption of an electricity works, it is convenient to divide the subject into two parts:

A. Boiler house economy, or the generation of steam in an economical manner; where the problem is to deliver into the steam range as many pounds of dry steam per pound of coal as possible, and,

B. Plant economy; where the problem is to generate the energy with the minimum weight of steam delivered into the steam range, this including the steam used for auxiliaries; or, if the station has electrically driven auxiliaries, the units generated being considered to be the total units generated less the units used on the station for auxiliary purposes.

A. BOILER HOUSE ECONOMY.

In the first place, to produce steam economically, the fuel must be burnt in an efficient manner, and the total heat units in the coal developed. To ensure this the fuel must be burned on a properly constructed grate, or by automatic stokers of a suitable pattern. Sufficient air must be supplied to the fire to ensure all the carbon in the coal being properly burned,

TABLE 2.

SHOWING PERCENTAGE OF TOTAL COAL BURNT, USED FOR STAND-BY PURPOSES.

	Figures for Week Ending October 13, 1904.		Estimated for One Week.		Estimated for One Week.	
	Totals.	Per Cent.	Totals.	Per Cent.	Totals.	Per Cent.
Units generated per week	23,241	...	27,510	...	2,520	...
Average per twenty-four hours	3,320	...	3,930	...	360	...
Maximum load, kilowatts	440	...	640	...	150	...
Load-factor, per cent	31.5	...	25.6	...	10	...
Number of boilers in use	3	...	4	...	2	...
Total coal burnt in week, tons	79.75	100	92.0	100	13.75	100
Coal for banking fires on boilers required for peak	1.5	1.9	3.0	3.3	1.5	10.9
Coal for banking fires on boilers kept as spares and used on peak, say, once a week	2.6	3.2	2.6	2.8	1.0	7.2
Total coal used for stand-by purposes	4.1	5.1	5.6	6.1	2.5	18.1

and to prevent any CO being left in the products of combustion. As is well known, if sufficient air is not supplied, CO is formed, and there is a great loss of heat owing to the combustion being incomplete, the heat generated by the combination of CO and O to form CO^2 being a considerable proportion of the total. On the other hand, the amount of air supplied must not be too great, otherwise the temperature of the gases is reduced unnecessarily, and there is a considerable loss owing to heat being carried away by the excess of air. It is usually considered that twelve to fifteen per cent of CO^2 is about the maximum to be anticipated in the flue gases, and in order to get this percentage it is necessary that the boiler, if of the water-tube type, should be enclosed by a thoroughly airtight casing to avoid air being drawn through the brickwork and so diluting the gases. CO^2 recorders have been recommended on many occasions, but, personally, the author has no experience of them.

The best way to make the setting of the boiler airtight is to entirely enclose it in a sheet-iron casing, as it appears to be difficult to avoid air leaks with brickwork settings.

As regards mechanical stokers the author has found the underfeed type very satisfactory, and thinks they offer many advantages. In working this type of stoker the fire should, in a water-tube boiler, be eighteen to twenty-four inches thick, and it is then difficult for an excess of air to pass through the fire, unless it burns into large holes; with the forced

[1] Paper read at the recent convention of the Incorporated Municipal Electrical Association, London.

Digitized by Google

draught in use the damper of the boiler can be kept very nearly closed, the opening being just sufficient to carry away the gases. The pull of the chimney on the casing of the boiler is then very much reduced, and less air passes through any leaks that there may be. The principal advantage with this type of stoker is that no moving parts are required in or near the fire, with the result that, if properly designed, the stoker costs very little for repairs as compared with those patterns where moving bars are used.

Five boilers at Grimsby are fitted with underfeed stokers of two different makes: these have been in use for from two to three years and have cost $36.75 per boiler per annum for repairs. This works out at four cents per ton of coal burnt by the stokers, and includes substituting steel worms for those originally fitted. Interest and repayment on the capital cost works out at 10.4 cents per ton of coal burnt, but the boilers have not been fully loaded.

Tests made at the works show that the efficiency of the boilers is about the same in the daytime as during the heavy load, and this is what might be expected, as boilers are added as the load comes on, each working at a moderate load as in the daytime. A certain amount of coal is used for stand-by purposes, for banking fires, etc., and on the tests published in the paper previously referred to, the amount of this varied from two to five per cent.

Table 2 shows the stand-by coal during one actual week and two estimated weeks, with different load-factors, and shows how variations in the latter affect the amount of coal required for this purpose.

Table 3 shows the results obtained by Ruthven Murray on the plant at Willesden as stated by him in a letter to the *Electrician*, June 30, 1905, and is useful for comparison.

TABLE 3.

TESTS MADE BY RUTHVEN MURRAY AT WILLESDEN—PUBLISHED IN A LETTER TO THE "ELECTRICIAN," JUNE 30, 1905.

Time.	Coal Percentages.				Evaporation.				Lbs. Coal per B. T. U.		Weight of Water per B. T. U. (Lbs.)
	Firing to Total.	Banking to Total.	Bringing Up to Total.	Banking, etc., to Firing.	Lbs. Water per Lb. Fuel, Total.		Lbs. Water per Lb. Fuel, Firing.		Firing.	Banking.	
					Actual.	From and at 212°.	Actual.	From and at 212°.			
8 A. M. to 4 P. M.	100.0%	.....	.....	.....	8.96	9.61	8.96	9.61	3.24	....	29.03
4 P. M. to 12 M	93.6%	.....	6.4%	6.9%	8.81	9.3	9.41	9.91	3.17	.217	29.77
12 M. to 8 A. M	81.1%	9.45%	9.45%	23.5%	11.1	11.47	13.7	14.07	5.7	1.34	78.14
24 hours	94.2%	1.1%	4.7%	6.29%	9.14	9.65	9.7	10.22	3.34	.21	32.44

TABLE 4.

TWO 24-HOUR TESTS ON PLANT AT GRIMSBY ELECTRICITY WORKS.

		May 3, 1906.	May 5, 1906.
Date of test			
Duration of test		24 hours	24 hours
Plant running		20 "	20 "
UNITS.			
Total generated		3,057	3,328.2
Used by fan		70	71
" " per cent total generated		2.29%	2.15%
Useful units generated		2,987	3,257.2
COAL.			
Total burnt	Lbs.	29,120	29,624.0
" " for stand-by	"	426	448
Per unit generated	"	9 54	8 9
Per useful unit generated	"	9.75	9.1
Average air pressure in main duct	Ins. water	1.84	1.75
Average air pressure in ash pit while draught was in use.	"	.72	.78
WATER.			
Total pumped to boilers	Lbs.	192,300	174,400
" used by stokers	"	4,810	4,360
" loss separator drains	"	5,750	4,199
" loss blow-down and gauge glasses	"	5,790	5,152
" from condenser	"	148,525	142,174
" balance unaccounted for	"	27,425	18,515
" water per pound of coal	"	6.6	5.89
" water per unit generated	"	62.9	52.4
Water from condenser per unit	"	48.6	42.7
PER HOUR.			
Units—Total per hour	Lbs.	152.8	166.4
Useful " "	"	149.3	162.9
Coal—Burnt per boiler per hour	"	832	871
" " stoker " "	"	416	436
Water—To boilers per hour	"	9,615	8,720
From condensers per hour	"	7,426	7,109
Used by stokers per hour	"	241	218
Loss, separator drains, per hour	"	287	210
Loss, blow-down and gauge glasses, per hour	"	290	258
Balance unaccounted for per hour	"	1,371	925
TEMPERATURES.			
Water—Into economizer	Fahr.	88.2	74.0
Out of "	"	232.5	243.0
Gases—Into economizer	"	520.0	548.0
Out of "	"	248.5	250.0

Table 2 shows the stand-by coal during one actual week and two estimated weeks, with different load-factors, and shows how variations in the latter affect the amount of coal required for this purpose.

Table 3 shows the results obtained by Ruthven Murray on the plant at Willesden as stated by him in a letter to the *Electrician*, June 30, 1905, and is useful for comparison.

B. PLANT ECONOMY.

In this part of the subject we have to consider the pounds of steam used per useful unit generated at the terminals of the dynamos. This must include all steam used for auxiliaries of all kinds, such as feed pumps, forced draught engines, condensing plant, etc.; it must also include the steam condensed in the range and separators, discharged from traps or drains, etc., and, if the station has electrically driven auxiliaries, the current supplied to these must, as noted above, be deducted from the total units generated, and the useful units generated alone considered.

The total steam used in the station can be divided into three parts:

A. The amount of steam supplied by the boilers when the plant is ready to generate current, but without actually giving a supply. This includes:

1. Leaks from blowdown pipes, scum cocks, separators on boilers, etc.

2. Leaky drains on steam pipes, condensation in the ranges, blown through separators, etc.

3. Steam required by condensing plant maintaining a vacuum in the exhaust pipe.

4. Steam required for feed pumps, and any other auxiliaries it is necessary to run if the station is working at light load.

5. Steam required for one engine at light load, or supplying the current required for auxiliaries as above.

B. The extra steam required for auxiliaries to deal with the load.

C. The extra steam required by the engines to deal with the load.

The author made numerous tests a year or two ago of the amount of water pumped into the boilers per hour at various loads

Digitized by Google

on the plant, some short tests of two hours' duration, others of twelve and twenty-four hours, and on plotting the water per hour against the average load it was found that the points lay fairly well on a straight line, this line starting at a point above zero indicating the minimum steam consumption. Fig. 1 shows this, and dotted

During the past year the steam consumption at these works has increased, and on making a series of tests at different loads, it has been found that the points of the curve now lie above the first curve (Fig. 2) pointing to some loss of steam at all loads. In order to find the cause of this increase, tests have been

error in these tests; the total water to the boilers being measured by a meter is not very reliable, and tests checking this give somewhat variable results, but the usual figure is two or three per cent slow; but occasionally a test has shown the meter to be fast. It seems difficult at first sight to see how the meter can read fast, but on

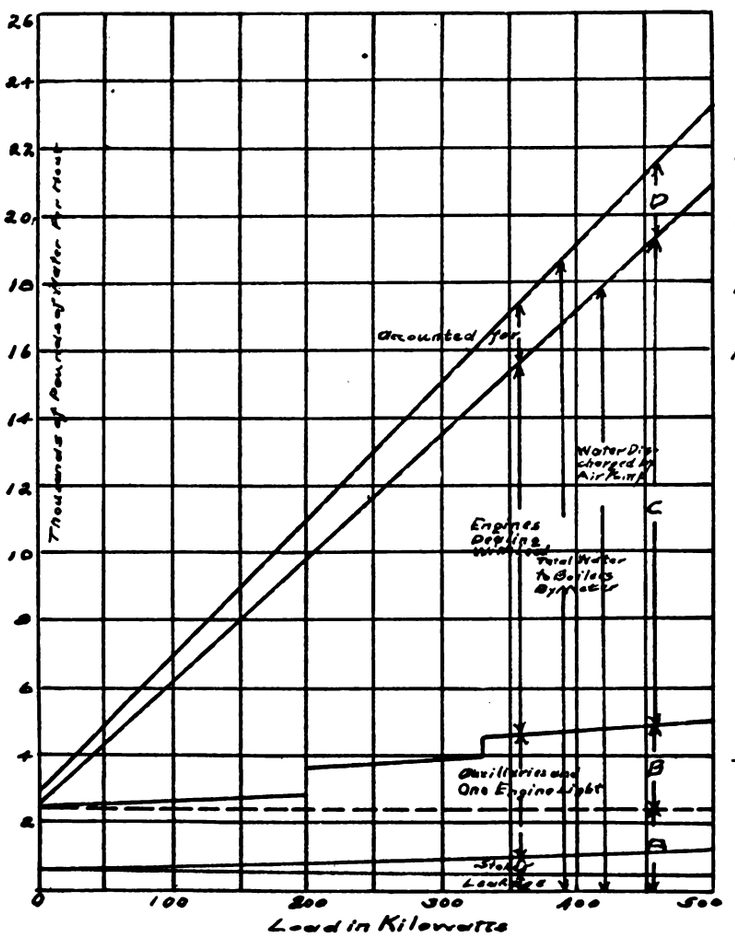


Fig. 1.—Curve Showing Steam Consumption Per Kilowatt at the Grimsby Electricity Works, 1904-1905.

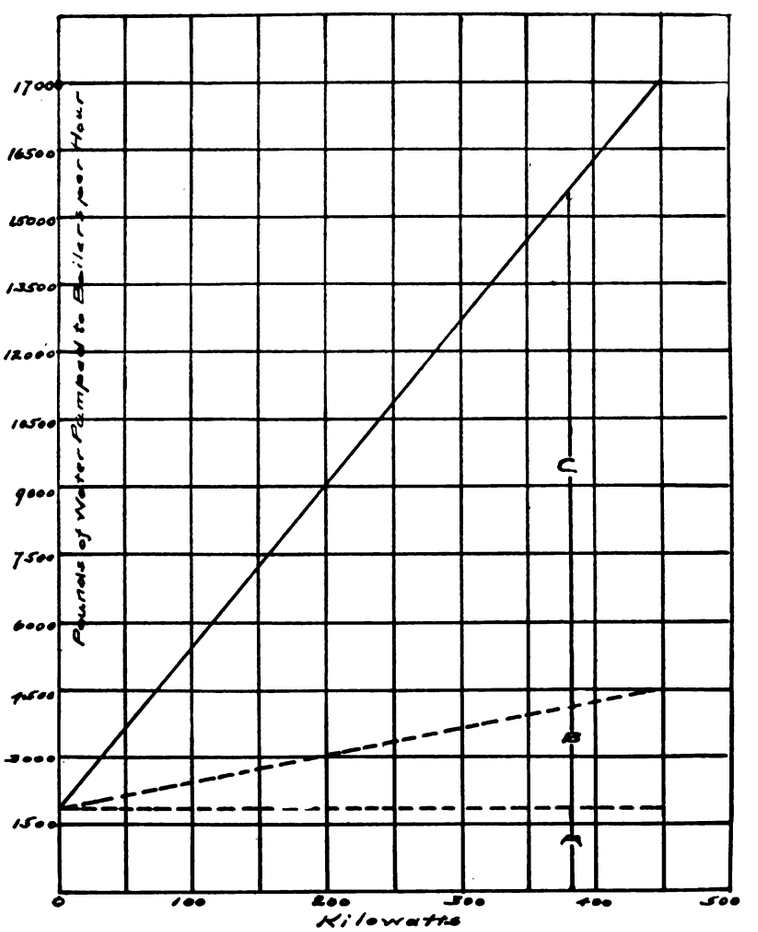


Fig. 2.—Curves Showing Analysis of Steam Consumption of Grimsby Electricity Works, 1906.

lines have been added to show how the total can be divided as set out above. If the steam used at no load be deducted from the total, the steam per kilowatt-hour works out at 33.7 pounds and the total water to boilers per kilowatt-hour is seventy pounds at fifty kilowatts, average load; about fifty-two pounds at 100 kilowatts and 37.5 pounds at 500 kilowatts. This curve is very useful, and is accurate as long as the plant is maintained in the same condition; if the average load on the plant is known for any period, say a day, or a week, or a month, the curve shows what the average steam consumption per hour should be. If such a curve be made for a station when the plant is new it forms a basis for comparison later on to show if the steam consumption is increasing from any cause.

made with a view of analyzing the steam consumption and measuring the losses.

Table 4 shows the results of two twenty-four-hour tests, in which the various losses of steam are shown, as far as can be measured with the apparatus available. The steam used by the stokers is calculated from previous tests, the results of which indicated a steam consumption of 2.5 per cent of the total water supplied to the boilers. The steam actually condensed in the range and blown through the separators was measured in a small condenser, as was the amount leaking from the blow-downs and gauge glasses. The amount of water returned by the air-pump discharge was also measured approximately by means of the tipping gear attached to the water-purifying plant. There are, of course, several sources of

one occasion it was undoubtedly due to air being drawn into the suction pipe by the feed pump, the water for the test being taken through a temporary suction pipe. The tipping gear is not very accurate, and there may be an error of five per cent in the amount of water measured through this.

Table 5 gives the average results of a number of tests of the water discharged from the condenser with the plant running light, ready to supply current, and also shows approximately how this total is made up.

The results of tests of the water discharged by the air pumps at various loads are shown by a line on Fig. 2, the starting-point being the amount of water discharged by the condenser at light load as given in table 5. The difference be-

Digitized by Google

tween this line and that showing the total water to the boilers is due to errors in measuring, to the make-up, *i.e.*, steam lost by leakage from the range, etc., and generally unaccounted for.

The steam consumption at the present time can therefore be analyzed as follows:

A. Stand-by losses, 2,450 pounds per hour, excluding 350 pounds per hour unaccounted for.

B. Extra steam required by auxiliaries to deal with the load, 5.1 pounds per kilowatt-hour.

C. Extra steam required by engines to deal with the load, 31.6 pounds per kilowatt-hour.

D. Unaccounted for, 350 pounds per hour plus 4.1 pounds per kilowatt-hour.

These figures show that the increase in the steam consumption is largely due to wasteful auxiliaries.

These curves may be compared with similar curves given by A. M. Taylor in his paper, read before the Birmingham section of the Institution of Electrical Engineers of Great Britain, on December 14, 1904, but which he worked out theoretically. Mr. Taylor proposed that his diagram should be built up by taking each item of plant and finding the steam required by, or the losses due to that plant, and building the various items up to form a combined diagram. In the present paper the process is reversed, the diagram having been made first and analyzed afterwards.

A few remarks on the lessons to be learned from a consideration of the above tests may not be out of place. First, the average load on the station is evidently very important, as the greater the load the smaller the stand-by losses are in proportion to the total. Where the maximum load on the station approaches the capacity of the plant, the load-factor is not very different to the average load divided by the capacity of the plant.

The load-factor has very little effect on the water evaporated per pound of coal, but a small load-factor increases the amount of coal required for banking fires during the day. The total steam consumption appears to follow the Willans law.

These tests bring out the enormous importance of the steam used for this purpose, and indicate the desirability of using electrically driven auxiliaries throughout.

There does not appear to be much difference between the economy of steam and electrically driven sets on the test plate. For example, a compound steam engine was installed at the Grimsby works a year or two ago, driving the air and circulating pumps; this took 808 pounds of steam per hour on test for the following duty:—pumping 68,000 gallons of water per hour against a head of twenty-six feet, and maintaining a vacuum of twenty-six inches of mercury while passing 7,000 pounds of water per hour through the condenser. A contract has recently been let for an electrically driven plant of the same capacity, but to pump against a head of thirty-five feet, and the makers have guaranteed a maximum consumption of twenty-seven units per hour under penalty. This at thirty-five pounds of steam per kilowatt-hour would represent about 940 pounds per hour. If, however, there is no saving shown on the test plate, the author thinks a very large saving would be shown in practice owing to the reduction in the length of the steam pipes and the number of valves, drains, etc.

In the author's opinion, almost any electrically driven feed pump would be more economical than a steam pump; but at the same time the mechanical question is very important and a searching investigation should be made into this point before adopting one. No doubt there are satisfactory electrically driven feed pumps on the market; personally, the author has had no experience with them, but this portion of the plant is one on which there should be no trouble in working, and great care should be exercised in its selection.

The curves show the advantage of using large units, as the steam required for the engines dealing with the load (C, Fig. 2)

TABLE 5.

LOSSES AT LIGHT LOAD—AVERAGE OF A NUMBER OF TESTS.

	Lbs. per Hour.	
Leaks, blow-down gauge glasses, etc	260	Included in water to boilers but not passing into condenser.
Condensed in range and blown through separators	340	
Engine driving pumps for condenser	800	Included in water from condenser.
One feed-pump	650	
One engine running light	400	
Total	2,450	

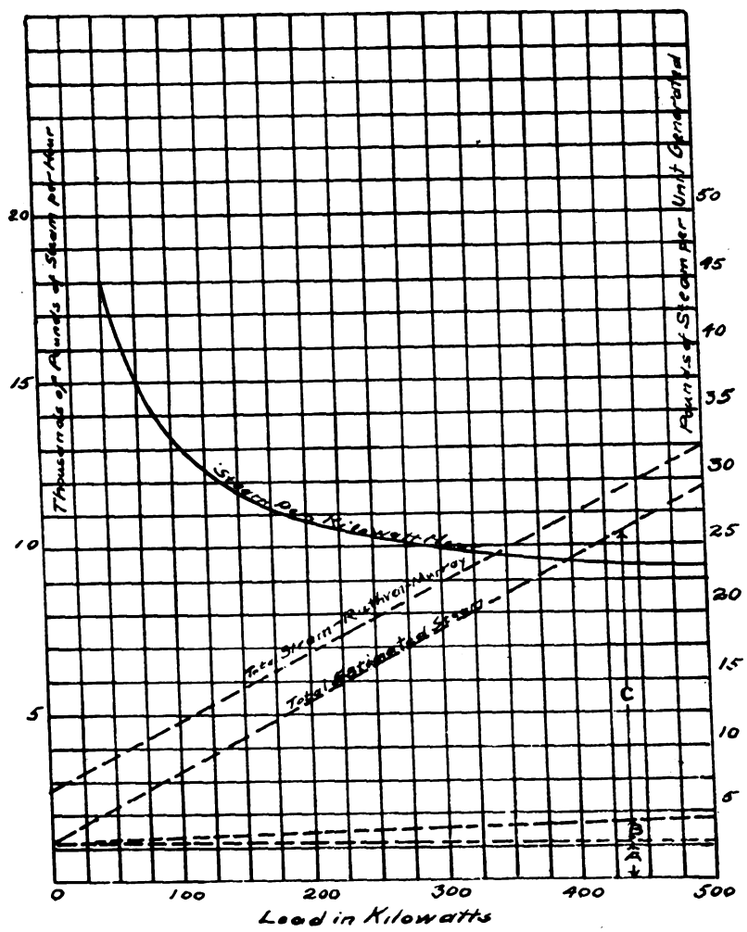


FIG. 3.—ESTIMATED STEAM CONSUMPTION OF A STATION RUNNING ONE 1,000-KILOWATT SET. CONDENSING, NO SUPERHEAT, 160 POUNDS STEAM PRESSURE.

Digitized by Google

would be largely reduced, while the only advantage of using a small set would be to reduce the starting-point of the curve slightly; as the steam used by the engine at light load is only a portion of the total, this is not very important, in fact, anything gained in this way would be lost by the waste in longer lengths of steam pipes, leaks at the extra valves, joints, etc., required by the larger number of sets.

As to the exact size of unit that should be adopted, if a plant is to deal with only one class of load, the author would suggest three 500-kilowatt sets, one as spare, in the case of a load with an estimated maximum demand of, say, 1,000 kilowatts. Each case must, however, be considered on its merits, and in very large stations the size of the unit is limited by the size it is practical to make. In cases where a traction load has to be supplied in addition to a lighting load, separate sets must be run to supply this, and sometimes, as at Grimsby, owing to peculiarities in the configuration of the town, the feeders have to be connected in the evening to two separate bus-bars at different voltages, and this increases the number of sets required.

The author's ideal station would be one with everything arranged to run from one large engine, with a second as a standby, boilers close to the engine, very short length of steam pipes, small number of bend, drains, etc., and with all auxiliaries electrically driven. Capital cost of spare plant must be considered in this connection, and if three or four sets were installed this would no doubt be reduced, but in any case it would be desirable to adopt at once the largest unit that could eventually be economically used.

Fig. 3 shows the estimated steam consumption in a station running one 1,000-kilowatt set, and equipped with electrically driven auxiliaries, the curve being calculated for saturated steam, 160-pound pressure. The losses at light load are as follows:

Condensation in the range	100	pounds	per	hour
Engine running light	700	"	"	"
Extra steam for generating current required by condensing plant	300	"	"	"
Ditto for feed-pump..	100	"	"	"

The steam for stokers is taken as 2.5 per cent of the total, and the steam for the engines to deal with the load at twenty pounds per kilowatt-hour.

It will be noticed that this curve shows a very large reduction in steam consumption for any load, as compared with the other curves; a second curve on the same figure is the one given by Ruthven Murray in his letter to the *Electrician*, June 30, 1905, as being the curve for the station under his control. In this case the double current generators used by Mr. Murray must be of great benefit in keeping the steam consumption down, as one large set can be used instead of two small ones.

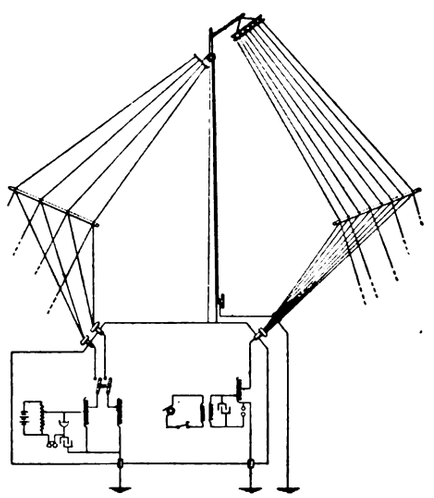
CONCLUSION.

In discussing this paper it must be remembered that all the tests were made on the plant under ordinary working conditions. The tests quoted are not given as being good examples of efficient working, as it is recognized that they show many points where economies should, and the author hopes will, be made, but the paper is put forward as an attempt to show what goes on in a central station with a plant five years old.

Great difficulties were experienced at times in getting one test to check with another, and at best the accuracy is not very great, but as much as possible has been done with the plant and staff available.

Electrical Patents.

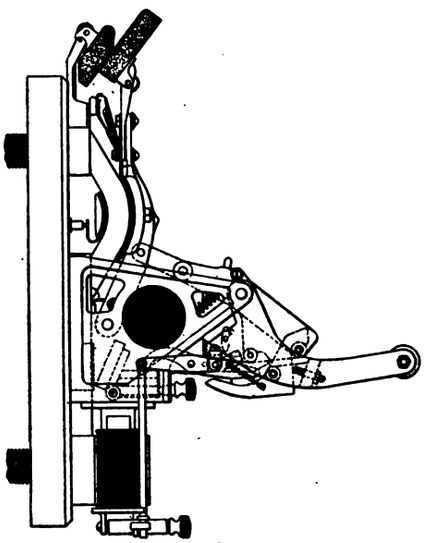
Lee De Forest, New York, N. Y., has obtained a patent (827,523, July 31) for an improved wireless telegraph system. The invention relates to wireless telegraphy and has for its object a system



WIRELESS TELEGRAPH CIRCUIT.

which is provided with separate transmitting and receiving antennæ at the same terminal station and which thereby has the advantage that the receiving operator at the station is enabled to cut in upon and interrupt the transmitting operator at another station. The invention consists in the combination with transmitting and receiving systems at a terminal station, of separate multiple antennæ for the transmitting and receiving systems, the transmitting multiple antenna comprising a larger number of conductors than the receiving multiple antenna and having its conductors more closely spaced than those of the receiving antenna, and means for attuning the transmitting and receiving antennæ to different frequencies.

An improved automatic magnetic circuit-breaker has been invented by William M. Scott, Philadelphia, Pa. (827,469, July 31). The invention relates to electrical switches for heavy currents and high voltages, especially to the automatic type adapted to control a cir-



AUTOMATIC MAGNETIC CIRCUIT-BREAKER.

cuit or circuits either by the rupture or closure of the circuit, or circuits upon the occurrence of predetermined electrical conditions, as, for example, either an abnormally great or small flow of current, abnormally high or low voltage or pressure, or upon a reversed flow of energy or of current. The invention resides in a structure and disposition of parts, whereby it shall be impossible for an operator during the existence or continuance of predetermined electrical conditions to actuate the switch member of the circuit-breaker to lock it or to hold it in a position from which undesired results might follow in virtue of such predetermined electrical conditions. The invention consists of a movable contact member, an actuator therefor, a latch for restraining the movable contact member in normal position, a latch for connecting the actuator, a movable contact member, an independent lever for actuating the latches, and electroresponsive means for actuating the lever whereby the movable contact member is released and disconnected from the actuator upon the occurrence of predetermined electrical conditions when the contact member is in normal position, and for disconnecting the contact member from the actuator upon attempted movement to normal position during the existence or continuance of predetermined electrical conditions.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Operation of Railway Switches and Signals by Power.

A description is given here of the electrical locking system as it has recently been developed to meet British ideas. This system is an improvement of the one now employed at Bethnal Green on the Great Eastern Railway. The controlling handles resemble miniature switch handles rocking back and forth instead of from one side to the other. This motion of the handle closes the control circuit which sets in action the pneumatic cylinder, which throws the switch as moved to its final position. The locking is accomplished by means of two electromagnets. The controlling switch is closed by means of a bar, which is moved horizontally by the operating handle. When in one position, this closes one end of one of the locking circuits. The other end circuit is closed by the switch tongue when it has completed its movement. The motion of the horizontal bar is limited by two pawls which are released by the two magnets, thus when throwing a switch the controlling handle is moved half way when its motion is locked by one of the above pawls. This motion, however, closes the controlling circuit for the air cylinder which throws the circuit, and, after the switch has completed its motion the circuit is closed, which lifts the locking pawl and enables the handle to complete its motion.—*Abstracted from Engineering (London), July* 27.

Dangerous Switchboards and Transformer Stations.

In a report submitted recently, Scott Ram, the British electrical inspector of factories, criticizes certain practices which he has encountered. He particularly points out the dangers often existing at high-tension switchboards and in transformer stations where sufficient space for passageways and for operating the switches has not been left. With the increasing supply of electrical energy over large areas the use of extra high pressures is becoming more and more common. It would be thought that this would lead to the use of every precaution which could be taken against an accidental shock, yet, as an example, the inspector found at one station in the switchboard area a passageway four feet wide between two rows of vertical brick cells facing each other. On each side of the passageway the cells contained isolating switches working at 10,000 volts. The switches and other connections are all of bare metal, and when closed the live metal is about eight inches back from the front of the brickwork. There is no screen or other protection in front of the cells. On one side the switches are about five feet six inches from the floor, and on the other side about two feet. When the blades are in the off position they project eight inches into the passageway, and should they become alive they would be exceedingly dangerous to any employé whose work might take him through there. The safe width of the passageway is thus reduced to about two feet. Further, the operation of these switches provides additional danger since they are opened and closed by means of a pole, necessitating the attendant to stand as far back as possible toward the opposite side with his back near the live switches there. In another case the inspector found a narrow passage with extra-high-pressure bus-bars alongside without any attempt at protection. A number of other instances are mentioned in which there was little or no attempt to protect employés from coming in contact with high-potential apparatus. —*Abstracted from the Mechanical Engineer (London), July* 28.

Wireless Control of Submarine Boats.

A description is given here of the controlling apparatus employed during the tests at Antibes Bay, France, of a submarine boat whose actions were directed by means of wireless telegraphy, a reference to which was made in the Electrical Review for June 2. During these tests it was possible to start and direct a boat in any direction and to discharge a torpedo. The boat carried a storage battery which supplied power for all movements. To control the propeller motor and the rudder motor, to light and extinguish the signal lamps, and to discharge the torpedo, local circuits are provided on the boat. These can be closed by means of an arm rotating over a series of contact posts. There are twelve of these contacts. Three are not connected to any circuit. The other nine are employed for the operations mentioned. This arm is rotated to the desired point, thus bringing about the desired action. By means of a ratchet wheel it is moved forward progressively step by step by an electromagnet. This magnet is actuated through a coherer which responds to the electric waves sent out from the directing station and a relay. By means of it the arm can be brought to any contact, and thus close the circuit. To prevent action other than that desired taking place, as the arm passes from point to point, the main power circuit is automatically opened whenever the ratchet moves, the switch tending to close each time the ratchet returns to its position of rest, thus when the motion has been completed the power circuit is closed and the proper motor brought into action. To prevent this taking place during the setting of the distributing arm, a frictional device, which drives a small flywheel, retards the closing of the main switch, so that this action can not be completed until the magnet has ceased to operate. The battery carried on the boat has a possible discharge rate of 100 amperes and sufficient capacity for four hours' continuous operation.—*Translated and abstracted from the L'Electricien (Paris), July* 28.

A Method for the Determination of Iron Losses in Pole Shoes, Due to Armature Teeth.

A method of determining the losses due to eddy currents set up in the pole shoes of a dynamo by the armature teeth is here described by T. F. Wall and S. P. Smith. These losses occur to some extent even when the pole shoes are laminated, and their calculation and separation from the total losses are difficult. The method employed by the authors consists in determining the temperature produced by these losses in the pole shoe and then measuring the electrical energy required to maintain the pole shoe at the same temperature, all other conditions of operation remaining the same with the exception that in the latter case the pole under consideration is not magnetized. To accomplish this four slots were cut in the pole shoe on the side facing the pole, and two coils were placed in these slots. Thermoelectric junctions were constructed by soldering thin copper strips to various points on the pole shoe. To prevent the conduction of heat from the shoe, it was insulated by means of mica. The thermoelectric junctions enabled the tempera-

Digitized by Google

ture of the shoe, reached under normal operation, to be determined and made it possible to adjust the heating current passed through the two coils mentioned above to be adjusted so as to bring the pole shoe to the same temperature. To maintain other conditions constant a four-pole field was selected. The magnetizing coils of two poles were disconnected and the two coils of two opposite poles only were used. Passing the current through these coils so as to make one a north and the other a south pole prevented any part of the magnetic flux from passing across the other two air-gaps, while reversing the current in any one of the two coils caused all four poles to become magnetized. During the test the machine was run at constant speed, and each test lasted four hours. The machine used during the test was a small one, and it was found that the loss per pole shoe varied with the flux density from forty watts, with a density of 2,100 lines per square centimeter, to seventy watts with a density of 2,900 lines. The loss also varies with the speed, being twenty-two and one-half watts per shoe, at a speed of 600 revolutions per minute, and seventy watts with a speed of 1,300 revolutions per minute. The density during the latter test was 2,900 lines per square centimeter. In the former tests the speed was constant at 1,300 revolutions per minute.—*Abstracted from the Electrician (London), July 27.*

Interference in Wireless Telegraphy and the International Telegraph Congress.

In concluding the series of articles on "Interference in Wireless Telegraphy," Professor R. A. Fessenden explains a number of tests which he has made to determine to what extent interference may take place between different systems and how this may be prevented. He was able to receive at Brant Rock, thirty miles from Boston, Mass., messages sent from Machrihanish, Scotland, although another station at Boston was trying to prevent this. The latter station succeeded in getting within three per cent in tune with the receiving station, and had at its disposal about fifteen kilowatts, but it could not render the signals unintelligible. The author does not think that the methods of directing wireless telegraphy which have been published, with the exception of Marconi's, are of any value. He has done some work in this direction by means of a horizontal iron transmitter screened on one side, but a more promising method consists in utilizing a transmitter submerged in distilled water. Water has eighty times the specific inductive capacity of air, and hence with the same apparatus, the length of wave is nine times as great and the energy eighty times as great as when used in air. He suggests a copper cylinder placed in a wooden vessel which is filled with water and covered with oil to prevent evaporation. A metallic reflector made of suitable shape may be placed at one side. With a cylinder one foot high, which would correspond to a cylinder of the same diameter eighty feet high in air and with a reflector 100 feet in diameter, a strong focusing of the waves should be obtained. The article concludes with a suggested method of international working. Professor Fessenden is opposed to government operation whenever it is not absolutely necessary, but he believes that some understanding should be reached and action taken to insure the safety of ocean traffic. This can best be done by the international adoption of two different wave lengths, one for mercantile use and the other for navy and army use. These might be for example 500 amperes and 550 amperes. Private systems should be allowed to operate at any wave lengths they may desire, except within five per cent on either side of the two mentioned above. A separate wave length should not be used for distress signals, for then it would not be likely to attract attention. A proper distress signal would be the repetition of a single letter, which would sooner or later attract attention. The limits set above allow for about forty different tunes, which the author believes to be sufficient for practical purposes.—*Abstracted from the Electrical Review (London), July 27.*

Recent Tests of Turbo-Alternators.

A description is given here by M. L. LeGros of some recent turbo-alternators constructed by the Oerlikon Company, and of the tests to which they were submitted. These machines are of the usual type with a revolving field and a stationary armature. They varied in output from 550 to 2,200 kilowatts. The wave form of the machines was determined both by point readings and by an oscillograph. The results agreed closely and showed a somewhat wavy form due to the teeth of the stator. The regulation characteristic was determined experimentally and computed from the usual tests, the results agreeing well. To determine the efficiency of the generator, the losses were measured in several ways and the efficiency computed from these. This was necessary, as it was not convenient to put a load upon the machine. To determine these losses, the retardation method was employed, the machine being brought up to full speed, then disconnected and allowed to run until it came to a stop. Measuring the negative acceleration and knowing the moment of inertia of the rotor, it was possible to compute the friction and windage losses, and repeating the experiment with the fields excited enabled the iron losses to be determined. To check these results and also to act as a check upon the computed moment of inertia, the tests were repeated, using the exciter to supply power at different rates during the test. Measuring the power thus supplied and the rate of retardation made it possible to deduce in this way the moment of inertia and to obtain fresh determinations of the losses. The agreement upon the results obtained from these ways was fairly good, the computed moment of inertia being within two per cent of that determined from the test. A heating test was made by running the generator on short-circuit with the field excited so that internal losses were somewhat greater than those which would occur when operating normally under full load. The efficiency of one machine, rated at 2,400 kilovolt-amperes, was about ninety-five per cent at full load and unity power-factor. It dropped to 93.3 with a power-factor of 0.8. At half load, the respective efficiencies were 91.4 and 87.8. The heating test showed that the temperature rise under the abnormal conditions employed was about forty-five degrees centigrade.—*Translated and abstracted from L'Eclairage Electrique (Paris), July 28.*

The Valle Maggia Single-Phase Railway.

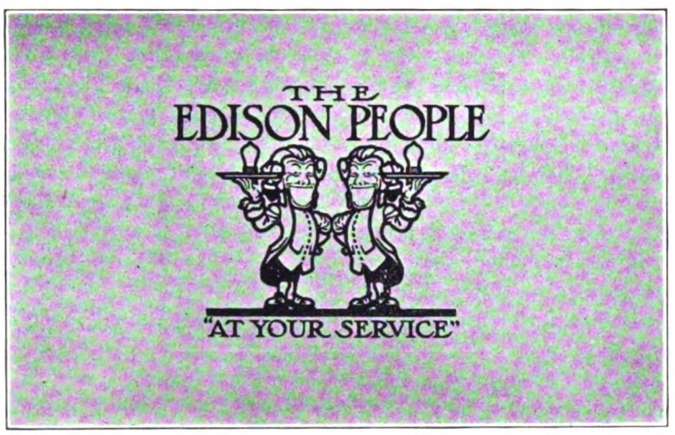
The railway which is now being equipped between Locarno and Bignasco is the second line in Switzerland to be equipped on the single-phase system, the first having been that between Seebach and Wettingen, says the *Electrician* (London). The line is about seventeen miles in length and is of metre gauge, the maximum gradient being 3.3 per cent. The pressure adopted on the overhead line is 5,000 volts, which is, with the exception of the 15,000-volt Seebach-Wettingen experimental line, the highest trolley pressure yet authorized by the Swiss Federal Railway authorities. The motor-cars have four axles, each of which is driven by a forty-brake-horse-power Oerlikon single-phase motor, and trailers are employed both for passengers and goods, the complete trains weighing about fifty-five tons. The Oerlikon curved bar collector is used. Power is obtained from a water-power station about ten miles from the line, where two alternators are installed, each for an output of 350 kilovolt-amperes, and driven by turbines working with a fall of about eighty feet.

Digitized by Google

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

The New York Edison Company, in line with its policy of distributing to its customers and to prospective consumers of current samples of high-class advertising literature, has prepared and is now distributing one of the most unique advertising booklets which has come to our notice. The Edison Company has created a series of characters showing numerous applications of electricity for comfort, safety and convenience. The attitude and expression of satisfaction depicted by these characters speak a content with Edison service which its many subscribers appreciate. The cover of the Edison book is in drab, the illumination being printed in dark brown. The inside pages are of cream stock, the text and illustrations being in brown, black and orange. There are some fifty odd applications illustrated. In addition to the illustrations, however, there is some well-chosen literature, calling attention to the utility of this service. During 1905, 19,680 contracts for electrical service were made. This was divided up as follows: 992,782 incandescent lamps, 6,719 arc lamps and 37,719 horsepower in motors.

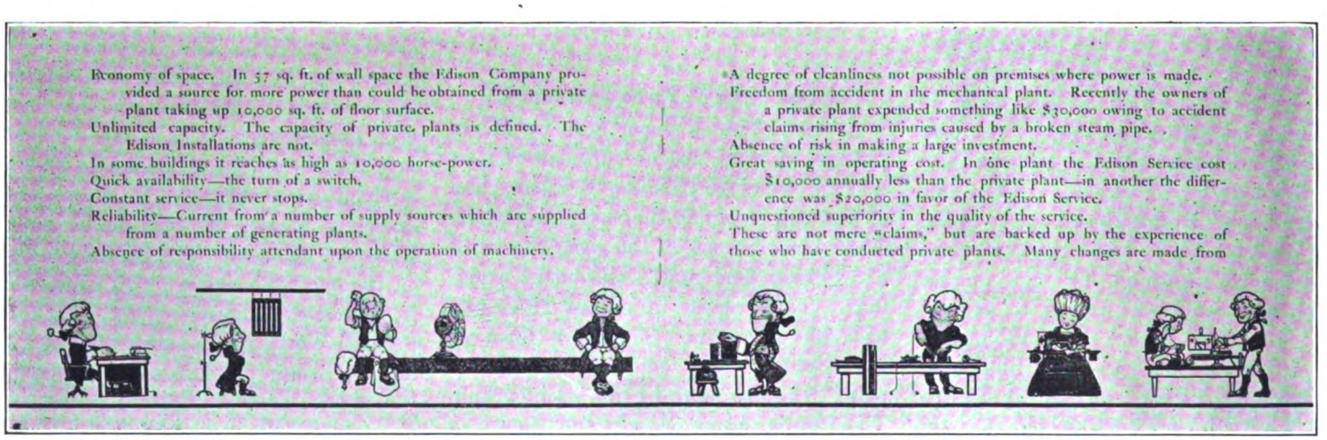


THE COVER PAGE OF THE NEW YORK EDISON BOOK.

The accompanying illustrations show respectively the cover and the inside double-page. The book measures six inches by nine and one-quarter inches, and the type is large enough to be easily read. Every phase of industry is touched upon, as well as the opportunities for electric service in the household. The electric sign is suggested as an instance of the immediate hold which electricity has taken upon business men as an advertising medium of unquestioned value.

The Phelps Company, Detroit, Mich., has begun the widespread advertising of "Hylo" lamps by means of illuminated posters bearing the signature of the lighting company in numerous towns. The accompanying illustration shows a poster which is now in use at Fort Wayne, Ind. This poster is of the regulation four-sheet size, is printed in colors, and calls attention to the fact that the Fort Wayne & Wabash Valley Traction Company will deliver "Hylo" lamps on thirty days' free trial. This is an example of where the manufacturer, operating together with the lighting company, can do much to facilitate and promote the use of current.

A FORT WAYNE "HYLO" POSTER.


Economy of space. In 57 sq. ft. of wall space the Edison Company provided a source for more power than could be obtained from a private plant taking up 10,000 sq. ft. of floor surface.
Unlimited capacity. The capacity of private plants is defined. The Edison Installations are not.
In some buildings it reaches as high as 10,000 horse-power.
Quick availability—the turn of a switch.
Constant service—it never stops.
Reliability—Current from a number of supply sources which are supplied from a number of generating plants.
Absence of responsibility attendant upon the operation of machinery.
A degree of cleanliness not possible on premises where power is made.
Freedom from accident in the mechanical plant. Recently the owners of a private plant expended something like $30,000 owing to accident claims rising from injuries caused by a broken steam pipe.
Absence of risk in making a large investment.
Great saving in operating cost. In one plant the Edison Service cost $10,000 annually less than the private plant—in another the difference was $20,000 in favor of the Edison Service.
Unquestioned superiority in the quality of the service.
These are not mere "claims," but are backed up by the experience of those who have conducted private plants. Many changes are made from

A SAMPLE OF THE INSIDE PAGES OF THE NEW YORK EDISON BOOK.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Victor Combination Meter.

The H. W. Johns-Manville Company, 100 William street, New York city, has placed on the market a combination meter designated as the "Victor," giving a simultaneous reading of volts, amperes, watts and horse-power on one dial. This is practically two separate and complete in-

FIG. 1.

struments combined in one case, each of which acts independently of the other as far as the volt and ampere readings are concerned. The readings in watts and horse-power are obtained from the point of intersection of the two indicators.

The company states that this instrument as a wattmeter is accurate at any voltage within the limits of the voltage

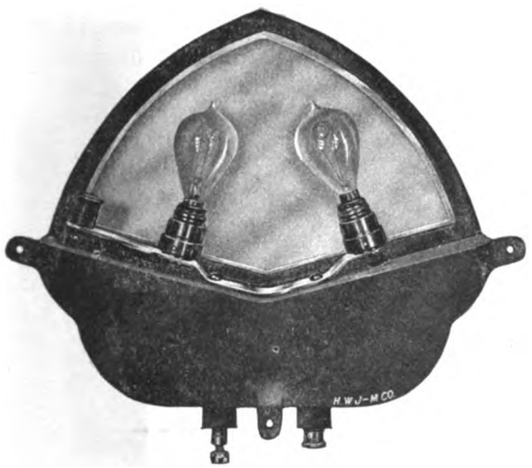


FIG. 2.

scale. The wattage scale is laid out from actual calibrations with a reliable standard, insuring accuracy in the result. The horse-power scale is obtained mathematically from the wattage scale. The company states that the workmanship and materials employed in the manufacture of this instrument are of the highest order, insuring accuracy and durability. While light in weight, it is rigid and will withstand vibrations of considerable violence without its accuracy being impaired. It requires a minimum of energy to operate, is sensitive and free from magnetic lag, unaffected by temperature variations, dead beat, and can safely remain continuously in circuit.

The instruments are illuminated from the rear, saving space on the smallest panels. Fig. 1 and Fig. 2 show, respectively, the front and rear views of this instrument.

The San Francisco Office of the Shelby Electric Company.

The accompanying illustration shows the San Francisco (Cal.) office of the

THE SAN FRANCISCO OFFICE OF THE SHELBY ELECTRIC COMPANY, SHELBY, OHIO.

Shelby Electric Company, of Shelby, Ohio, located at 320 Sansome street. The company claims the honor of being the first incandescent lamp company to open an office in San Francisco after the earthquake. The gentleman standing in the doorway is O. D. Pierce, the company's western manager.

Electric Railway Building in Oregon.

The Oregon Electric Railway Company is entering the Willamette Valley, south of Portland, with an electric road constructed for the handling of freight as well as passengers. This road opens up a rich territory in the centre of which is located Salem, the capital of Oregon. The first section of the railroad will be fifty miles in length and will connect the city of Portland with Salem. It will be constructed, in accordance with the best railway practice, of seventy-pound rails on rock-ballasted roadbed, with a maximum grade of 2.2 per cent and a maximum curvature of five degrees. A portion of the fifty-mile line will consist of a tangent of twenty-six miles with practically no grade. The road crosses the Willamette river, over which is being constructed a steel-deck span bridge on concrete piers. There are five piers in the river, and the approaches to the bridges on either side consist of fills aggregating some thousand feet in length. The bridge proper consists of four 200-foot spans, the distance from the rail to the surface of the river being 110 feet. This is one of the largest bridges in the state and is being constructed for the heaviest type of electric locomotive drawing trains of 100,000-pound freight cars. The road enters the southern boundary of the city of Portland and continues into the centre of the city, where the passenger station is located. Connection will here be made by the Southern Pacific, Northern Pacific

Digitized by Google

and Great Northern railroads. There will be a number of branches, aggregating some fifty miles, constructed as soon as the main line is in operation, and plans are in contemplation to extend the main line to the south of Salem to the city of Eugene, making an electric railway system of some 150 miles.

All of the engineering and construction work is being done by W. S. Barstow & Company, Portland, Ore. Among the financial people interested in the enterprise are Moffat & White, bankers, New York; Charles Pratt & Company, New York; Franklin Trust Company, Brooklyn, N. Y., and numerous other financiers of the East and West.

High-Speed, High-Overload-Capacity Motors for Testing Purposes.

Several especially interesting motors have recently been installed for testing purposes by the International Steam Pump Company in its new Worthington hydraulic works at Harrison, N. J. The motors were built by the General Electric Company, Schenectady, N. Y., and are used in testing blowers, pumps, air-compressors, etc., being permanently installed on suitable foundations in such a way that the machinery to be tested can be easily brought up to them. The machines are

High-Speed, High-Overload-Capacity Motors for Testing Purposes.

remarkable because of their high overload capacity and wide speed range for these purposes.

The largest of these units is shown in the accompanying illustration. This motor delivers 200 horse-power at 220 volts running at 750 to 1,500 revolutions per minute, and 100 horse-power at 110 volts running at 375 to 750 revolutions per minute. A similar range in capacity and speed is obtainable with each of the other motors, having full-load rating of 100 horse-power, thirty horse-power and ten horse-power respectively, at 220 volts.

All the machines are of the four-pole type and will carry fifty per cent overload for two hours at any speed within the range specified. The motors operate on the three-wire system, the fields being excited from the 220-volt mains, and the armatures being connected through double-throw switches to the 220-volt or 110-volt mains, according to the speed range required. The speed ranges are obtained by field control, and the 200-horse-power and 100-horse-power machines are built with commutating poles. A German silver resistance, shown just below the terminal board in the illustration, is used to make the final adjustment of the current in the commutating field coils. By this arrangement sparkless commutation at all loads, including fifty per cent overload, is obtained.

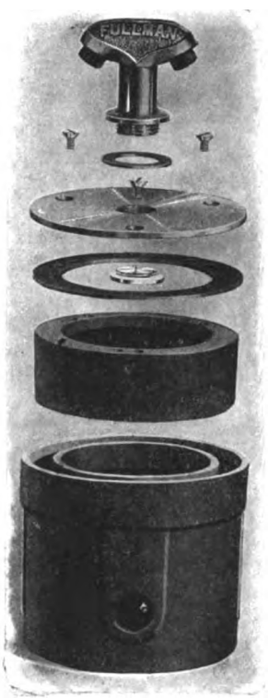
Aside from the large capacity and high speed range, these motors have several interesting structural features. On account of the high surface speed of the commutators in the 200-horse-power and 100-horse-power machines, an improved shrunk ring type of commutator is used. The brush rigging is similar to the form recently adopted in high-speed direct-current Curtis turbine-generators. The brush-holder studs are of stiff, ribbed design, and the brush holders are secured to the studs by bolts passing through machined joints of special form, making the entire brush system extremely rigid in spite of the unusual length of the studs. The motors are materially lightened by making the magnet frames of steel, and both armature and field coils are built to give proper ventilation at the overload capacity. Particular attention has been paid to balancing rotating parts so that vibration within the wide variation of speed and load is eliminated.

There is a wide field among machinery manufacturers for motors of this type having high overload capacity with high speed range, not only for permanent installation for general testing work, as in the case of the machines for the Worthington works, but also for the driving of machine tools.

Water-tight Floor Outlets.

The accompanying illustration shows the assembly of the "Fullman" water-tight floor outlet, manufactured by the Steel City Electric Company, Third street and Penn avenue, Pittsburg, Pa. Beginning at the bottom of the illustration, the parts appear as follows: box body, adjusting ring (made in various heights), gasket and brass plug, brass plate and attaching screws, nozzle gasket and brass drip nozzle. The illustration shows the standard plain outlet. These outlets are also furnished with suitable arrangements for receiving standard plugs and receptacles.

This outlet has been used in a great many special forms, such as with larger boxes with partitions for supplying several kinds of service at one outlet. The



Water-tight Floor Outlet.

universal adjustment feature may also be supplied with a flange to attach to special forms of large boxes, either round, square or rectangular.

The box body, when set with "roughing-in" work, is subject to much interference by workmen carrying on other details of construction, which causes it to be more or less out of exact level when the finished floor is laid. This is taken care of by the adjusting ring dipping into the groove more on one side than on the other. Adjustment for elevation is made by raising or lowering the ring in the groove. When the ring is properly set the groove is filled with melted compound, sealing the box and securing the parts in place. Templets for setting the rings are furnished. These templets fasten to the ring and rest on the floor, making the adjustment instantly without trial.

A New Gasolene Torch.

The Zeidler Lamp and Brass Company, Lomira, Wis., for which the Boggs-Howland Company, 23 Warren Street, New York city, has the eastern selling agency, has placed on the market the "Baby" gasolene torch, an illustration of which is shown herewith. The novelty of this device is its small size, absence of air pump,

Digitized by Google

cocks or valves, and its inherent simplicity. The nickeled brass fount is two and one-half by one and seven-eighths inches, the curved tube one-quarter inch in diameter, and the friction-tight Bunsen tube, with

"Baby" Blow-Torch.

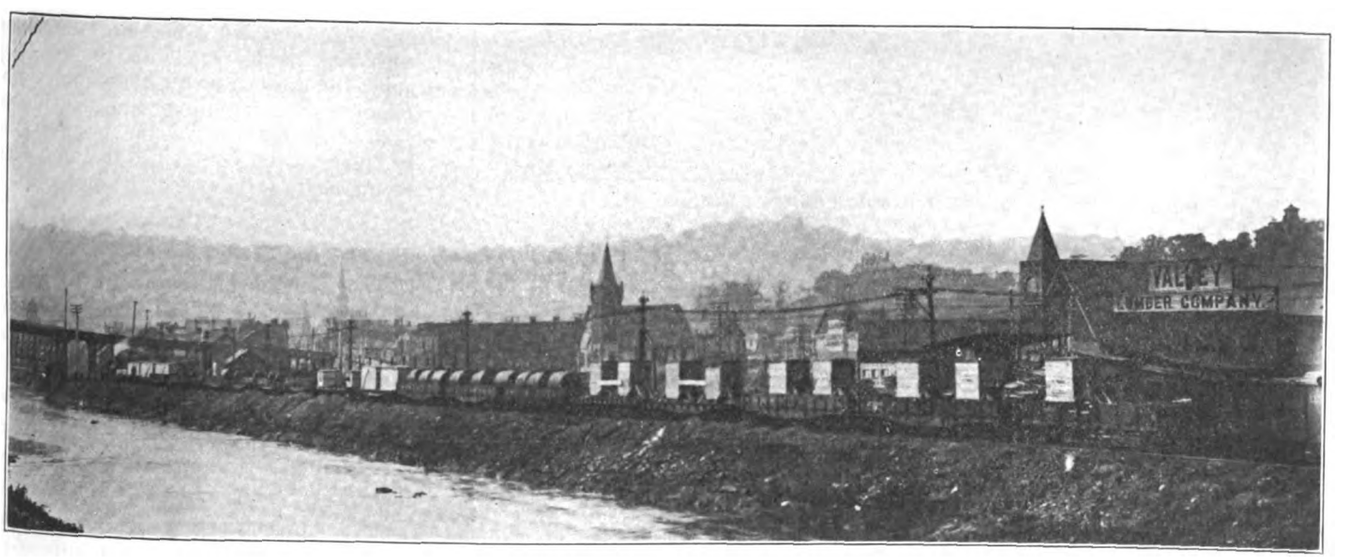
eight three-thirty-seconds-inch holes, is two and one-half by seven and one-sixteenth inches in dimensions. Inside, a loose cotton wick, attached for convenience to a small strip of brass, serves as the conductor of the fluid, not coming in contact with the flame. Two or three lighted matches held under the curved tube heat and vaporize the volatile material, producing a jet of fire. The device is recommended by the company as peculiarly suitable for telephone and telegraph linemen and other electricians. In size the device fits the hand, and in use can be turned in any position, burning equally well in all.

A Large Shipment from the Westinghouse Company.

One of the largest single shipments recently made from the works of the Westinghouse Electric and Manufacturing Company is shown in the accompanying illustration. The photograph was taken just as the train was pulling out of the East Pittsburg yards, its destination being the Hauser lake power plant of the Helena Power Transmission Company, at Iron Siding, Mont. The train was composed of nineteen cars, and the shipment consisted, among other apparatus, of the following: four 2,800-kilowatt Westinghouse revolving-field generators, three-phase, 2,400 volts, 7,200 alternations, 227 revolutions per minute, these generators being intended for direct connections to water-wheels. Two 200-kilowatt direct-connected exciters, 125 volts, compound-wound, 475 revolutions per minute, these also being intended for direct connection to water-wheels. Nine 2,000-kilowatt water-cooled transformers, 7,200 alternations, 70,000 volts primary, 2,400 volts secondary.

A large quantity of auxiliary detail apparatus was included in the shipment.

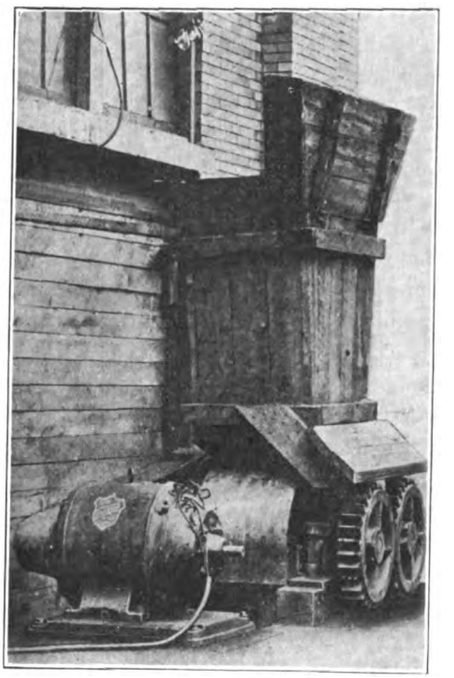
This shipment is an example of the amount of apparatus moving from the Westinghouse works at East Pittsburg daily, where the capacity of the plant, it is said, is being taxed to keep up with the orders.



A Notable Shipment from the East Pittsburg Works of the Westinghouse Electric and Manufacturing Company.

Motor Drive for Coal-Crushing Rolls.

The accompanying illustration shows a set of twenty-four-inch by thirty-inch Allis-Chalmers coal-crushing rolls, belted to an electric motor, such as are now being installed by many users of steam-driven power machinery. In connection with furnaces at which automatic stokers are used, or where for other reasons it is desirable to have the coal crushed to a uniform size, the advantage of such an arrangement will be readily apparent. The coal, as it is unloaded from the car, is passed through these rolls and drops to the hopper which feeds the stokers. Where it is possible to secure coal in hopper cars at all times, a further improvement is made by placing the crushing rolls beneath the track, allowing the coal to drop from the car into the rolls, and falling



Motor-Driven Coal Crusher.

Digitized by Google

from there to the stoker supply hopper. Motor drive is the most satisfactory for an equipment of this character, as such rolls are in operation for a limited time only each day; there is therefore no waste of power and no idle belts or extra shafting to be cared for while the rolls are not in operation.

The Growth of the Automatic Electric Company.

The growth of the business of the Automatic Electric Company since its incorporation in 1901 has been remarkable. The company has been obliged for the third time since its incorporation to enlarge its plant to enable it to meet the increasing demand for automatic equipment, and is now erecting, on the property adjoining its present plant, southwest corner Van Buren and Morgan streets, Chicago, Ill., a duplicate of the building now in use, to be joined to it by a smaller structure, the administration building, in which will be housed the company's offices.

PLANT OF THE AUTOMATIC ELECTRIC COMPANY, CHICAGO, ILL.

The new buildings, which will be completed and occupied by December of this year, will be of mill construction, brick, with a cream brick facing exactly similar to the present structure.

The factory addition will be eighty-five feet front on Van Buren street and 165 feet deep. It will be six stories high. The administration building will be forty feet front and forty feet deep, the same height as the factory buildings, but the first story will be omitted and the space underneath the second floor used for a driveway to the large court between the two factory buildings. This court will be forty feet wide by 123 feet deep. Fire-walls will separate the administration building from the factory buildings.

The entire frontage of the plant on Van Buren street will be 210 feet. The monotony of such an extensive frontage will be broken by recessing the administration building two feet from the line of the factory structures.

While the actual floor space of the plant will be a little more than doubled, by reason of a most economical arrangement of space, machinery and the routing of the product from start to finish of manufacture, the capacity of the plant will be trebled.

The enlarged plant will be supplied with all that is most modern and most efficient in machinery and appliances for rapidity of manufacture, and the comfort and convenience of operatives.

The various manufacturing departments will be so arranged that the raw material will enter at one part of the plant and will take a direct route through, coming out as finished material at another point.

The completed plant will be one of the finest and best arranged factories in Chicago. The architect is W. Carbys Zimmerman; the contractors are Wells Brothers Company.

The Link-Belt Company.

The two link-belt companies, located respectively at Chicago and Philadelphia, and the Ewart Manufacturing Company, of Indianapolis, will hereafter be known as the Link-Belt Company, and the three plants will be operated at the present locations under one management, of which the following named gentlemen are the official heads: James M. Dodge, Philadelphia, chairman of the board; Charles Piez, Philadelphia, president; Glen G. Howe, Indianapolis, first vice-president; Staunton B. Peck, Chicago, second vice-president; S. Howard-Smith, Philadelphia, treasurer; P. G. Reid, Philadelphia, assistant treasurer; Dyke Williams, Chicago, secretary; Edw. H. Burr, Philadelphia, assistant secretary.

The Chicago house bought both of its associates and under the new name will continue the manufacture of the same type of conveying and power transmission machinery that characterized the previous individual corporations. None of the concerns have been competitors. The Chicago and Philadelphia plants were operated on parallel lines, and the Indianapolis firm, the maker of the original, or as it is known, "Ewart" detachable link-belt, supplied both companies with the conveying and power-transmission chains. The Link-Belt Machinery Company was organized in 1880, establishing a plant at Chicago, and in 1882 opened a branch office in New York city. Six years later saw the Link-Belt Engineering Company succeeding the well-known firm of Burr & Dodge, which was established at Philadelphia and took over the New York office and maintained it in connection with the new works near Philadelphia, as eastern headquarters for the manufacture of the link-belt type of labor-saving machinery. The Philadelphia firm became, too, the manufacturer of all of the apparatus used by the Dodge Coal Storage Company.

The development of the Link-Belt Company has been (in a measure) coincident with the strides made in the electrical field; the modern power-house and appurtenances for handling and distributing fuel being features of the progress that has marked the years since the first labor-saving chain was devised and marketed.

A Tungsten Filament Lamp.

The General Electric Company has for many years been engaged in the development and perfection of a pure tungsten filament for the manufacture of high-candle-power incandescent lamps. Tungsten possesses the property of withstanding very high temperatures, and when used as a filament for an incandescent lamp shows an efficiency of between one and one and one-quarter watts per candle. The life of the tungsten lamp will be at least equal to that of the ordinary incandescent lamp. The recent results attained by the company in the production of tungsten filaments place it in the front rank of those who have been engaged in working upon this difficult problem. Preparations are being made by the General Electric Company for the manufacture of these lamps of high candle power upon an extensive scale.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW CABLE OPEN TO THE ORIENT—The Commercial Cable Company has announced the completion of its new cable to China and Japan. This establishes a system from San Francisco to Honolulu, Midway, Guam and Manilla, and thence to China and Japan. The cable is open for transmission of public business over the lines of the Postal Telegraph-Cable Company.

VIRGINIA WATER-POWER CANAL OPENED—The canal of the Virginia Passenger and Power Company, owned principally by Frank Gould, of New York, is completed. Water was turned in on August 6 for the first time from the Appomattox river. The canal cost $200,000. It will furnish power for the new electric light plant erected near Petersburg at a cost of $300,000 and also for the power plant in Petersburg.

POWER PLANT WORK STOPPED—Work has been stopped on the electric power plant on Cape Fear river, at Buckhorn Shoals. Judge Purnell, of the Federal court, who appointed the receivers, ordered the contractors to continue work, but they will not obey the order. Four hundred thousand dollars has been expended, and a hundred thousand more is needed to finish the work. There are three principal contractors, one local, the others in Richmond and Pittsburg.

TROLLEY FROM PITTSBURG TO CLEVELAND—Pittsburg to Cleveland by traction will be accomplished within a year. Seven contractors employing hundreds of men are at work on the connecting link. Running directly to Harmony the line will open a branch going to New Castle and the other to Butler. The Cleveland line will also connect at Sharon with the Pittsburg road. Engineers have estimated that the line will have a gross earning capacity of $300,000 a year, with net earnings of $150,000. R. H. Boggs, of Pittsburg, is president of the company; M. G. Hibbs, of Pittsburg, secretary and treasurer.

TWIN FALLS LAND AND POWER COMPANY—A scheme for the reclamation of some 400,000 acres of land in Nevada and Idaho, principally on the southern side of the state line, has been formulated by the Twin Falls Land and Power Company, an Idaho corporation—the one which projected the great irrigation scheme, reclaiming hundreds of thousands of acres of land in the southern part of that state. Aside from the irrigation project, it is proposed by the Twin Falls company to furnish electric power for the mines and mills of Contact when the time arrives for the inauguration of the electric system in that promising camp.

CALUMET AND ARIZONA INSTALLS ELECTRIC EQUIPMENT—The Calumet & Arizona Company at Bisbee, Ariz., has completed the installation of an extensive electrical equipment, the power from which is distributed to that company's Oliver and Irish Mag shafts and the Pittsburg & Superior's Junction and Hoatson shafts. Later it will be wired to the latter company's Cole shaft. Pumping by electricity is also planned, and work is now in progress to this end. It is expected that a 600-gallon pump will be in service in the Oliver shaft within the next three months. Electric haulage is also in contemplation, but its details have not yet been worked out.

MARYLAND ELECTRIC MERGER—The Baltimore & Annapolis Short Line and the Maryland Electric Railways Company have been merged by the organization of the Maryland Electric Railways Company, capitalized at $1,200,000. The outstanding $350,000 stock of the Short Line is to be taken over on the basis of three shares of the Electric Railways stock for one of the new. The terms on which the Maryland Electric Railways Company entered have not been made public. The merged properties will authorize an issue of $8,000,000 five per cent bonds, of which one-half will be put out as soon as the consolidation is completed. This issue has already been underwritten by local capital.

MAHONING VALLEY IMPROVEMENTS—The Pennsylvania & Mahoning Valley Railway Company is expending $1,000,000 for improvements to its trolley system which connects Youngstown with Hubbard, Sharon, New Castle, Lowellville, Struthers, Niles, Girard, Warren and nearly every other point in the Mahoning and Shenango valleys. The Sharon-Youngstown branch of the system has been extended to Wheatland, and the work of putting down the track to West Middlesex will be pushed forward rapidly. West Middlesex is six miles from Sharon, and it will be another town connected with Youngstown by the successors of the old Penhale-Devitt syndicate. West Middlesex has a population of 12,000 people, the principal industries are two big blast furnaces, and many of the people when the line is completed will come to Youngstown to do their buying.

BRAZILIAN RUBBER EXPORTS—Consul-General Anderson reports from Rio de Janeiro that Brazilian rubber exports are still on the increase, and quotes some interesting figures. The entries at Manaos and Para from July, 1905, to March, 1906, aggregated 32,840 tons against 31,590 tons in the same period of 1904-1905 and 29,080 tons in the 1903-1904 period. At the two principal rubber-shipping ports of the republic during the month of May there were sixty tons more exports than in the same month last year, and 760 tons more than in the corresponding month of 1904. The entries in January this year, 5,710 tons, broke the record in the history of rubber exports from this or any other country. The United States has been taking considerably more than half of the entire crop, and present indications are that the proportion of the crop going to the United States this year will be larger than usual.

NEW INCORPORATIONS.

EVANSVILLE, ILL.—Evansville Lighting Company. $3,000,000.

ST. LOUIS, MO.—St. Louis Car Lighting Company. $24,000. Incorporators: Edith Foster, Hilda Standinger, John H. Soell and others.

INDIANAPOLIS, IND.—The Chicago & Western Indiana Traction Company. To be known as the "Educational Route." $100,000. Incorporators: Edward H. Bowras, Daniel W. Bolen and John S. McCullough.

ST. LOUIS, MO.—North St. Louis & Suburban Railway Company. $50,000. Incorporators: John Scott, James Scullin, Edward J. Scott, John R. Scott, Thomas W. Murphy, William Scullin and John Scullin.

INDIANAPOLIS, IND.—New York, Boston & Chicago Electric Railway. To touch Hammond, La Porte, South Bend, Mishawaka and Elkhart. Incorporators: W. V. Robinson, E. W. Curtis, J. L. Knox, Charles Schisano and W. M. Watson.

DANVILLE, ILL.—Danville & Eastern Illinois Railway. Principal office at Champaign. To construct from Danville to a point in Vermillion county. $5,000. Incorporators: George M. Mattis, Charles A. Wright, W. H. Burke, Charles Zilly, of Champaign; J. E. Johnson, of Danville.

SPRINGFIELD, ILL.—East St. Louis, Granite & Alton Suburban Railway Company. Principal office, East St. Louis. To operate a line between East St. Louis, Alton and Edwardsville. $2,500. Incorporators: L. C. Haynes, G. Pierce, I. L. Gregory, F. H. Thomas, of East St. Louis, and F. E. Allen, of St. Louis.

SALEM, ILL.—Ohio & Mississippi Electric Railroad Company. To build a line from Centralia north to Sandoval, Patoka, Vernon; west from Sandoval to Odin, Salem and Iuka; north from Salem to Alma and Kennedy, and south from Salem to Cartter and Kell. William Wham, of Cartter, president, and B. Pullen, of Centralia, secretary.

GUTHRIE, OKLA.—Santa Fe, Liberal & Englewood Railroad Company. To build a line from Englewood, Kan., to Des Moines, N. M., passing through Beaver county, Okla. $6,000,000. Incorporators: Frank E. Jennison, New York; Jesse G. Northcutt and A. Watson McHendrie, Trinidad, Col.; John Morrow and Thomas D. Lieb, Raton, with J. H. Albright Hooker as Oklahoma agent.

Digitized by Google

ELECTRIC LIGHTING.

MALVERN, ARK.—The electric light plant at Malvern, owned by B. W. Turner, has been destroyed by fire.

WILLISTON, N. D.—The city of Williston has opened the bids for the installation of an electric light plant and waterworks.

ORANGE, N. J.—It has been decided to hold a special election for the purpose of deciding whether the people want a municipal lighting plant.

OTTAWA, QUEBEC—The Consolidated Light, Heat and Power Company is the outcome of recent negotiations between the Ottawa electric and Ottawa gas companies.

PIQUA, OHIO—The Piqua city council has appropriated $500 for the securing of an expert electrician to estimate the cost of installing a municipal electric light plant.

LEADVILLE, COL.—An electric light franchise has been granted to Walter W. Davis. It is to run for twenty years, and provides for a substantial reduction from the present rates.

PITTSTON, PA.—The contract to light the city of Pittston has been awarded to the Citizens' Illuminating Company. The price is to be $60 for open arc and $15.50 for incandescent lamps.

GREELEY, COL.—The Greeley Gas and Electric Company has been sold to the Federal Gas Corporation, of Chicago, for $15,000, the purchaser to pay all outstanding debts against the Greeley company.

OGDENSBURG, N. Y.—The Hannawa Falls Power Company is now sending electricity over the new transmission line to Ogdensburg, and it is expected that a number of steam plants will at once be displaced by electric power.

RICHMOND, VA.—An agitation is under way to make use of the old pumping station near Hollywood for conversion into an electric light plant. The property and water power is estimated to be worth from $250,000 to $300,000.

LANCASTER, MASS.—The Clinton Gas and Electric Company has begun the work of placing extra poles in Harvard street for the purpose of extending the lighting system. Twenty-five-candle-power incandescent lamps are used, burning from sunset until midnight.

CAMDEN, N. J.—The city council has decided to submit to the vote of the people at the November election the question of the accepting of the Jones law, passed by the last legislature, permitting cities to construct and maintain electric light plants, for which bonds may be issued.

WORCESTER, MASS.—The Worcester Electric Company has petitioned the board of gas and electric light commissioners for permission to issue 2,000 additional shares of capital stock. It is stated that the growth of business has made necessary improvements to the plant.

PADUCAH, KY.—The contract presented by the General Electric Company, in which it proposed to equip the Paducah city lighting plant for $11,000, has been ratified by both boards of the general council. The mayor was authorized to sign it at once, that the work of equipping the plant might begin without delay.

ELIZABETH, N. J.—A resolution has been introduced into the council and approved, instructing the city attorney to report to the council all proceedings to be taken by the city council to submit to the voters at the next general election the question as to whether or not the people are in favor of a municipal lighting plant.

FRANKLIN, IND.—The Franklin Water, Light and Power Company, which has been controlled by Chicago people for the last five years, has been sold to the Ferris Brothers, owners of lighting and water plants at Yanktown, S. D., and Eldorado and Osage, Iowa. Thomas Ferris, now managing the Osage plant, will assume charge of the local plant.

LYONS, N. Y.—The stockholders of the Wayne County Electric Light Company at their annual meeting elected three directors for the ensuing year. The directors met after the stockholders' meeting and elected the following officers: president, Dwight Chamberlain; vice-president, Charles A. Lux; treasurer, William H. Akenhead; secretary, Attorney Benton S. Rude.

SCHENECTADY, N. Y.—Arrangements have been made by the Schenectady Railway and the Schenectady Illuminating companies for extensive additions to the underground feeder system. On account of the fact that part of the feeders will be used by the railway company and part by the illuminating company, the issues were combined and the work will be done together.

DES MOINES, IOWA—The light committee of the city council has decided to recommend to the city council that each ward of the city be given five additional arc lights or fifteen additional incandescents at the option of the alderman from such ward. The additional lights will entail an added expenditure of $2,000 a year by the city. Fifteen East Des Moines lights have been put on the all-night schedule.

SYRACUSE, N. Y.—The assessment of the plant and franchises of the Syracuse Lighting Company has been materially increased over that of last year. This year's assessment of the company's franchises is $1,660,000, as against $970,000 last year. The total franchise and real estate assessment is about $3,240,000, nearly a million and a half over last year. This will mean an increase in taxes of $25,000.

RUTLAND, VT.—The Rutland Railway, Light and Power Company has taken possession of the electric light plant on Post street recently purchased of the Rutland City Electric Company, and for the present no change in the management or operation of the plant will be made. It is expected, however, that eventually the newly acquired property will be used only as an auxiliary to the company's main plant, and water power will be used instead of steam.

EAU CLAIRE, WIS.—The city council has granted a lighting power franchise for twenty years to the Chippewa Valley Electric Railway Company with only two dissenting votes. The maximum rates for arc lamps are cut to $15 a year less than the old franchise rates, which were $75 per lamp, according to service. The company is to put in a new power plant and also to transmit power from Red Cedar river to Eau Claire for manufacturing purposes.

UTICA, N. Y.—To the Central New York Power Company, of Utica, has been awarded the contract to light the streets of the city of Amsterdam at a cost of $39 a lamp per year, including the building of a conduit system as mentioned in the specifications, the contract to run for a period of five years. The company's authorized capital is $1,000,000. The officers are: president, William E. Lewis; vice-president, H. S. Patten; secretary and treasurer, Byron E. White.

DETROIT, MICH.—Recently the Union Trust Company, receiver of the City Savings Bank, applied to Judge Donovan for an opinion as to whether or not it should expend about $5,000 on the water, sewer and lighting plant on Mackinac Island, one of Frank C. Andrews's ventures held by the company as part of the assets of the defunct City Savings Bank, for the purpose of substantially increasing the revenues of the property and making it more salable. The judge decided that the bonds were a safe investment.

PORTLAND, ME.—The Portland Electric Light Company has bought the Hargreaves Woolen Mill property at West Buxton, and has commenced the construction of a power station for the transmission of electricity for lighting and power purposes in Portland and vicinity. The same company is also to acquire the plants and good will of the Consolidated steam plant and the Portland Lighting and Power Company, operated by water from Great Falls. The purchase of these companies involves the expenditure of $1,000,000.

HYATTSVILLE, VA.—The town council has signed an agreement with the Potomac Electric Power Company, of Washington, to light the streets of Hyattsville for a period of ten years. This will obviate the necessity for the erection of a local electric lighting plant, which has been considered a sure thing. Bids for its construction have already been received and opened. The bid of the Potomac company is a material reduction on its proposition submitted two months ago to agree to furnish thirty-candle-power incandescent lamps for $12 per year and arc lights for $65 per year. The light will be furnished on an actual and not a supposed moon-

Digitized by Google

light scale, that is the lamps will be dark only on such nights as the moon is not obscured by clouds.

BALDWINSVILLE, MASS.—At a special town meeting the chairman of the electric light board reported that, according to figures submitted by an engineer, the cost of constructing and maintaining within the limits of the town a plant for the distribution of electricity for light for municipal use, and light, heat or power for the use of its inhabitants, would cost about $21,500, or a sum $6,500 in excess of the sum appropriated for the purpose at the special meeting in May. It was voted to appropriate the sum of $6,500 in addition to the sum of $15,000 previously appropriated.

WILMINGTON, DEL.—The street and sewer commissioners of Wilmington have granted a franchise to the Commercial Light, Heat and Power Company, which will secure for the city the company's electric power from the Susquehanna river. The franchise had been pending since 1904. The new concern will give the city three per cent of its gross receipts and will sell electricity to the municipality for two cents a kilowatt-hour. The public rates will be ten cents a kilowatt-hour. These are lower rates than now prevail. The company will expend within one year $100,000 in constructing its plant.

TELEPHONE AND TELEGRAPH.

TOPEKA, KAN.—Construction work on the new building to be occupied by the Independent Telephone Company is to begin at once.

DUNKIRK, N. Y.—The Bell Telephone Company's exchange will be enlarged to provide needed facilities. A new switchboard will be installed.

CINCINNATI, OHIO—Action on the application for a franchise of the Queen City Home Telephone Company has been indefinitely postponed.

LOWELL, MASS.—It is announced that early in the fall a new telephone company will petition for a franchise to construct and operate a telephone system.

DEDHAM, MASS.—The New England Telephone Company will erect a $10,000 exchange on Church street. The building will be of brick with granite trimmings.

BROCKTON, MASS.—The special aldermanic committee has made a request to the Southern Massachusetts Telephone Company to make a reduction of twenty-five per cent in rates.

MANCHESTER, IOWA—At the recent semi-annual meeting of the Delaware County Telephone Company it was decided to lay additional cables in the Manchester residence district.

OSWEGO, N. Y.—The Bell Telephone Company is making plans to remove its poles and wires from the streets and reestablish its entire system in Oswego on the block plan of distribution.

TORRINGTON, CT.—The line of the Southern New England Telephone Company between Torrington and Litchfield has been completed. The rates have been reduced from fifteen to ten cents.

PITTSBURG, PA.—The bid of the Morganstown-Ochiltree Company has been accepted for constructing conduits and laying cables for the police and fire bureaus in Frankstown avenue and Forbes street.

PARIS, ILL.—A serious telephone war is threatened between the Kinloch Telephone Company and the Bell Telephone Company, which, it is said, will build an exchange at Paris in the next sixty days.

BANGOR, ME.—The Aroostook Telephone Company has recently made arrangements for 130 miles of copper wire. When this is installed the company will have a complete copper circuit throughout the county from Danforth to Fort Kent.

MANITOWOC, WIS.—Papers increasing the capital of the Manitowoc & Western Telephone Company to $25,000 have been filed, and the company will start work to extend its lines and improve equipment. The line runs west of the city in the rural districts, and last year declared a dividend of nearly twenty per cent to its stockholders. It is proposed to expend $12,500 at once in improvements, the project contemplating additional lines in Manitowoc and Brown county.

LEAVENWORTH, KAN.—The People's Telephone Company, an independent line, announces that it will put in a new central energy system and will put the wires under ground in the business portion of the city. A building is also to be erected at Sixth and Delaware streets.

LINCOLN, NEB.—The Farmers' Cooperative Telephone Company, of Jefferson county, has filed articles of incorporation with the secretary of state. The officers of the company are: C. W. Robinson, president; J. W. Ulmer, vice-president, and A. R. Sollenberger, secretary. Capital stock is authorized amounting to $15,000.

DANBURY, CT.—The Southern New England Telephone Company is erecting a building to be devoted exclusively to the business of the Danbury exchange on West street, but a short distance off Main street. The building will be two stories high, of brick, with a frontage of thirty feet and depth of fifty feet. The building is to be ready for occupancy before cold weather.

MINNEAPOLIS, MINN.—Because of the increase of its Minneapolis-Chicago business, the North American Telegraph Company is planning extensive improvements between the two cities. A new 300-pound copper line is to be constructed over the line of the Chicago Great Western Railroad. Extensive improvements in some of the old lines are planned also. Work is to be undertaken at once and rushed. Everything in the improvements is to be the newest and best possible.

EASTPORT, ME.—The New Brunswick Telephone Company is planning to extend its service to the neighboring island of Grand Manan, and the work of installing the system will be started at once. Connection with the mainland of New Brunswick, and possibly Maine, will be made by cable, and the advantage of the service to the islanders can not be overestimated. It is expected that fully 200 instruments will be installed as soon as the line is in operation.

PITTSBURG, PA.—Superintendent R. J. Daly, of the bureau of electricity, is busily engaged in the work of placing the public safety utilities under his jurisdiction in such order that there will be no trouble when the telephone and telegraph companies are compelled to remove their poles. Every fire-alarm circuit in the city, the wires of which have been placed in underground cables, is being equipped with the new fire-alarm boxes. Instead of being placed on telegraph poles, as heretofore, the boxes are being mounted on iron pedestals about six feet in height. This work has been completed in the downtown section, and is nearing completion in the Penn avenue district.

NORTHFIELD, VT.—The Northfield Telephone Company has made an advance in its rates. This is found necessary because of the increased expenses due to extension of lines. The new tariff will be $15 yearly for each telephone with no reduction where more than one is used; stockholders will pay this rate the same as other subscribers. A charge of five cents will be made for each outgoing message over other lines the same as has always been charged on incoming messages. The Northfield Telephone Company is a local organization. Some years since it made arrangements with the New England Telephone Company whereby it could connect with its lines.

PORTLAND, ORE.—Contracts are being made between the Home Telephone and Telegraph Company and business men of the central east side district, on the agreement that service will be given probably in forty days, and at least in sixty days. The company has built two exchanges for the east side, and will build three more. The three new exchanges to be started by the company at once are to be located at Sellwood, on Killingsworth avenue, near Michigan, and at Holgate and East Fifteenth streets. Each of the new buildings will cost $15,000 and will be two stories high, with a full basement beneath. Those in charge of the east side work for the company say that the heavy part of the contract has been finished. The setting of miles of pole lines and underground conduits was the chief task, and this is finished.

Digitized by Google

ELECTRIC RAILWAYS.

ALTOONA, PA.—Altoona capitalists have started a movement for a trolley line between Altoona and Johnstown, a distance of thirty-eight miles. The proposed road is to pass through Patton, Barnesboro and other towns in Cambria county.

HOUSTON, TEX.—The Stone & Webster Company, Boston, Mass., has purchased from the Houston-Galveston Interurban Company all the rights, franchises and privileges of that concern, consisting principally of franchises inside the limits of Houston and Galveston.

PHILADELPHIA, PA.—Between the Philadelphia Rapid Transit Company and the Pennsylvania & New Jersey Traction Company a trackage agreement has been made, which will enable the latter, upon completion of its line, to operate cars into Willow Grove over the Doylestown & Willow Grove line.

GALVA, ILL.—At a special meeting of the Galva city council, a franchise was granted to the Galesburg & Kewanee Electric Railway Company to construct, maintain and operate a system of electric railways on certain streets in the city of Galva for a period of twenty years. Previous to this a motion that the term of the franchise be fifty years was voted down.

WELLSVILLE, OHIO—The East Liverpool Traction and Light Company has closed deals for a complete right of way between Wellsville and Empire, Ohio, and will begin immediately the construction of an extension westward. This will give the company a through line from Smith's Ferry, Pa., to Brilliant, Ohio, passing through East Liverpool, Wellsville, Empire and Toronto, Ohio.

NEW YORK, N. Y.—At a meeting of the directors of the Philippine Railway Company the following officers and directors were elected: William Salomon, chairman; Charles M. Swift, president; H. M. Steele, first vice-president; C. Lewis, treasurer; P. H. Ashmead, secretary. Directors: William Salomon, Charles M. Swift, Cornelius Vanderbilt, Alonzo Potter, C. Lewis, Thomas H. Hubbard, J. G. White, Frederick H. Reed, Henry R. Wilson.

INDIANAPOLIS, IND.—The Indianapolis & Western Traction Company has let the contract for building its line between Greencastle and Brazil. McArthur Brothers, of Chicago, will do the grading, and the National Concrete Company, of Indianapolis, the concrete work. The materials for the tracks are now being delivered. The company is about to complete its line as far as Danville and will probably finish the Greencastle extension by the first of the year.

SEATTLE, WASH.—The West Seattle city council has set a price of $30,000 on its street railway and light plant—the only municipally owned street railway in the country—and the Seattle Electric Company has signified its acceptance of the terms, the sale being provisional with the approval of the taxpayers of that city, who will be given an opportunity to vote on the issue. The fund realized would be devoted to the establishment of municipal water, lighting and sewer systems.

LYNCHBURG, VA.—The Lynchburg Traction and Light Company has purchased more than a half a square of property fronting on Main street, between Fifth and Sixth streets, on which it purposes to erect a building for its general offices and car sheds. This will do away with two division sheds, concentrating all of the operation of the entire system of the city at this one point. The new car barns are to be equipped in the most modern manner, the plans already having been drawn for the buildings.

FORT SMITH, ARK.—At a meeting of the Commercial Club and representatives of the railroad projected from Fort Smith to Prairie View, Logan county, the club agreed to donate the right of way and terminal facilities for the road at Fort Smith. It was stated by the representatives that the road will spend $2,500,000 in the building of the line and that its headquarters would be established at Fort Smith. The road, it is said, will in the course of time be extended to Memphis in a direct air line. The road is primarily for the purpose of opening some large coal land holdings which the backers of the road own and which they propose to develop on a large scale.

WALLS, PA.—Residents of Walls expect in the near future to have communication with the outside world by means of a trolley car line. A new project assures a line that will be of more advantage than an original proposition which, it is said, has fallen through. During the past two or three weeks engineers have been running a line for a private right of way for the road, and many options on valuable property between Walls, Wilmerding, Turtle Creek and East Pittsburg have been secured. Plans of the promoters include connection with the lines of the Highland Grove Electric Company. Bowman Brothers, of Wilmerding, Pa., are said to be leading spirits in the enterprise.

MODESTO, CAL.—The statement that Modesto and Stockton will soon be joined by an electric line has been made by a director of the Western Pacific Railroad, although he will not admit that his company is behind the project. The road will enter Modesto on the north, following the McHenry road or a right of way adjacent. The new road has nothing to do with the county franchise now lapsed under which H. B. Kinney, a year ago, sought to win support to his proposed Riverbank-Modesto line. Applications will be made to the county supervisors for other franchises traversing new lines of travel and reaching the city through the tracts now developing for home sites north of town.

CLEVELAND, OHIO—The Cleveland, Ashland & Mansfield, upon which construction has just been started, has been granted franchises in Richland, Ashland and Wayne counties. It has yet to obtain a franchise in Medina county. The road is to be built the entire distance between Seville and Mansfield over a private right of way, and in consequence the franchises in question carry only privilege to cross cross-roads where that becomes necessary. The intention of the management is to build a line from Ashland to Mansfield first, and the indications are that this will be completed late this fall or by the first of January. The line from Ashland through to Seville will take a longer time, and will not be finished until the latter part of next year.

EAST LIVERPOOL, OHIO—Officials of the Youngstown & Ohio River Railroad have been approached by officials of the Ohio River & Northern Railroad seeking a consolidation of the two companies for at least a connection to be made at West Point. The Youngstown & Ohio River has started an electric line from Youngstown to West Point, and the Ohio River & Northern has secured the right of way from West Point to Wellsville and is now trying to get a franchise in East Liverpool. If the connection is made at West Point there will be a through line from East Liverpool to Youngstown, and the terminal and intermediate points will be supplied with coal from West Point fields. Persifor F. Smith, of Pittsburg, is the principal stockholder behind the Ohio River & Northern Railroad.

POTTSTOWN, PA.—Work will be begun in thirty days on the construction of an electric railroad from Pottstown to Paoli by the Philadelphia Interurban Railway Company, an organization chartered under the laws of Pennsylvania some time ago. Right of way between the two points has been secured and it is understood that the new line will reach Sixty-third and Market streets, Philadelphia, over the tracks of the Philadelphia & Western Railroad. The line will run through Phoenixville, Linfield, Royersford, Valley Forge and a number of small intermediate towns and boroughs, serving a population of about 2,500 a mile. The new company is capitalized at $3,000,000 common stock at $50 par, and $3,000,000 five per cent bonds. The stock is full paid and sufficient bonds, it is understood, have been placed to finance the present needs and warrant beginning the construction of the road.

SYRACUSE, N. Y.—At the annual meeting of the Syracuse & Suburban Railroad Company at Suburban park, the matter of extending the road was left to the executive committee, it being practically decided to build from Manlius through Cazenovia and Delphi to Deruyter. The proposed extension will add eighteen miles to a road now twelve miles long. The line will be double-tracked, according to present plans, making thirty-six miles of new track. In round numbers the track, power and equipment will cost $1,000,000. It has not been decided how the project will be financed. The capital stock of the Syracuse & Suburban company may be increased, a new company may be incorporated to take over the Suburban or a new company may be organized to build the extension and the two companies merged later. The capital for the undertaking will be furnished by New York and Philadelphia men, principally by the former, it is understood.

Digitized by Google

PERSONAL MENTION.

MR. R. B. WISEMAN has been appointed manager of the Missoula (Mont.) exchange of the Rocky Mountain Bell Telephone Company.

MR. FREDERICK L. MARSHALL, of Centralia, Ill., has been appointed superintendent of the gas and electric company at Hopkinsville, Ky.

MR. E. I. EMERSON has been made manager of the Portland (Me.) exchange of the New England Telephone and Telegraph Company. Mr. Emerson entered the employ of the telephone company in 1901, and was manager of the company's Burlington (Vt.) exchange since February 1, 1905.

MR. R. M. SEARLE has assumed the duties of the general manager of the Rochester (N. Y.) Railway and Light Company. Mr. Searle was connected with the Westchester Lighting Company, Mount Vernon, N. Y. Previous to that he was general manager of the Atlanta (Ga.) Gas Light Company.

MR. WINTHROP G. BUSHNELL, the well-known electrical magnate, has a summer home at the beautiful Sound shore resort of Pine Orchard, Ct. At a recent meeting of the leading residents Mr. Bushnell was honored by the appointment to the position of police commissioner of Pine Orchard, and a handsome diamond-studded badge of office was given him with eloquent words of appreciation. The recipient responded with much emotion, and declared his intention to do his duty conscientiously and fearlessly. The New Haven *Register* said: "The people of Pine Orchard will feel perfectly safe from every annoyance with Mr. Bushnell at the head of their police force. Mr. Bushnell wears his badge of office with great pride. A dinner followed the surprise."

MR. JOHN C. KILDAY has been appointed superintendent of the new Portland district of the New England Telephone and Telegraph Company. Mr. Kilday worked for the Western Union Telegraph Company as a messenger boy, soon securing a position of trust in the cashier's office at Portland. He later went to the Boston office of the Western Union as right-hand man to Mr. J. H. Wentworth. In 1894 he entered the office of Superintendent George S. Dresser, then in charge of the underground construction and maintenance work of the Boston division of the New England Telephone and Telegraph Company. He was made chief clerk, remaining with Mr. Dresser after the latter became general superintendent of construction. Three years ago Mr. Kilday became assistant superintendent of the eastern division.

OBITUARY NOTICE.

MR. CARLTON KING, of New York, died at Fort Collins, Col., August 5, at the age of thirty-five years. He attended the Elk's convention in Denver and contracted a cold which resulted in pneumonia. He was sick two weeks. He went to Colorado from New York four months ago and was made president and manager of the Northern Electric Company, the largest power and light company in the state.

ELECTRICAL SECURITIES.

In the earlier stages the market was more or less buoyant, but toward the close of the week a sagging tendency developed and speculation ranged within very narrow limits. At present, as far as internal affairs are concerned, the harvest holds the attention of all. The yield predicted is of a bounteous order with the inference that the demand and quality are so good that a new peak in the wave of prosperity will be developed. General business conditions, according to all reports, continued highly favorable during the week, and statements of railroad earnings showed gratifying increases. The figures of New York Central and its allied lines for the month of July were highly satisfactory, and would probably have offset the effect of the selling of the 3½ per cent bonds had it not been that the market had become entirely professional, and that for the time being no influential efforts were made to sustain it. A good deal of disappointment has been expressed in various quarters that the public had not responded to the recent advances in the market, but there was a strong feeling in many quarters that should the anticipated stringency in money fail to materialize, the coming fall would be marked by a broader and more wholesome speculation than has been seen in Wall street at any time in the present year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 11.

New York:	*Closing.*
Allis-Chalmers common	17⅝
Allis-Chalmers preferred	46½
Brooklyn Rapid Transit	78
Consolidated Gas	140
General Electric	167
Interborough-Metropolitan common	35½
Interborough-Metropolitan preferred	75½
Kings County Electric	160
Mackay Companies (Postal Telegraph and Cables) common	74
Mackay Companies (Postal Telegraph and Cables) preferred	73
Manhattan Elevated	140
Metropolitan Street Railway	108
New York & New Jersey Telephone	127½
Western Union Telegraph	91¼
Westinghouse Manufacturing Company	152

There was considerable interest in the quarterly statement of the local traction lines. Traffic in the subway is showing increases of 10 to 20 per cent a day over the corresponding days last year; the elevated lines show gains, although at a much smaller rate, and the surface roads are gaining also. Up to the end of May, Metropolitan was $500,000 ahead as compared with the corresponding period a year ago, and in the four months ended June 30 the three systems earned enough to show almost the full proportion of the dividend for Interborough preferred stock.

Earnings of the Brooklyn Rapid Transit system continue to show exceedingly satisfactory gains over a year ago. The average gain for July was $2,000 a day. Earnings on Sunday, July 22, were $76,000, an increase of $20,000 and on July 1, were between $75,000 and $80,000. The company's record day showed earnings of $81,000.

The directors of the Kings County Electric Light and Power Company have declared the regular quarterly dividend of 2 per cent, payable September 1. Books close August 18 and reopen September 1.

Boston:	*Closing.*
American Telephone and Telegraph	131½
Edison Electric Illuminating	240
Massachusetts Electric	68½
New England Telephone	130
Western Telephone and Telegraph preferred	85

The telephone stocks suffered a slight decline at closing. Local business was very dull, the intensely hot weather apparently driving away all traders.

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	70
Electric Storage Battery preferred	70
Philadelphia Electric	8½
Philadelphia Rapid Transit	30
United Gas Improvement	86½

Philadelphia market was dull and heavy, although local electrical issues made gains over the figures of a week ago.

Chicago:	*Closing.*
Chicago Telephone	118
Chicago Edison Light	135
Metropolitan Elevated preferred	67¼
National Carbon common	81¾
National Carbon preferred	118
Union Traction common	4
Union Traction preferred	14

The new protective committee of stockholders of the Chicago West Division Railway Company, consisting of Byron L. Smith, Cyrus H. McCormick, Chauncey Keep and John F. Bass, intend, it is said, to block the present plans for financial reorganization of Union Traction. In a circular to the stockholders they call attention to the supplemental bill filed by the Guarantee Trust Company, of New York, asking for a new set of receivers for all the companies to facilitate a sale of the properties. The communication is addressed also to the stockholders of the North Chicago. The committee warns the stockholders that if a sale were accomplished, as proposed, they would get nothing, or very little. It objects to the proposed issuance of receivers' certificates to pay for the removal of the tunnels. Objecting stockholders are depositing their stock with the Merchants' Loan and Trust Company, and contributing $1 per share toward a fund for legal service.

The Chicago Telephone Company during July gained 1,552 telephones. The total number now in use is 158,874.

Digitized by Google

INDUSTRIAL ITEMS.

THE C. O. SCHNEIDER COMPANY, Chicago, Ill., is the manufacturer of the thermostatic flasher used with the flashing sign described in the issue of the ELECTRICAL REVIEW for July 28.

LINDSTROM, SMITH COMPANY, 59 Dearborn street, Chicago, Ill., has placed on the market a vibro-massage machine, descriptive matter concerning which they will be pleased to send upon request.

THE MOORE ELECTRICAL COMPANY, 52 William street, Newark, N. J., has ready for distribution a new booklet describing the Moore tube light. In addition to the text the booklet shows illustrations of various installations of this system of lighting.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., will be pleased to send the Emerson monthly to parties interested in all kinds of electrical machinery. This periodical contains a bargain list of second-hand apparatus and numerous sketches calling attention to adaptations of Emerson apparatus.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., is furnishing the entire switchboard equipment for the Winona Lake Interurban Railway Company, which is building a new line at Winona Lake, Ind. There will be a main station board and three smaller boards for substations. The transmission voltage will be 35,000.

THE O. C. WHITE COMPANY, Worcester, Mass., has published a very handsome catalogue describing its standard adjustable fixtures for incandescent lamps in plain forms and in combination with gas fixtures. These fixtures are adaptable for shop, mill and factory; drawing room, office and bank; house, library and dressing room.

THE POWER AND MINING MACHINERY COMPANY, Cudahy, Wis., has published an attractive bulletin describing the Loomis-Pettibone gas-generating system operating gas engines for power. This is designated as publication No. 102. In addition to the descriptive text, there is a large engraving in colors showing the complete cycle of operations in the gas-generating system.

THE ATLAS ENGINE WORKS, Indianapolis, Ind., would be pleased to send to any one interested bulletin No. 131 describing throttling and automatic single-valve engines. This bulletin contains a carefully arranged treatise on the subject of Atlas single-valve engines, and, in addition to the text, shows numerous views of the assembly and several reproductions of indicator diagrams. There are also several tables giving complete specifications on five different classes of Atlas engines.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has issued the sixth edition of price list "A," which includes a description of all types of the "Chloride Accumulator" applicable to central station lighting and power, electric railway power, isolated lighting and power stations, railway car lighting, etc. In this addition is also catalogued auxiliary apparatus used in connection with "Chloride Accumulator" installations. This price list will be forwarded, upon application, to the general offices at Philadelphia or to the sales offices throughout the United States.

THE BRISTOL COMPANY, Waterbury, Ct., will be pleased to send to any one interested its descriptive bulletin No. 41, which simply touches upon the many different types and ranges of the recording instruments made by this company. Owing to the convenient size of this bulletin and the brevity of the descriptive matter, it is believed that it will be used as a file for easy reference when in need of information concerning recording instruments. These bulletins are not intended to take the place of the large illustrated catalogues and price lists, any of which will be sent upon application.

THE GOULD STORAGE BATTERY COMPANY, New York, N. Y., has secured a permanent office in the Monadnock Building, San Francisco, Cal., from which point all Pacific coast business will be handled. Owing to the growth of business with consequent demands for a closer base of operations, the company has found it necessary to establish a Canadian branch with offices at 62-64 Wellington street West, Toronto, Ontario, with P. B. Yates in charge. Besides the regular line of storage batteries for load regulation in connection with the Gould counter-electromotive-force booster for street-railway lighting and power-plant systems, the Gould Storage batteries are being manufactured for use in train lighting and also for telephone and telegraph work. The company has now in press a booklet on telephone batteries, which it will be pleased to send, without charge, to those interested.

THE AQUALITE FIRE-PROOFING PAINT COMPANY, 141 Broadway, New York city, has ready for distribution a circular setting forth the principal points regarding "Aqualite" hot-water paint for weatherproofing and fire-retarding. This is a hot-water paint put up in a powder form for either outside or inside use. It presents a hard surface, and the manufacturer claims it will not rub off, flake or peel, and is not affected by dampness in any manner. It can be applied with either a brush or spraying machine, and one barrel of dry paint mixed with boiling water will cover from 8,000 to 12,000 square feet of surface.

THE AMERICAN INSTRUMENT COMPANY, Philadelphia, Pa., has issued a comprehensive catalogue of direct-current switchboard and portable voltmeters and ammeters. In addition to general descriptive matter with illustrations the catalogue contains data as to dimensions of switchboard instruments and shunts, together with necessary particulars for drilling switchboards. The catalogue is decidedly attractive in appearance, and should be obtained by all who have occasion to buy or use electrical instruments. Enquiries for it should be addressed to James G. Biddle, general sales agent, 1114 Chestnut street, Philadelphia. The company's factory is at Newark, N. J.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., announces that every large city on the Pacific coast from San Diego, Cal., to the northern border of the United States has now adopted its automatic telephone system. The contract for the last large city, Spokane, Wash., was signed recently between the Home Telephone Company, of Spokane, Wash., and the Automatic Electric Company. It calls for the building and installation of a 3,500-line automatic exchange of the most modern type, together with power appliances, telephones, etc. San Diego, Los Angeles, San Francisco and Oakland, Cal.; Portland, Ore., and Walla Walla, Tacoma, Bellingham and Spokane, Wash., all having automatic installations, will be important factors in an extensive long-distance system being worked out on the coast by local capital.

THE HOLOPHANE GLASS COMPANY, New York city, announces that the central stations of the country are rapidly awakening to the necessity of giving their customers not only the maximum amount of light, but also the best illumination possible. An example of this awakening to the need of better illumination is that of the Portland General Electric Company, Portland, Ore., which has secured the services of H. N. Lauritzen of the engineering department of the Holophane Glass Company for a period of two months to assist them in the designing of lighting of numerous installations which are now under way, to assist the architect in the correct laying out of the lighting scheme before the buildings are wired, and also to instruct their salesmen to lay out the lighting in order to get the best illumination possible. So great has been the demand for this class of work that the Holophane Glass Company announces that for the present no more engagements can be made for members of its engineering staff for work of this kind.

NEW MANUFACTURING COMPANIES.

ALBANY, N. Y.—The Simplex Telephone Equipment Company has been incorporated with a capital of $100,000. The headquarters of the company will be at Rochester.

AUGUSTA, ME.—The American Telemestic Company has been organized for the purpose of dealing in electrical instruments, with a capital of $1,500,000. The officers are: president, A. M. Macomber, Augusta; treasurer, E. J. Pike, Augusta.

BALTIMORE, MD.—The Electrical Construction Company has been incorporated to manufacture and install electrical wires and apparatus by Ambrose Fleming, Kenneth Fraser, B. Carroll Shipman, Harry K. Brooks and Elmer J. Jones. The authorized capital stock is $5,000, divided into 500 shares of $10 each.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 8. NEW YORK, SATURDAY, AUGUST 25, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Manhattan Bldg., Chicago, Ill., L. W. MARSHALL, Manager
BOSTON OFFICE: Delta Bldg., 10 Post Office Square, M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad St., London, E. C., HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.
Copyright, 1906, by Electrical Review Publishing Co.
Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

CONTENTS.

EDITORIAL:
Electric Railways and the Baggage Men . . . 277
The Possibilities of the High-Speed Railroad . . . 277
Effect of Recent Scientific Progress . . . 278
Scientific Unbelievers . . . 279
Electric Traction in Greater New York . . . 279
The York (England) Meeting of the British Association . . . 280
The Twelfth Annual Convention of the Ohio Electric Light Association . . . 282
An Exposition of Safety Devices . . . 282
The Electric Railroad between Schleitheim and Schaffhausen, Switzerland, by Frank Koester . . . 283
Railway Motor-Car Traffic, by T. Hurry Riches and Sidney B. Haslam . . . 285
Divided Poles and Field-Winding Litigation . . . 287
Nernst Lamps for the New York Terminal of the New York, Pennsylvania & Long Island Railroad Company . . . 287
New Electrical Installations and Apparatus on the Continent, by C. L. Durand . . . 288
The New Engineering Building of the State University of Iowa, by William G. Raymond . . . 292
Electric Generating Equipment for a Gold Mine . . . 292
The Spokane & Inland Railway . . . 294
Extension of Southern Power Company's System to Concord, N. C. . . . 295
Independent Telephone Officers Elected . . . 295
Some Notes on the Mechanical Equipment of Collieries, by E. M. Hann . . . 296
The Cosmopolitanism of Science . . . 297
A 50,000-Volt Transmission for Seville . . . 297
Submarine Telephone Tests . . . 297
Electrochemical Papers Before the American Chemical Society . . . 298
The Greenock, Scotland, Electricity Works Extensions . . . 298
ELECTRICAL PATENTS . . . 299
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 300
METHODS OF GETTING NEW BUSINESS—"The Winning of New Power Business," by S. M. Kennedy . . . 302
Municipal Ownership Abroad . . . 304
Belmont Tunnel Terminus . . . 304
New York & Ontario Power Company . . . 304
INDUSTRIAL SECTION:
G. I. Outlet Boxes . . . 305
Power-Operated Hatches . . . 306
Forty Thousand Horse-Power in Hydraulic Turbines for Duluth . . . 306
Portable Air-Compressor Outfit . . . 307
Power Machinery Exportations . . . 307
CURRENT ELECTRICAL NEWS . . . 308

ELECTRIC RAILWAYS AND THE BAGGAGE MEN.

That the electric railways in cities affect the business of the cab men is undoubtedly true, and it is also true that in some sections, at least the country roads, notably the interurban electric lines, have cut into the receipts of the steam railroads. But it seems that the effect has been felt more widely, for the Springfield (Ill.) *News* says that it has greatly reduced the income of the baggage transfer men.

The electric lines, it is said, enable one traveling man to cover twice as much territory as he could when he was forced to depend upon the comparatively few steam railroads. This would cut down the baggage carried by one-half, but the reduction has gone even further, for the traveling man now finds that he can easily cover a country district by means of the electric lines which radiate from a large town. He therefore makes the town his headquarters, starting from and returning there each day. On his trips he takes only such baggage as can be conveniently carried in his hand. Formerly, he found it necessary to go from town to town with all his samples, and in each place found the services of a transfer man necessary. Frequently, to-day, he does not find it necessary even to have his trunks hauled to his hotel headquarters. He leaves them at the baggage room, taking with him only such samples as he needs for the day's work, for by means of the excellent service afforded by the local electric lines, he covers the district in the day and by nightfall starts for the next point.

Every increase in the efficiency of our methods of doing things necessarily cuts off certain losses and seems at first to be a hardship to those who lived on these losses. In this case it is the baggage men who suffer, and there seems no help for it but that they should turn their energies in other directions and utilize their equipments in other ways. Their loss is the gain of the community as a whole, and the sooner they adapt themselves to the new conditions, the better it will be for them and us.

THE POSSIBILITIES OF THE HIGH-SPEED RAILROAD.

The application of the electric motor to meet the immediate needs of railway terminals at large cities has drawn attention for a while from the so-called high-speed railroad, the expression meaning here a road on which a speed of 100 miles an hour or more may be made on regular schedule. It has been shown pretty conclusively that there is now no physical reason why such speeds may not be attained and held, so that the problem has resolved itself into one of securing sufficient safety; that is to say, of building a suitable roadbed and of devising a suitable system of controlling the trains. The electric motor furnishes the means by which any speed which the roadbed or the car itself will stand can be maintained indefinitely.

Aside from the design of the roadbed, the method of controlling the trains therefore becomes the next in importance. As has been said, it is obvious that some extension of the block system must be employed in which the blocks are longer and the safety devices much more complete than anything in use to-day. One plan would be to divide the road into long blocks, each block ending at a stopping point, and to allow no train to start from one station until the preceding train had left the one ahead. Another plan recently proposed contemplates dividing

Digitized by Google

the road into shorter blocks with intermediate blocks each long enough to enable a train to be brought to a stop on it. The power supplied to these blocks is to be controlled by the train on the next block ahead, and is to be cut off automatically from these intermediate blocks until there is no train in the block ahead.

The interesting feature about these plans is the fact that the very means which makes it possible for us to attain such high speeds is the means which will enable us to make use of them. The electric motor is the only driving mechanism considered for such high speeds, and the electric railway system is one which readily adopts itself to automatic control. On such a road, not only would the signals be operated more or less automatically by the trains themselves, but the safety devices which would be necessary for the road would also be controlled electrically. There would be no difficulty in having the power supplied to one whole block cut off automatically by the presence of a train on another part of the road, a feature difficult to obtain if any other motive power be used.

The high-speed road is more than a probable development in railroading, and that it will be purely electrical there seems at present to be no doubt. It is because the power is supplied to the moving train from a stationary power-house that such speeds may be maintained, and the movement of the trains may be controlled automatically.

EFFECT OF RECENT SCIENTIFIC PROGRESS.

Popular writers on scientific subjects are happy if they can describe some new discovery as revolutionary, as upsetting all our old ideas and forcing us to start from a new foundation, as it were, and entirely reconstruct our theories. All of our old theories are pictured as wrong, and, therefore, are to be wiped out and an entirely new conception formed upon a new foundation with new ideas. This is, of course, erroneous, for in the first place scientific theories are stated with a reservation. They, as every one should know, apply only to known facts, and they serve merely to classify these and to suggest new lines for investigation. In the second place, scientific advance is constructive rather than destructive. It enlarges our structure rather than tearing it down. This idea was expressed by Dr. E. R. Lankester in his presidential address before the British Association for the Advancement of Science, when he said:

"The kind of conception to which these [radioactive] and like discoveries have led the modern physicist in regard to the character of that supposed unbreakable body—the chemical atom—the simple and unaffected friend of our youth—are truly astounding. But I would have you notice that they are not destructive of our previous conceptions, but rather elaborations and developments of the simpler views, introducing the notion of structure and mechanism, agitated and whirling with tremendous force, into what we formerly conceived of as homogeneous or simply built-up particles, the earlier conception being not so much a positive assertion of simplicity as a non-committal expectant formula awaiting the progress of knowledge and the revelations which are now in our hands."

The idea of the atom has been the greatest value to chemistry. Physicists can get along without it, as has been shown by Gibbs. But none of the new ideas of matter affect the atom so far as the chemist is concerned. To him, matter is still atomic; that is to say, definite portions of matter act as units and possess certain distinctive properties. No chemical reactions known are able to change the atom, and hence up to the present time, at least, it is chemically indestructible. And even should it be shown possible to transform matter of one kind into another, none of our knowledge of chemistry will become false, for no one doubts that a newly formed atom of a known element would possess all the peculiarities which distinguish that element. The chemistry of the present day at least is concerned only with atoms and atomic groups or molecules, and should it eventually be proved that the atom is transmutable, it would simply mean that a vast and unexplored field has been opened to chemistry and not that the chemistry of to-day is founded on false ideas.

Science may be compared with a large building from which we view nature as she surrounds us. Each new experiment or advance adds a little to the structure at this point, or raises that tower a little higher, or opens a window in another place, thus, in one way or the other, giving us a new view, or enabling us to see another side of some particular phenomenon. Sometimes the new addition seems to be detached from other parts of the structure, but before long, galleries are built connecting them. Sometimes it does not seem to harmonize with the whole structure, because, perhaps, the builder did not put it together just as he should, but later some one else will correct the incongruities and bring the new into proper proportion. Perhaps a new window is not opened in just the right place and it, therefore, gives a perverted view, but this is before long corrected. Perhaps the work of laying the foundations for a new addition seems to jeopardize an adjoining part of the structure, yet if the foundations of the latter are properly laid on the bedrock of facts there is no danger. And if they be not so laid the new work may make the opportunity for shoring up the endangered part until secure foundation can be laid for it. Seldom is it necessary to destroy utterly any part of the building.

Too frequently, workers in this building confine themselves more closely to their own little part than they should so that they get a perverted idea of the importance of the little view seen from their window, and even do not see this in the proper perspective. If they would only take a little excursion into another part of the building under the guidance of a friend familiar with it, they would not only get a better idea of the relation of their little bit of scenery to the rest, but they would behold it in proper proportion and would, perhaps, see something new in it not discernible from their own window.

The new discoveries of science have been truly wonderful, and no one can say where they will lead; but we have not lost anything, and all the new knowledge is pure gain.

Digitized by Google

SCIENTIFIC UNBELIEVERS.

No scientific discovery in recent times has aroused so much interest and will apparently exert so powerful an influence as that of radioactivity. The remarkable phenomena exhibited by substances possessing this property and the brilliant way in which the problems have been attacked and apparently solved, aroused universal enthusiasm. There has been a rush of workers into the new field, and a display of activity and of earnestness as has never before been witnessed. Indeed, it is possible that the very enthusiasm with which these men have gone to work has carried them further than they anticipated. Some, indeed, seem to have lost their balance, and have given expression to ideas which the conditions hardly warrant.

There is no lack, however, in the scientific world of conservative men who are wont to exert at such times their influence in preventing the acceptance of hastily proposed theories. Certain of these are now raising their voices against the latest theories of radium. At the recent meeting of the British Association for the Advancement of Science, Lord Kelvin objected to the idea that the production of helium from radium establishes the fact of a gradual evolution of one element into others, and Professor H. E. Armstrong, in a letter to the London *Times*, vigorously supports this stand. He says:

"The thanks of the public are due to Lord Kelvin for his protest against the conclusion being drawn from the evidence at present before us that it is proved that there is a gradual evolution of one element into others. No one has yet handled radium in such quantity or such manner that we can say what it is precisely. That helium can be obtained from radium appears proved, but no proof has yet been given that it is not merely contained in it.

"There was a time when the expression 'scientific caution' meant the highest degree of caution, and it was supposed to be an attribute of workers in science. Workers in the radium school appear to have cast caution to the winds and to have substituted pure imagination for it. Among ourselves we should always be at liberty to postulate the most crack-brained hypothesis, to dream the wildest dreams, as a means of guiding enquiry, but we should not court popularity on such a basis. By so doing we lose all claim to guide public opinion."

These are timely words, and the scientific world is under obligation to those who are courageous enough to take a stand against any new theory. Only in this way can the weak points of a theory be weeded out and it, itself, be gradually strengthened. But the blame for the present situation can not be laid to those who have done the most to increase our knowledge regarding the wonderful phenomena connected with radioactivity. As Professor Armstrong points out, scientists are at liberty to postulate most absurd ideas, but this is always done with a mental reservation, and proper weight is always given to such. It is the semi-scientific who seek a popular audience that turn a scientific suggestion into a statement of facts. There seems to be no way of controlling this matter and of providing the world at large with nothing but strictly scientific writings, but it is probable that if popular articles were always written with the caution employed in a scientific treatise they would lose much of their interest for the non-scientific reader, and it is a benefit to the world at large to have every one more or less interested in science. This offsets in some degree the bad effects of the poor science.

The rather small number of men who have really done the great work on radium should be given credit for their labor and the skill with which they have met and overcome difficulties. The scientific world is under a lasting debt to them, but science is never content blindly to follow one set of workers. She always insists that some one look at the matter from another standpoint and that some act as balance-wheels, so that by retarding a too hurried advance due to our first enthusiasm, we store up momentum to carry us over difficult points met further along.

ELECTRIC TRACTION IN GREATER NEW YORK.

The few statistics published in the ELECTRICAL REVIEW last week dealing with the electric railway traffic in Greater New York, throw some light on the present situation. The magnitude of the traffic in this city is shown by the figures giving the totals. During the quarter ending with June of this year, over 332,000,000 cash fares were collected in the entire city, an increase of nearly 30,000,000—a little more than nine per cent over the corresponding period of the previous year. Of this increase, the greatest part numerically took place in the borough of Manhattan, the increase there being 17,700,000. The increase in the borough of Brooklyn was something over 8,000,000. When, however, the percentage of increase in each case is determined, it is found that that of Manhattan is one of the smallest, it being nine per cent; that of the borough of Brooklyn is eight and a half per cent, while the increase in the borough of The Bronx was forty-eight per cent. These figures correspond somewhat to the increase in population of each borough, but the relation is not very clear.

The report shows that the great increase in traffic in The Bronx was due mainly to increased facilities, for the car mileage during the three months considered was about twenty-two per cent greater that it was during the previous year. The increase in car mileage in the borough of Brooklyn was about five and a half per cent, but in Manhattan there was a decrease, probably due to a better arrangement of the schedule and trains, for the service is as good.

Some idea of the tremendous traffic existing in this city is given by the figures showing the heaviest traffic on any day. The elevated division of the Interborough Rapid Transit Company carried on one day during last April 938,959 passengers. The surface lines of the New York City Railway Company carried on one day in May 1,846,538 passengers. Figures showing the greatest amount of travel on the subway are not given. The figures for Brooklyn are also significant, for the Brooklyn Heights Railway Company carried on one day during last June 2,129,264 passengers. The figures for the heaviest duty in the other boroughs are comparatively small, but it is in these boroughs where the greatest increase of traffic is taking place, due both to increased facilities and to increase in population. The figures from all the boroughs taken together show a rate of increase in traffic about three times as great as the growth of the population.

Digitized by Google

The York (England) Meeting of the British Association.

August 1 to 8, 1906. Papers of Electrical Interest.

By John B. C. Kershaw.

THE seventy-sixth annual meeting of the British Association for the Advancement of Science was held at York from August 1 to 8, under the presidency of Professor Ray Lankester, of the Natural History Department of the British Museum.

The meeting derived special interest from the fact that the association held its first meeting at York seventy-five years ago, and that many distinguished scientists were attending the 1906 meeting who were present at the Jubilee gathering at York in 1881. On that occasion the exhibition hall, in which the presidential address was delivered, was lighted by electric arc lamps, this being one of the earliest demonstrations in England of the new form of illumination, Robert Hammond, a consulting electrical engineer of London, being responsible for this innovation. The 1906 gathering of the British Association thus marks the completion of a twenty-five-years' period in the development of electric lighting in England, and an unusually large number of electrical engineers attended, in consequence, the York meeting.

The weather was favorable for the success of the numerous outdoor functions and excursions, and although the attendance, which reached nearly 2,000, was not so large as at the previous York meeting in 1881, the gathering is considered to have been above the average, as regards the value and importance of the papers and discussions. It is obviously impossible in the small space allotted to this report to give any adequate account of the whole work of the association, which is now divided into eleven sections, and covers every branch and department of natural and social science. In what follows, therefore, attention will alone be directed to the papers and discussions likely to be of special interest to readers of the ELECTRICAL REVIEW. The most important of these papers was that contributed by Sir William Preese upon "Glow Lamps Up to Date and the Grading of Voltages," read on Monday, August 6.

In this paper the author traced the history and development of the carbon filament lamp in the United Kingdom from its first introduction by Swan in 1881, down to the present date, and then gave a description of the Nernst lamp and of the newer metallic filament lamps—the osmium, tantalum, zircon—and other lamps of this character. In this connection he stated that by a new method of manufacture now adopted in the United States the filament of the carbon lamps had been rendered much denser in character. This improvement had reduced the consumption per candle-power to 2.5 watts while at the same time lengthening the life of the lamp. The metallic filament lamps, however, gave a much higher efficiency than these improved carbon lamps—the zircon, or Z lamp, the newest and latest of these, requiring only 1.07 watts per candle-power, as compared with 1.325 watts for the Nernst lamp, and 1.5 to 2.1 watts for the tantalum lamp. The mercury vapor lamp, with a carbon filament glower, was also described.

In the remainder of his paper the author dealt alone with the carbon filament lamp, and stated the urgent necessity that existed for more exact grading of voltages in these lamps as supplied to the British consumer. The very unsatisfactory results obtained in recent tests of British lamps in New York were referred to, and a strong plea was made for the introduction of a system of testing which should put a stop to the dumping down from abroad and sale in the United Kingdom of lamps so unsatisfactory as those revealed by these tests. Part of the difficulty in the United Kingdom was caused by the extreme variations in the voltage at which current was supplied, a table being exhibited which showed that only ninety-three central supply stations out of a total of 472 had adopted the standard pressures of 110 and 220 volts. The author recommended that lamps should be graded as follows:

110 volts	100 105 110 115 120 volts
220 volts	200 210 220 230 240 volts

and that every lamp should be marked with the voltage at which it must be used.

The National Physical Laboratory and Engineering Standards committee, in conjunction with the local supply authorities, ought to take the initiative in this matter, and if the electric lighting acts were at the same time amended to allow the local supply authorities to take charge of consumers' lamps, and replace the same when the efficiency had fallen below a fixed limit, the difficulties due to inefficient glow lamps would be largely solved.

The discussion upon this paper was opened by Professor Sylvanus P. Thompson, of London, who stated that in his opinion the carbon filament lamp was doomed to displacement by the metallic filament lamp, and that therefore it would be a foolish waste of time and energy to devise systems and organizations for prolonging its life. Professor Thompson illustrated his remarks by lantern slides based on Langley's researches, showing the scientific principles underlying the higher efficiency of the metallic filament lamps, and proved that though these bright filaments radiate less heat and light than the black carbon filaments, the light radiation is to a much larger extent within the range of natural vision.

Colonel R. E. Crompton disagreed with Professor Thompson and thought for the present, at any rate, the introduction of a system of grading and testing carbon filament lamps was urgently required.

As regarded the future he also disagreed with Professor Thompson, for in his opinion not metallic filament lamps—but incandescent vapor lamps—similar in principle to the mercury vapor lamp, would displace the carbon glow lamp. Already he had seen and tested one such lamp which yielded one candle-power for one-sixth of a watt; and more would be heard of this remarkable lamp—the invention of a Frenchman—shortly.

Mr. Hammond, Professor J. D. Henderson and M. Leon Gaster also joined in the discussion, and the last-named gentleman exhibited samples of the newer metallic filament lamps now being made in Germany—the best of these, the "Osram" lamp, requiring only one watt per candle-power.

The paper next to that of Sir William Preece in interest and importance was that by C. F. Jenkin, of Siemens Brothers, London, upon "The Advent of Single-phase Electric Traction."

The author called attention to the rapid advance of electric traction on railways, pointed out its advantages, and described briefly the system on which it should be carried out. Electric traction, in his opinion, will not be adopted simply to reduce the cost of hauling trains. The cost of electric hauling may be more or less than that of steam, according to circumstances. The real advantage of electrification is that it will make the line pay better. It will provide a faster, more fre-

Digitized by Google

quent and more comfortable service for the public, and consequently will attract a much larger traffic. It will provide means by which this increased traffic can be carried where this can not be done by steam. Further, it will enable new methods of handling the traffic to be adopted, such as extending the railway service on to the tram lines, providing an express service to every suburban station instead of stopping trains, and developing the traffic on branch lines upon an economical basis. Examples of these methods were described in the paper, the suggestions relating to the working of all trains express being most novel. The advantages of increased traveling facilities to the inhabitants of towns have been pointed out by Charles Booth, and the author pleads for a relaxation of the extravagant precautions now demanded in Great Britain for the public safety, and points out that these result in far more lives being lost in the crowded slums than are saved by the avoidance of rare accidents.

The merits of the two alternative systems — alternating-current transmission, continuous-current distribution with low-tension third rail; and alternating-current transmission with high-tension trolley wire—were discussed, and the great advantages of the latter were pointed out, together with the superiority of the single-phase over the three-phase system.

The equipment of a single-phase line was then described, the various features being touched on.

In conclusion the author urged the railway companies to proceed with trial lines in order to convince themselves of the advantages and possibilities of the single-phase system.

The most novel and important of the author's points were those relating to the possibility of running all trains at express speed with slip carriages for the intermediate stations, and to portions of the electrical equipment of the line for single-phase work.

The discussion upon this paper was unfortunately postponed until late in the morning, and as a result it was wholly inadequate to the importance of the subject; R. W. Cramp and Sir William Preece being the only participants. The former criticized Mr. Jenkin's remarks on repulsion motors, while Sir William Preece agreed with the author as to the obsolete character of the third-rail system of electric traction with direct current, so far adopted in the United Kingdom for railway work. It is important to note in this connection that contracts have been placed for the electrification of a short branch of line on the Midland Railway in Lancashire, connecting with its new Irish service. This line will be worked on the single-phase system, and when completed it will be the first example of single-phase traction work in the United Kingdom.

Another paper of exceptional interest at the moment for electrical engineers was that read on Tuesday, August 7, by Gerald Stoney, of Parsons's Newcastle works, upon "Recent Advances in Steam Turbines—Land and Marine."

Professor J. A. Ewing opened the discussion upon this paper and stated that the steam turbine had undoubtedly arrived, and that the next advance would be a gas turbine. In his opinion the reciprocating engine was doomed. Robert Hammond referred to the new County of London power-supply scheme, and intimated that 10,000-kilowatt steam turbines would be adopted as the units for this power-house, if the council obtained parliamentary powers next session.

Professor McCall and Colonel Crompton also joined in the discussion, and referred to the loss of efficiency shown by turbine plants after one or two years' running, due to the wear on the ends of the turbine blades. Mr. Stoney, in reply, explained the means now used by the Parsons company to prevent stripping and wear of the blades on continued running.

Troubles arising from the vibration caused by reciprocating engines in modern electricity-generating stations have sometimes led to expensive lawsuits, and therefore, some notes of a lecture delivered on Tuesday, August 7, by Professor W. E. Dalby, of London, upon "Experiments Illustrating the Balancing of Engines," may find a useful place in this report. After discussing the mathematical side of the problem, Professor Dalby showed by beautifully made working models of reciprocating engines hung on springs and driven by electric motors, that in every case the correct adjustment of the cranks or the addition of balancing weights of the right mass to certain parts of the machine or of the flywheel, would entirely stop the vibration which otherwise occurred on running. The larger problem is always how to arrange the actual working parts of the engine or machine so that the reaction on the frame, due to their several accelerations, forms a system of forces in equilibrium among themselves. This can in almost all cases be done by adjustment of the cranks, even without the addition of compensation or balancing weights.

Colonel Crompton gave an instance of the successful application of Professor Dalby's methods in an electricity station in London, where a vibration nuisance had been completely suppressed by careful adjustment of the moving parts of the engines, so as to obtain the equilibrium of forces referred to above.

All the above papers were read in Section G, the "engineering" section of the association.

In Section B (Chemistry) Messrs. Cramp and Leetham read a paper on Thursday, August 2, dealing with "The Electrical Discharge in Air and Its Commercial Application."

Since 1904 the authors have been engaged in developing an apparatus for the production of a peculiarly active gas for bleaching and sterilizing purposes, discovered by Sidney Leetham in 1903, and now much used for flour-bleaching purposes. This work has led to a number of investigations on the electrical discharge, and of its effects on air, the results of which were given in this paper.

Professor H. E. Armstrong, of London, was the chief contributor to the discussion of this paper, and stated that ozone alone when used for flour bleaching and sterilization left an intolerable odor in the flour, but that the compound gas obtained from the Leetham and Cramp apparatus gave entirely satisfactory results when used for the same purpose.

Finally a paper contributed to Section G on Friday, August 3, by S. H. Davies and F. G. Fryer, of Rowntree's chocolate and cocoa works at York, may be referred to, since the subject, "The Removal of Dust and Smoke from Chimney Gases," is one of some interest to electrical engineers.

The boiler plant at Messrs. Rowntree's works in York is somewhat small for the steam demands made upon it, and, in order to increase the capacity, induced draft has been installed with Bennis sprinkling stokers. The coal used is a dusty pea slack from the South Yorkshire coal fields, forty per cent of this fuel being fine dust and smudge. The evaporation obtained in this way is good (8.5 pounds of water per pound of coal) but an intolerable amount of dust and unburnt coal is carried up the chimney. In order to overcome the nuisance arising from this dirt and smoke discharge from the chimney top, a smoke-washing plant has been installed with entire success.

A large brick chamber, thirty-seven feet by fourteen feet six inches and seventeen feet high, has been erected between the economizers and chimney, and in this chamber, four iron baffle-plates have been fixed. Water in the form of a coarse spray is supplied by Harrison's patent spraying nozzles, and the dirt and soot carried down by the water are discharged through a water-sealed trough into an outside tank, from which they can be periodically removed. The quantity of water required to work this washing plant is about 6,400 gallons per hour, with a fuel consumption of 350 tons per week. Attempts to recover the sulphurous acid from the wash water have failed so far, and on this account a large volume of water is required in order that only a dilute-acid solution may be run to waste. The total sulphur acids in the chimney gases were reduced from 0.2 to 0.005 gramme per cubic metre, and the grit and smoke were removed completely by the use of this apparatus.

Robert Hammond, of London, was the chief contributor to the discussion on this paper. He stated that while the smoke-washing device described by the authors might prove entirely satisfactory at Messrs. Rowntree's works, it would not solve the smoke problem for electricity stations generally, since the amount of water required was almost prohibitive in all but small and exceptionally situated generating stations.

Digitized by Google

THE TWELFTH ANNUAL CONVENTION OF THE OHIO ELECTRIC LIGHT ASSOCIATION.

HOTEL VICTORY, PUT-IN-BAY ISLAND, OHIO, AUGUST 21, 22 AND 23.

On August 21, 22 and 23 the twelfth annual convention of the Ohio Electric Light Association was held at the Hotel Victory, Put-in-Bay Island, Ohio. A feature of the convention was the series of papers devoted to the commercial side of central station development. Elaborate preparations were made for the entertainment of the delegates and the ladies present, the interest being enlivened by the presentation of prizes donated by the manufacturers.

The following programme was announced:

TUESDAY, AUGUST 21.

Meeting of all committees, 1.00 P. M.

FIRST SESSION, 1.30 P. M.

Address of Acting-President W. E. Russell, Massillon, Ohio.

Papers—"High-Efficiency Lighting Units in Ohio by Central Station Men," A. N. Cope, Public Service Company, Columbus, Ohio; T. D. Buckwell and J. W. Gilmartin, Toledo Railway and Light Company, Toledo, Ohio; C. C. Collins, Columbus Railway and Light Company, Columbus, Ohio.

Papers—"New Lamps and New Opportunities," F. W. Wilcox, General Electric Company, Harrison, N. J.

General talk on Nernst lamps, Max Harris, Nernst Lamp Company, Pittsburg, Pa.

Entertainment—Automobile ride around the island and visit to the caves for the ladies; prize contests and bathing; evening band concert and reception.

WEDNESDAY, AUGUST 22—FIRST SESSION, 9.30 A. M.

"Best Methods of Increasing Business"—Papers—"As Applied to Small Cities and Towns," Samuel M. Rust, Greenville Electric Light and Power Company, Greenville, Ohio. "As Applied to Cities," W. C. Anderson, Canton Light, Heat and Power Company, Canton, Ohio. "As Applied to Large Cities," Frank M. Tait, Dayton Lighting Company, Dayton, Ohio.

"Successful Ways of Increasing Business"—Papers—J. Kermode, Cleveland Illuminating Company, Cleveland, Ohio; J. H. Maxon, Gallipolis Light and Coke Company, Gallipolis, Ohio; D. W. Low, Alliance Gas and Electric Company, Alliance, Ohio; E. H. Beil, Youngstown Consolidated Gas and Electric Company, Youngstown, Ohio; M. E. Turner, Cleveland Illuminating Company, Cleveland, Ohio.

SECOND SESSION, 2.00 P. M.

Papers—"Gas Engines in Competition with Electric Motors," Wm. Wolls, Columbus Railway and Light Company, Columbus, Ohio.

"Advertising and New-Business Getting," Chas. A. Parker, Detroit, Mich.

"Wiring of a $3,500 Residence Scientifically Lighted," J. R. Cravath, Chicago, Ill.

"Series Luminous Arc Rectifier Systems," N. R. Birge, Schenectady, N. Y.

EVENING.

Rejuvenation of Sons of Jove.

Entertainments—Card party for ladies for prizes, forenoon; bowling contest and croquet for prizes; bathing and trolley ride; grand ball, evening.

THURSDAY, AUGUST 23—FIRST SESSION, 9.30 A. M.

Papers—"Report of Committee on Cost Determination," E. J. Bechtel, Toledo Railway and Light Company, Toledo, Ohio.

"Report of Committee on Publicity," B. S. Young, Ada Water, Heat and Light Company, Ada, Ohio.

"Legislation, Its Uses and Abuses, and Report of Advisory Committee," D. L. Gaskill, Greenville Electric Light and Power Company, Greenville, Ohio.

"Report of Committee on Uniform Accounting and Records," F. E. Crawford, Library Bureau, Cleveland, Ohio.

SECOND SESSION, 2.00 P. M.

Paper—"Electric Heating Devices, their Latest Commercial Developments," H. J. Mauger, Schenectady, N. Y.

Report of secretary and treasurer.

Election of officers.

Question Box.

Executive session.

Entertainment—Finishing of contests for prizes; bathing and games.

Officers, 1905-1906—W. E. Russell, acting president, Massillon, Ohio; D. L. Gaskill, secretary-treasurer, Greenville, Ohio.

Committee for twelfth annual convention—reception committee— B. S. Young, Ada, Ohio; W. J. Hanley, Columbus, Ohio; George Dusenberre, Cleveland, Ohio; A. A. Serva, Ft. Wayne, Ind.; L. B. Hoit, Cleveland, Ohio; George Porter, Columbus, Ohio; N. C. Cotabish, Cleveland, Ohio; Elliot Reynolds, Pittsburg, Pa.

Entertainment committee—F. W. Wilcox, Harrison, N. J.; A. C. Robeson, Greenville, Ohio; Fred Bissell, Toledo, Ohio.

Committee on Arrangements—E. J. Bechtel, Toledo, Ohio; M. C. Hull, Columbus, Ohio; E. F. Gwynn, Delaware, Ohio; E. H. Beil, Youngstown, Ohio.

CONTESTS AND PRIZES FOR THE LADIES.

Contest No. 1, Euchre Party—First prize: Electric breakfast set, consisting of chafing dish, cereal cooker and coffee percolator, donated by General Electric Company; second prize: One alternating fan donated by Westinghouse Electric and Manufacturing Company; third prize: One piece cut glass donated by Libby Glass Works; fourth prize: One electric flat-iron donated by the W. J. Barr Electric Manufacturing Company; fifth prize: One curling iron donated by the W. J. Nagel Electric Company.

Contest No. 2, Guessing Contest—First prize: One French coffee urn donated by Electric Appliance Company; second prize: One oscillating fan donated by the Robbins & Myers Company; third prize: One electric water heater donated by the Fisher Electric Company; fourth prize: One electric flat-iron donated by American Electrical Heater Company.

Contest No. 3, Bowling—First prize: One electric stand lamp donated by Post-Glover Electric Company; second prize: One alternating fan donated by Westinghouse Electric and Manufacturing Company; third prize: One electric flat-iron donated by Cleveland Electrical Supply Company; fourth prize: One heating pad donated by General Electric Company.

Contest No. 4, Croquet—First prize: One stand lamp donated by Moreau Gas Fixture Manufacturing Company; second prize: One desk fan donated by the Star Electric Company; third prize: One desk fan donated by the F. Bissell Company; fourth prize: One electric flat-iron donated by the Erner Electric Company.

Contest No. 5, Tennis—First prize: One drop-head sewing-machine motor donated by Doubleday-Hill Electric Company; second prize: One revolving electric fan donated by Ft. Wayne Electric Works.

Contest No. 6, Natatorium—First prize: One Cleve glass dome donated by Cleveland Window Glass Company; second prize: One disc stove donated by General Electric Company.

An Exposition of Safety Devices.

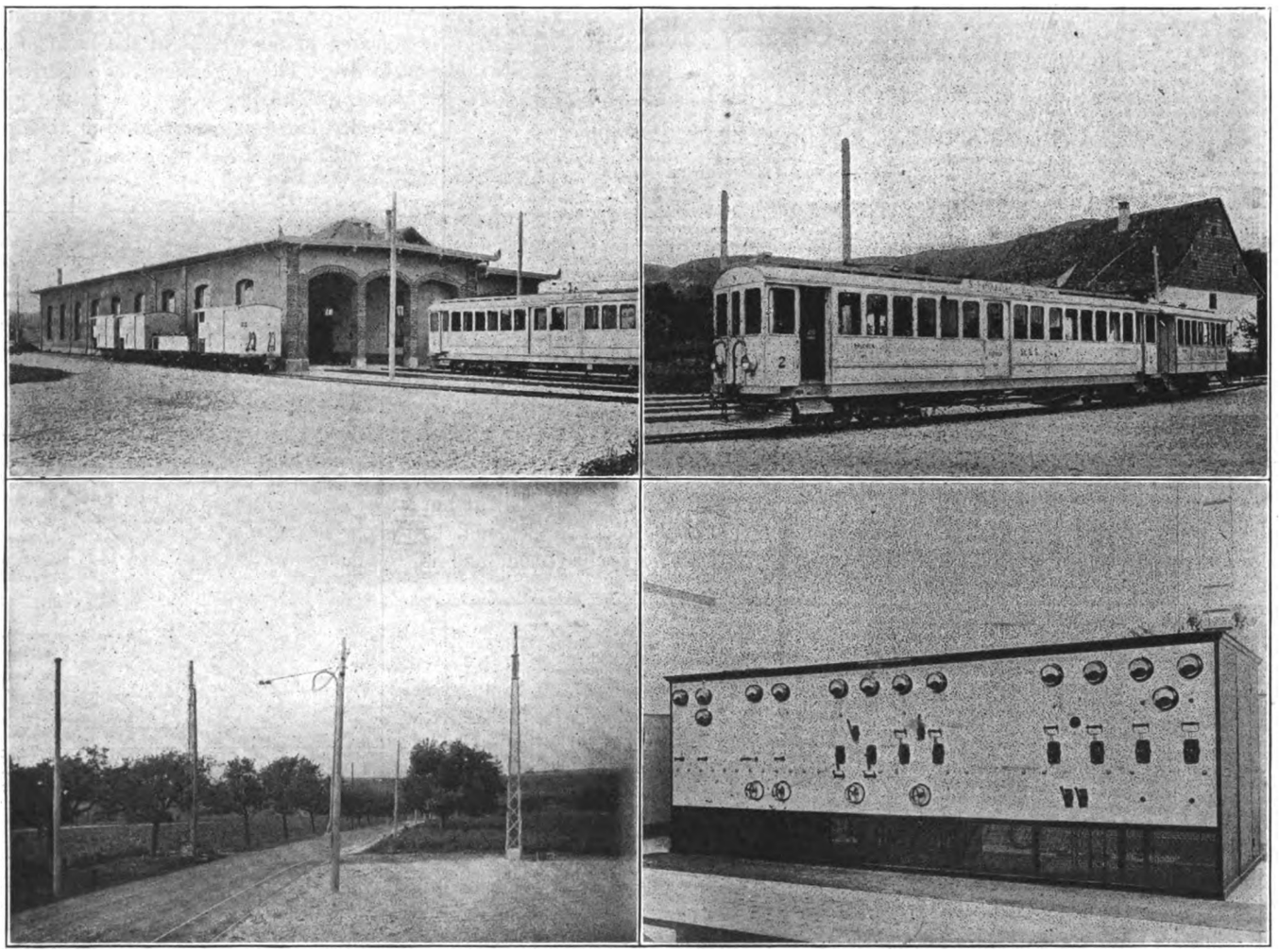
The American Institute of Social Service will hold in New York city, in January next, an exposition of devices for safeguarding the lives and limbs of working men and women, and for preventing accidents under the ordinary conditions of life and labor to which the general public is exposed. Requests for information regarding space should be made to Dr. William H. Tolman, director, 287 Fourth avenue, New York city.

Digitized by Google

The Electric Railroad between Schleitheim and Schaffhausen, Switzerland.

By Frank Koester.

RECENTLY a street-railway system was installed between Schleitheim and Schaffhausen, in northern Switzerland, which has many interesting features. The road is 10.3 miles in length and runs for the most part on the Canton road, the greatest grade being one of six per cent, which, however, is only for a distance of 170 feet, the smallest curve having a radius of forty feet.



SCHAFFHAUSEN-SCHLEITHEIM ELECTRIC RAILWAY—CAR BARN; MOTOR CAR AND TRAILER; TROLLEY SUSPENSION SYSTEM; DIRECT-CURRENT SWITCHBOARD.

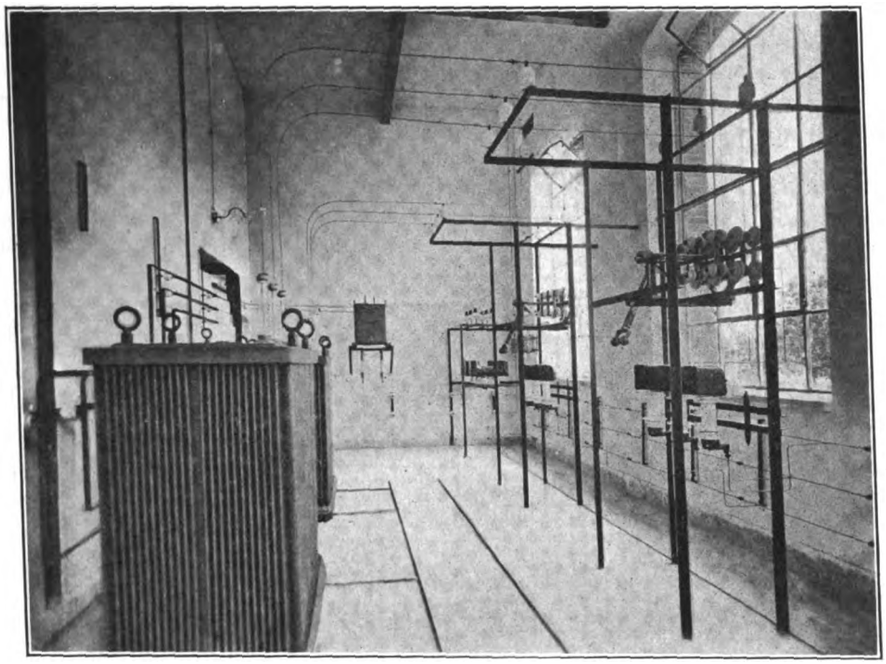
In cities and at street crossings the rails are of the flanged type, while at all other places the Vignole type is used, the gauge being one meter (3.28 feet). The roadbed is 6.7 feet wide and is made of ballast twelve inches thick. The rails rest on iron ties and are forty feet long, weighing 30.8 kilograms per meter.

The power to supply the road is taken from the power-house at the city of Schaffhausen, where there are installed two 150-kilowatt transformers which step up the pressure to 10,000 volts, at which it is distributed to the transformer stations along the road, being again reduced to 380 volts, there being in each station two step-down transformers and two motor generators of 165 horse-power each, the alternating motor, of the Oerlikon type, consisting of a stationary primary winding and a rotary induction winding while the directly connected generator—110 kilowatts—has its exciting coils connected in shunt, taking current directly from the bus-bar system. The efficiency of the set is ninety-two per cent at full load, ninety-one per cent at three-quarter load, and ninety per cent at one-half load. The sets are mounted upon insulators on the foundation, as is frequently found in Swiss practice. For equalizing the load there is a battery comprising 390 cells with a capacity of 200 amperes. The feeders from the transformers to the bus-bar system are provided with two three-pole switches, six one-pole fuses and two ampere-meters provided with measuring transformers. Between the transformers and the motor-generators are also two three-pole switches, the fuses and an ampere-meter. There is also a starter with which the machines are brought up to speed before being thrown on the line. The generators and battery feed to a common bus-bar system and are well provided with switches, fuses, and ampere-meter, while the outgoing wires are provided with all necessary measuring instruments, switches and trusses, as well as lightning arresters.

The switchboard, containing eight panels, consists of a steel frame upon

Digitized by Google

which are mounted white marble slabs bearing the necessary instruments and levers, while the lower portions as well as the sidewalls are covered with perforated sheet iron.

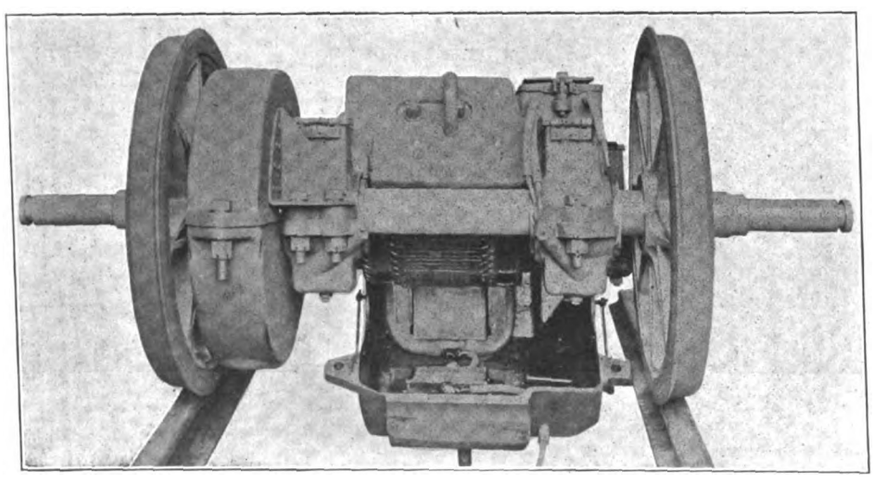


SCHAFFHAUSEN-SCHLEITHEIM ELECTRIC RAILWAY—INTERIOR OF TRANSFORMER STATION.

The trolley is made of a copper wire of eighty square millimetre sectional area and carried by suspension wires on wooden poles twenty feet above the ground.

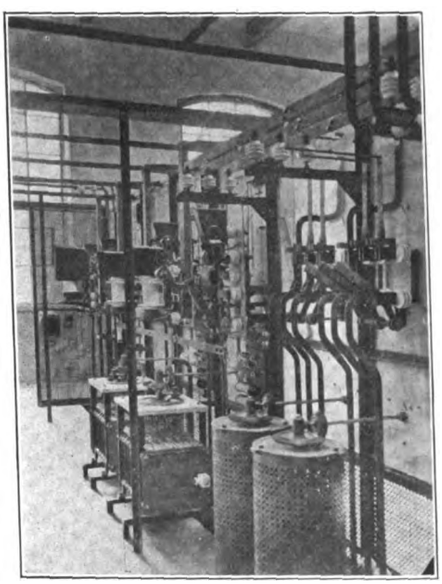
The feeder wires are carried partly on poles and partly on suspension wires, the rails being used for the return. The rail bonds consist of eight millimetre copper wire, every tenth rail joint being interconnected by copper wire in a similar way.

The rolling stock, consisting of four motor-cars, three trailers, five box cars and three flat cars, were built by the Swiss Industrial Company, of Manhausen, the electrical equipment being installed by the Oerlikon Company. The motor-cars are of the two-truck type, the distance from centre to centre of which is 28.2 feet, while the entire length over all is 49.2 feet. The cars are provided on each end with sliding doors giving access to a smoking compartment, each having a seating capacity of eighteen, between which there is a small space for parcels-post but which may, should occasion demand, be used as a passenger compartment and is provided with four folding seats and has standing room for four. With the seats folded the cars accommodate twelve passengers standing. As the rear platform can accommodate four passengers standing it will be seen that the whole car can, when the occasion demands, accommodate fifty to fifty-two passengers without being overcrowded.



SCHAFFHAUSEN-SCHLEITHEIM ELECTRIC RAILWAY—CAR MOTOR.

The braking system consists of a Boecker air-brake and a hand-brake working in combination, which can be operated from either platform, and also an electric solenoid brake. Should the brakes on either truck be out of order there is an arrangement on each platform whereby the brakes on the other truck may be operated independently. The fender and sand box are operated pneumatically in connection with the air-brakes, the sand in the sand box being heated by electricity to prevent the sand from gathering in lumps in damp weather, for which about 800 watts have been found to be necessary. Each car is provided with four forty-five-horse-power, 750-volt Oerlikon motors geared to the wheels in the ratio of one to five. The large wheel is of cast steel, and the smaller one of a harder grade steel. The compressor for the air-brakes is mounted directly against the motor casing and operated by gearing from one of the main motors, thus eliminating the compressor motor. The controlling system is designed so as to allow the motors to be operated either in series or parallel and is provided with an arc extinguisher. The cars having two trolley poles are equipped with an automatic circuit-breaker which may also be operated by hand, and also with lightning arresters, all cars being lighted and heated by electricity.



SCHAFFHAUSEN-SCHLEITHEIM ELECTRIC RAILWAY—REAR VIEW OF DIRECT-CURRENT SWITCHBOARD.

The trailers are of the two-axle type, having a seating capacity of twenty-four and standing room for eight, and are equipped with air-brakes which may be operated from the main car or from the platform of the trailer itself.

Digitized by Google

RAILWAY-MOTOR-CAR TRAFFIC.[1]

BY T. HURRY RICHES AND SIDNEY B. HASLAM.

The best method of conveying passengers clearly is that one which yields the best results in the balance sheet, and at the same time gives satisfaction in other ways. The opinion held by most locomotive engineers, and by a large number of electrical engineers, on the broad and general question of railway electrification, is that for suburban close traffic only is it justifiable. It is suggested and maintained that the electrification of branch and main line traffic will, as a general rule, result in a loss to the railway company, as the load-factor at the power-station will be a very poor one, owing to the intermittent traffic. On the other hand, suburban traffic, especially if in thickly populated areas, calls for a more frequent service and a greater acceleration of speed than is attainable with ordinary passenger trains. It is not only desirable but is quickly becoming a necessity that, if the suburban railway system is to hold its own with municipal tramway competition, a frequent service with high acceleration must be established in suburban districts. It was to meet this competition that one or two attempts were made to produce self-contained cars on various lines in the early part of the last century. While these cars were more or less a success, the requirements were not then great enough to encourage continuation.

It may not be out of place to mention here that in 1873 or 1874 a Mr. Rowan designed and built self-contained steam cars for which he could find no sale in this country. His cars were, however, taken up to a certain extent abroad, notably in Austria and Switzerland. In 1902, however, the competition of street cars in the suburban districts, especially around London, became more acute, and caused the railway companies to give serious thought to the matter and railway motors were introduced by the London and South Western Railway Company as an experiment. This proved so far successful that the Great Western Railway Company and the Taff Vale Railway Company followed by building cars for trial upon its railways to fulfil the requirements of a more frequent service upon sections in certain districts where traffic was light. It was obviously impossible to run such a frequent service with ordinary trains as being too expensive, the running expenses and the capital outlay involved being too great in proportion to the passengers carried. It was then seen that the solution of the difficulty lay in self-contained cars, and the question of what motive power to use then arose; steam or electricity, and if electricity, which of the many methods of application would be employed. Many people doubtless think that electricity is the only panacea for everything, but the problem is, of course, purely one of commercial results. The authors hope later on to prove, by giving comparative figures, that for lines where the service is necessarily light and intermittent, and where the distances to be run are several miles, the power-house would need to be large in proportion to the average work done; and where heavy gradients have to be worked, the peak-load would be large in proportion to the average and minimum, and rapidly fluctuating therefrom. The necessarily large units which would have to be provided in the generating station to meet this maximum motor power and high peak-load, would be large, and consequently the capital outlay would be out of proportion to the work done.

The first railway to move in the direction of self-contained car traffic was the London and South Western Railway Company which placed a steam car on its line between Fratton and Southsea in 1903. This car, which was equipped with small cylinders and a vertical boiler, was fairly successful, and encouraged the idea that progress in this direction promised a solution of the problem. The next railway company to move was the Great Western Railway Company, who adopted the four-wheel coupled type, the boiler being vertical and the engine being placed under the car. This car, which had to contend with heavier gradients than the car of the London and South Western Railway Company, was necessarily more powerful.

About the same time, or immediately afterwards, the Taff Vale Railway Company, which had for some time been considering the various possible methods of treating this problem, put its first car on the rails. This car, which was different in several important features from those previously mentioned, was deemed so far satisfactory that a further six were ordered. Owing to the heavy gradients to be overcome, namely, one in forty, it was necessary that more provision should be made for dealing with these heavy gradients than had previously been made in cars. The engine and boiler of this car were made separate from the carriage-body, while the leading wheels of the four-wheeled bogie, which carried the engine and the leading end of the car, were made the driving wheels. The boiler was of a design giving a large heating surface (in comparison with the small space occupied by the boiler) and therefore fulfilling that most essential requirement of raising steam rapidly. The engine was of the outside cylinder type, carried beneath the boiler, while a novel feature of the car was the ease with which the body could be detached from the engine. The next railways to deal with the subject were the North Eastern, Great North of Scotland, Great Central and the Great Northern.

Before coming to the actual experience of the authors and the reasons which caused the adoption of steam cars on the Taff Vale Railway, the authors wish to point out that this is not done with any idea of comparison with other systems, but given merely as first-hand information. The Taff Vale Railway Company has a certain branch, which, owing to the paucity of passengers as a general rule, was not as profitable to work as was desired, and it was to this branch that attention was first drawn for any better and cheaper method of working. To be sure of getting the best results, careful comparisons were taken of the cost, both capital and running, of steam and electricity, the latter of which was subdivided as follows:

1. Self-contained cars, that is, worked with secondary batteries.
2. Third-rail system.
3. Overhead system; (1) with bonded rail return; (2) with new return rail.
4. With lead and return rails.

With a view to gaining experience in the methods obtaining abroad, one of the authors visited Belgium, France, and Germany, and also collected information from all parts of the world where electricity was being used for railway traction, and the matter was thoroughly gone into. Various makers were asked to tender for the different classes of equipments, and the cost was carefully summarized. It was at once seen that the expenses of sections 2, 3 and 4 were much too costly, the manufacturers and contractors, in fact, preferring not to quote for these, on account of this great initial expense. The cost of a car with dynamo, driven by a petrol-engine with accumulators for working in parallel with the generator when necessary to overcome stiff gradients, was also considered. The outlay for this was, however, enormous, as the equipment, besides the above, also comprised a milking booster and two seventy-five horse-power motors, and caused the scheme to be abandoned.

The idea of a car run by current from secondary batteries was, however, given

[1] Abstract of a paper read at the recent meeting of the Institution of Mechanical Engineers of Great Britain, at Cardiff.

Digitized by Google

more consideration, and one of the authors visited Belgium and Swansea, and examined the cars used there, which at that time were run by storage batteries. The gross weight, without passengers, of each car was forty-five tons and nineteen tons seven hundredweight respectively, and the seating accommodation was in Belgium fifty to sixty, and at Swansea forty-two inside and fifty-seven outside. The capacity of the batteries was 140 ampere-hours, and the normal discharge rate twenty amperes at Swansea and 250 ampere-hours with discharge rate of 125 amperes in Belgium.

The general conclusion arrived at on the subject of battery cars was not favorable, as their first cost, namely, £4,000-£5,000 ($20,000-$25,000), was high, and their maintenance was also excessive, while their weight and periods of inactivity when charging (a time equal to their period of activity) were all features which did not compare favorably with steam cars.

The results of the costs of the other sections are given in Table 1, and the running cost of an ordinary train is also given as a comparison, as well as the actual cost of the self-contained steam car.

These figures were based on the original design of the Taff Vale Railway Company's car to hold fifty-two passengers, its latest design holding seventy. The conclusion drawn from these figures was, that unless the service is very frequent, that is, a train every few minutes, and the maximum distance from the power-house short, the steam service is better and more economical than the electrical. The question of taking current from a supply company in preference to installing generating plant was also thoroughly considered, and there is no doubt that when the amount of current or load-factor fluctuates much, or where the power is originally small, the supply company can work at a considerably cheaper price per unit. Again, if the distance is great, that is, if the start and finish of that part of the line which is to be electrified are some way apart, a considerable point in favor of the power supply is raised, as the current could be supplied at two or three points along the line, thereby doing away with and saving a considerable voltage drop and the resultant losses and the increased outlay. In the question of steam and electricity the subject of control has also to be considered.

It is worthy of remark that even those railways which have gone in for the electric system have mechanical braking on their cars in preference to electrical, and it is generally held that the steam cars are, as a whole, more amenable to requirements and more easy to control. The usual system of braking on electrical railway cars is one or another of the ordinary air or vacuum brakes—the pump being driven by a small electric motor.

It was while these results were being arrived at that the London and South Western Railway Company placed its steam car on the rails. The Taff Vale Railway Company having satisfied itself that the steam car was undoubtedly the most economical for its purpose, then designed and placed one on the rails, suitable for carrying the above-mentioned fifty-two passengers at a maximum speed of twenty-five miles per hour, and having a capacity of acceleration of thirty miles per hour in thirty-two seconds. This speed of twenty-five miles per hour, however, was found to be insufficient, and the greater speed, which had to be and was attained, caused at first some considerable trouble in axle-heating. Since then the journals of the driving wheels have been increased in length to ten and one-half inches instead of seven inches, and with other small alterations the car now attains a speed of thirty-five miles per hour with ease.

This railway company has also an electrical car running between Scarborough and Filey, which is operated in a somewhat novel way. A storage battery of thirty-eight cells is suspended between the frames and supplies current to the generator, which is used as a motor to start up the petrol engine. After the engine has been started the current is switched off and the motor takes its proper place as a generator. A small exciter is used both to excite the main generator which drives it and to supply the lighting current for thirty seventy-two-volt sixteen-candle-power lamps. The voltage of this machine can be increased to ninety-five volts for charging the battery when not required for lighting.

Missouri Pacific Railway Car—This company is now building a car which is being manufactured by the St. Louis Car Company, the special feature of which is the engine, which is being manufactured under the Wagenhal's patents. The engine is the double-cylinder actuated by the Stephenson link-motion. The frame of the engine will be secured to the rear of the frame of the truck, and the forward end of the engine frame will be secured in journal-bearings on the axle. The crank-disc will be located on a jack-shaft carrying a gear which will mesh into a gear on the axle of one pair of wheels. Steam is generated with oil fuel, of which the car will carry 1,000 gallons, and the engine will develop 275 horse-power.

Port Talbot Railway Car—The car being built to the order of the Port Talbot Docks and Railway Company is well worthy of mention, and presents many novel features. The motor bogie is a six-wheel coupled type, with three-foot wheels, the valves being operated by an adaptation of the Walschaert's gear. The car is lit by electricity generated by a steam turbine-driven dynamo. The gradient this car has to work is extremely stiff three miles of one in forty.

The details and remarks, given in table 2, on some of the best-known electric railway systems, may be of some interest.

It is a fact worthy of remark that, while the Metropolitan, North Eastern, and Liverpool & Southport, are the only English electric railways to make use of high-tension transmission, all the foreign ones do so with the exception of the

TABLE 1.

COMPARATIVE COSTS.

Details.	Cost of Original System. Small Engine and Train.	Secondary Battery. Own Power Supply.	Secondary Battery. From Supply Co. at 2c. per Unit.	Third-rail System from Supply Co.	Steam Cars.
I—Single car: Capital cost.....	1/3 engine, per day..$3,665 Carriages.. 8,875 $12,540	Car complete.... $20,000 Generating station... 5,750 $25,750	Car..... $20,000 Transformers..... 500 $20,500	Car..... $6,750 Preparing six miles of rails.. 35,680 $42,430	Car..... $10,500
Interest at 4 %.....	$500	$1,030	$820	$1,695	$420
Maintenance, wages, etc.....	4,875	3,580	2,710	3,400	1,255
Total.....	$5,375	$4,610	$3,530	$5,095	$1,675
Giving, at 11,000 miles per annum, a cost per mile of.	46.9 cents	40.04 cents	30.8 cents	44.22 cents	15.48 cents
II—Two cars: Cost per mile.....	.....	39.2 cents	30.6 cents	38.6 cents	.....
III—Three cars: Cost per mile.....	.....	38.8 cents	30.4 cents	28.2 cents	.....

Digitized by Google

Boston Elevated and Grenoble-Chapriellan. The Isle of Man electric tramways, while perhaps not coming under the description of an electric railway, may be mentioned here, owing to the fact that it transmits the power at 6,000 volts.

Again, the foreign railways are the only ones up to the present, with the exception of the Metropolitan, who have made use of the turbine to provide the motive power to the dynamo. In the case of the Grenoble-Chapriellan, this motor power is supplied by a waterfall 1,476 feet high, and is distributed to the turbines from a collector placed outside the station.

The Valtellina Electric Railway also derives its motive power from water. In this case the water is taken from the river Adda, and has a flow of 550,000 cubic feet with a maximum head of ninety feet, and is sufficient to develop 7,500 horse-power.

The advantages of the rail-motor system of carrying passengers may be placed as follows: owing to the small unit a much more frequent service is given with a better percentage of freight to dead weight hauled, while the mileage cost of working is only about one-third the cost of an ordinary passenger train-mile. The facility of picking up and setting down passengers at line crossings, small villages, etc., makes the service more popular, and enables many passengers to travel who would not otherwise be able to. The rapid rate of acceleration makes the through-speed higher. The experience of those railways who have given both an extensive trial is that the system is equally advantageous for heavy and sparse traffic. In the first case the motors sandwiched in between the regular trains find a traffic without taking it away from the trains, while in the second the traffic has been developed by the more frequent service. The number of steam cars at present running, and the ever-increasing number both at home and abroad proves their utility, and it seems certain that in them railways have the best, and in fact only, effective answer to street-car competition.

TABLE 2.

DETAILS OF ELECTRIC TRACTION ON THE VARIOUS RAILWAYS SHOWN BELOW.

Name of Railway.	Gross Power in Kilowatts.	Pressure Generated in Volts.	Pressure Used in Motors, in Volts.	Gross Power Capacity of Each Train.	Number of Passenger Seats per Train.	Ruling Gradient.	Remarks.
Liverpool & Southport	6,750	1,500 (3 phase)	600 (direct current)	H. P. 1,200	270	1 in 85 for a short distance	
Great Northern & City	3,200	500 (direct current)	500 (direct current)	500	50	1 in 30	
Mersey	4,650	650 (direct current)	650 (direct current)	400 (single) 800 (double)	Average per train = 60	1 in 30; maximum 1 in 27	Secondary batteries are utilized in the generating station for taking peak loads.
Liverpool Overhead	5,400	500 (direct current)	500 (direct current)	400	160	1 in 200	"
Metropolitan	14,000	11,000 (3 phase)	550 (direct current)	1,200	322	1 in 44 for about 14½ chains	
North Eastern	11,200	6,000 (3 phase)	600 (direct current)	600	186	1 in 27 (goods line) 1 in 50 (passenger line)	
Liverpool & Manchester	6,000	10,000 (3 phase)	550 (direct current)	560	35	.....	Proposed monorail.
Central London	.....	500	500	....	336	.....	
Metropolitan District	4,000	550	550	1,600	312	1 in 48	
City & Waterloo	1,200	525 (direct current)	500 (direct current)	160 (single) 320 (double)	50 204	1 in 30 for a distance of 900 feet	
Boston Elevated	36,844	550.	550	1,200	192	1 in 20	
Paris Metropolitan	6,000	5,000 (3 phase)	600 (direct current)	200 300	60 per car	1 in 8.6	
Paris-Orleans	2,060	5,500 (3 phase)	550 (direct current)	668	525	1 in 100	
Grenoble-Chapriellan	750	600 (direct current)	600 (direct current)	70	36 per car	.....	Water turbines.
Lecco-Sondrio (Ganz)	4,476	20,000 (3 phase)	3,000 (direct current)	600	56 per car	.....	Steam turbines.
Valtellina Electric	6,000	20,000 (3 phase)	3,000 (direct current)	600	170	1 in 50	Water turbines.
Burgdorf-Thun.	3,720	4,000 (3 phase)	750 (direct current)	240	136	1 in 40	Steam turbines.

Divided Poles and Field-Winding Litigation.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In the legal paragraph in your paper issued the 21st inst., 1906, on page 117, there appears an article under the subject of divided pole and field winding, pertaining to the Emerson Electric Company *versus* Century Electric Company litigation. This article is somewhat misleading if read by our customers, as these are the facts: Just before the Emerson Electric Company brought to our attention the fact that they considered we were infringing their patent, we had developed a new style of field winding and immediately commenced to use it. The Emerson Company sued us and we made answer to the suit, but refused to go to the expense of taking any testimony as we were not interested in breaking down this patent, and therefore the decision was rendered as stated in your paper. You might therefore state that this decision was rendered on account of our not contesting the suit, not having any interest in the same on account of our having developed a field winding that suited our conditions much better and that enabled us to accomplish the same results with considerable saving in material; and therefore the court has not passed on the validity of this patent.

We trust you will make such mention of this as is necessary to place this matter in the right light before our customers.

CENTURY ELECTRIC COMPANY.

St. Louis, Mo., August 7.

Nernst Lamps for the New York Terminal of the New York, Pennsylvania & Long Island Railroad Company.

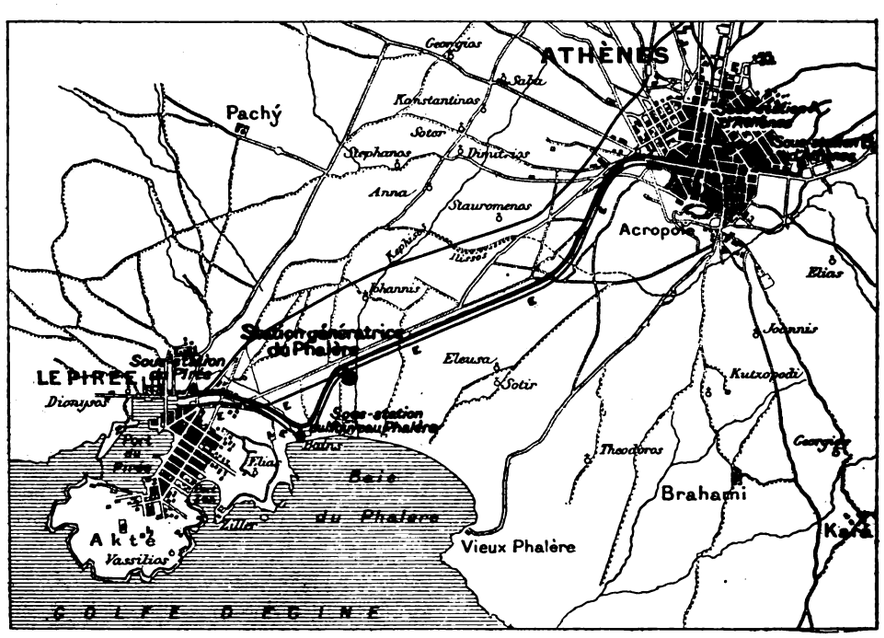
It is announced that after an exhaustive study of all commercial systems of illumination, the engineers have decided to use the Nernst lamp for a large proportion of the illumination of the New York terminal of the New York, Pennsylvania & Long Island Railroad Company. The main waiting room is approximately 100 feet wide, 300 feet long and 167 feet high. The building itself is approximately 450 feet wide, 800 feet long and 100 feet high, divided into waiting rooms, dining rooms, arcades, offices for railroad officials, baggage rooms, drawing rooms, concourse and train platforms. On account of the great variation in the architectural features of each room, no uniform arrangement of lamps was permissible, each room being a problem in itself. It is estimated that about 20,000 glower units will be used.

Digitized by Google

New Electrical Installations and Apparatus on the Continent.

By C. L. Durand.

AMONG the most important of the electrical enterprises which have been undertaken within recent years in the Mediterranean region is the large electric plant erected in order to supply the city of Athens and the surrounding district, besides the three lines of electric railroad which now connect that city with the coast. Before the present plant was erected, the city of Athens had a comparatively small station which furnished the lighting current, but as the demands for current were constantly increasing it was found necessary to enlarge the plant considerably. Lack of water supply within the city made it practically impossible to do this, and therefore it was decided to erect a large plant at a point near the coast and to generate alternating current, this to be carried over a transmission line to Athens and to be converted in a number of substations. Accordingly the main plant was erected at Phalere, and at the same time it was proposed to extend the field of operations so as to furnish current for the surrounding district, including the port of Piræus, the locality of Phalere, which is a favorite bathing resort, and the town of Kiphissia, another summer resort. A large amount of current was also to be supplied to the lines of electric railroad which were then about to be put in operation. Thus it will be seen that a large station was needed from the outset, and this has since been increased in capacity. The equipment of the plant and the electric roads was carried out by the Hellenic Electric Company, and the material furnished by the Thomson-Houston Company. The station at Phalere is situated some 3,000 feet from the sea, where a good supply of water at a depth of eighteen feet was secured. When complete, the station is to contain six main groups of 750 kilowatts each. Three of these groups will supply alternating current for the district, and two groups will furnish direct current for the Athens-Piræus electric road which passes near this point. A sixth group, composed of a 1,000-horse-power engine coupled to an alternator and a generator of like power, will act as a reserve for either kind of current. At present two of the alternator sets have been installed for the lighting circuits. Each of these consists of a triple-expansion engine having four cylinders placed two in tandem on either side. The engine will develop 1,000 horse-power and is run at ninety-four revolutions per minute. Upon the flywheel is mounted the revolving field of the alternator. The alternators are of the 750-kilowatt, Thomson-Houston pattern, and, like all the rest of the material, were built at Paris. At ninety-four revolutions per minute these machines will deliver 5,500 volts. For the electric road, two other groups have been installed. One of these is a direct-current generator working at 600 volts, while the second group has been designed to furnish both kinds of current, and the engine drives two machines at the same time, one of these being an alternator of the same type as above and the second a 750-kilowatt generator. All the engines are of the Escher-Wyss pattern, and the alternators and generators are all designed to give 750 kilowatts, using the same type of machine for each class.



MAP SHOWING ATHENS TRAMWAY SYSTEMS AND LOCATION OF SUBSTATIONS. EE SHOWS ELECTRIFIED STEAM LINE.

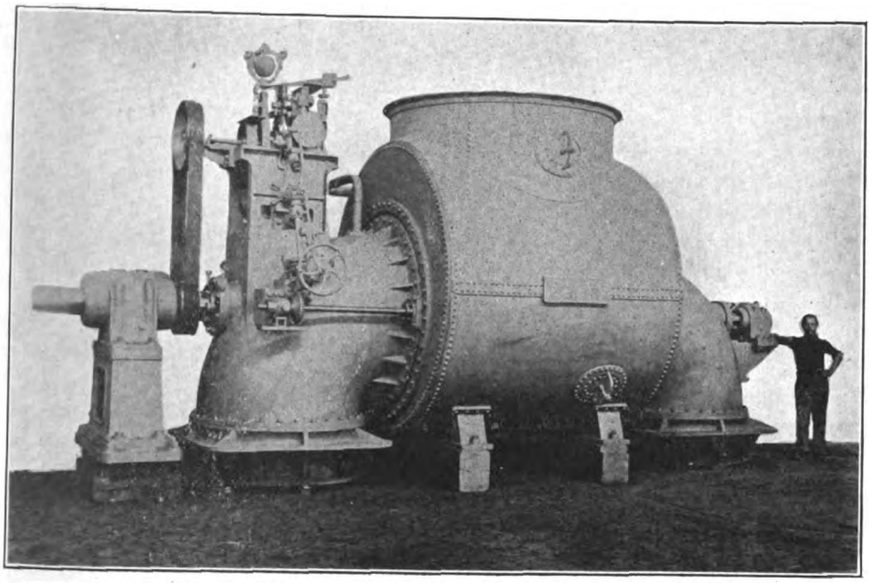
A large boiler plant has been installed in the station, consisting of eight tubular boilers having 280 square yards heating surface each, and provided with superheaters of seventy square yards surface. The superheaters raise the steam to 300 degrees centigrade. Each of the boilers can produce 7,000 pounds of steam per hour, at thirteen atmospheres pressure. A set of four feed-water heaters is used in the boiler plant. The boiler-feed is assured by two duplex compound steam pumps. Sea water is employed to good advantage for cooling the condensers, and motor-driven pumps are used for the water supply. At either end of the dynamo hall is a large switchboard for handling the circuits of the alternators and the generators. Two overhead lines run from the station to the city of Athens. In general they are worked in parallel, but one of them can be worked alone, if need be. The distance from the plant to the city is about four miles and the line, which operates at 5,500 volts, is formed of six wires of fifty millimetre section. Wood poles are used to support the wires. The line follows along the tracks of the Athens-Piræus railroad. At the station of Theseus, lying on the edge of the city, the line runs in underground cable to the terminal point within the city, for a distance of one mile or less. Here are used two cables of three conductors each. From the generating station proceed two other overhead lines, one of which runs to the substation of Piræus over a length of 1.6 miles, while the second passes to the Phalere substation located some 3,000 feet off.

Athens is connected with the coast at the Piræus by three lines of railroad. The first of these lines belongs to the trunk line which runs to the south, and passes by Athens where the station is located in the suburbs. The second line which has been laid within a recent period, runs from the Piræus to Larissa, and is eventually to be connected with the Continental lines. At Athens the station is also placed in the suburbs. The third line of railroad, which has recently been

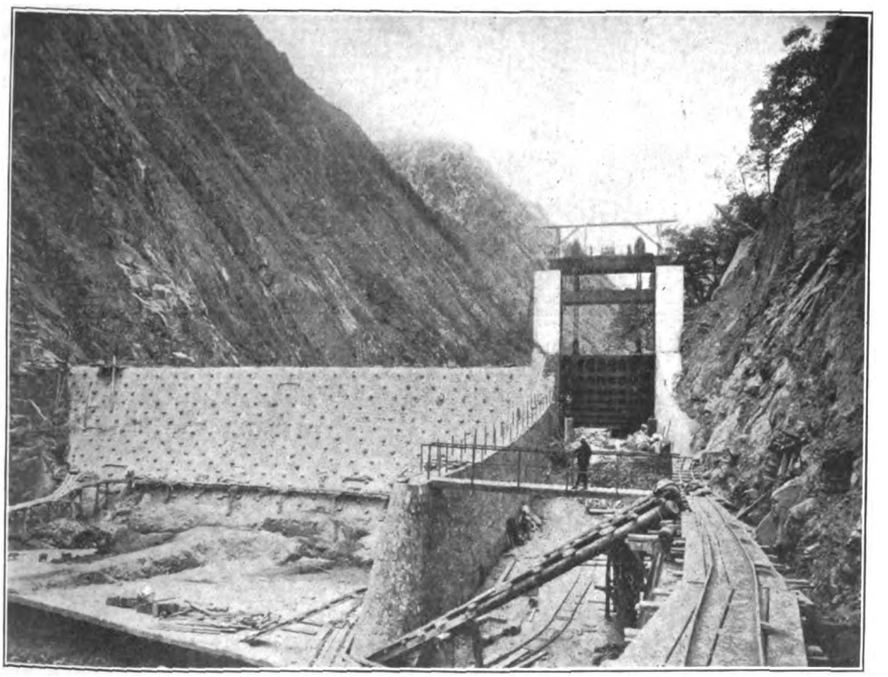
Digitized by Google

electrified, belongs to the Athens-Piræus Railroad Company. From the Piræus the road bends to the south to take in the Phalere beach station and then proceeds to Athens, where it passes by the Theseus station on the outskirts of the city and then runs in tunnel to the two stations lying within the city. As the use of steam trains upon this line proved unsatisfactory for many reasons it was decided to electrify the road, and to take the necessary current from the new Phalere station. To this end two feeding points are used for the line. One of these is located at the Phalere plant, while the second is placed at the substation "A" at Athens. The group lying within the main station which is used for the railroad line has accordingly a direct-current-generator. The third-rail system is used on the electric line. During the summer season the traffic is very high during certain periods. To carry on the traffic under these conditions the Mediterranean Thomson-Houston Company, which is a branch of the main Paris company, furnished forty cars of a type resembling the motor-car used on the Paris Metropolitan Subway, along with trailers of about the same appearance. These cars are of a square build with two sliding doors at the side and a central passage. Another type of car has two compartments for first and second class, and three doors. These cars are mounted upon bogies containing Thomson-Houston motors. In general they have seating capacity for forty to forty-eight persons. Each motor-car is equipped with two motors which are similar to those which have been illustrated in a recent number as operated on the Paris subway, and the system of multiple-unit control for the circuits has also been adopted in this case. Some of the cars are a combined freight and passenger pattern, but as the freight traffic is increasing, it has been decided to build a type of freight car which resembles the others in appearance.

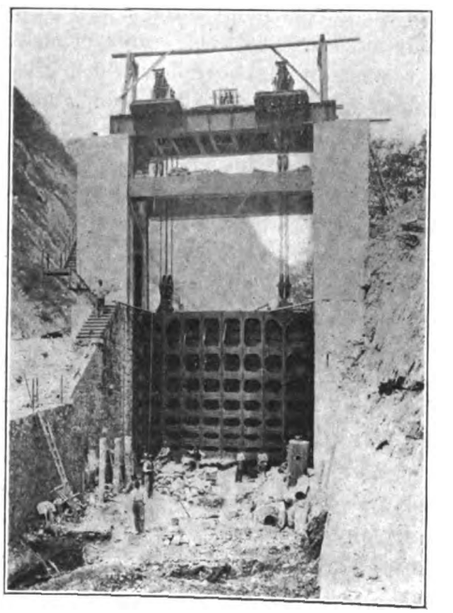
Within the city of Athens have been installed two substations. The larger one, known as station "A," contains stepdown transformers which lower the line voltage of 5,500 volts to 170 volts, and a set of rotary converters takes this current and supplies 250 volts direct-current. Substation "B" lying in the suburbs, is used to raise the voltage on the part of the line lying farthest from station "A." Here are two groups each formed of a ninety horse-power synchronous motor running on the three-phase line current at 5,500 volts, and a sixty-kilowatt generator furnishing 250 volts. At the Piræus is a substation for supplying the lighting current for the town and the port, and at Phalere, on the coast is a similar station. Later on, a line has been run from the central station to the summer resort of Kiphissia, where is placed another substation. To supply part of the current for the electric railroad, two special rotary



ONE OF THE 1,750-HORSE-POWER TURBINES FOR THE AVIGNONET PLANT.



DAM AND OVERFLOW GATE, AVIGNONET PLANT.



OVERFLOW GATE, AVIGNONET PLANT.

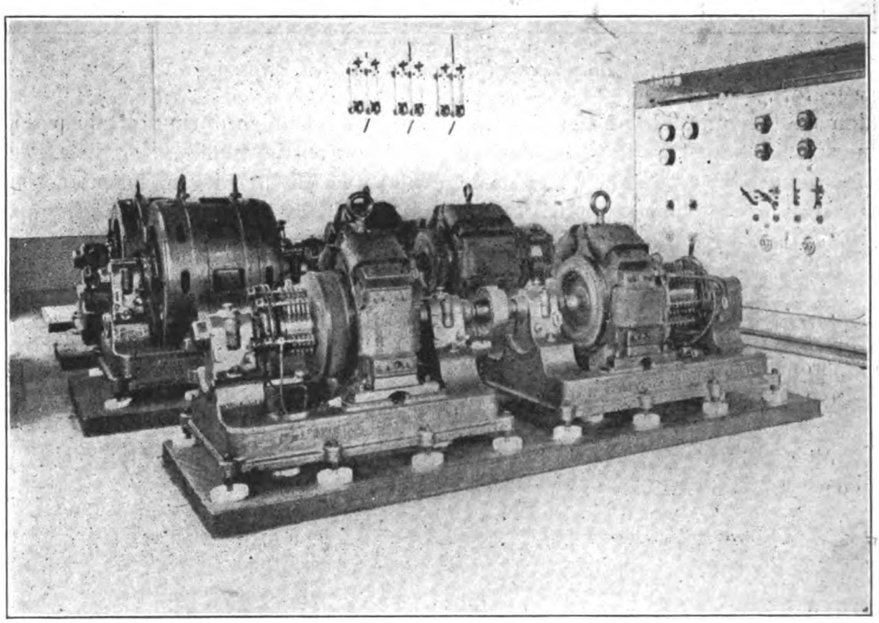
Digitized by Google

converter sets of 450 kilowatts each have been erected in the substation "A" at Athens.

Among the large hydraulic plants, which are located in the mountainous regions of France, in the neighborhood of Grenoble, is the Avignonet plant, situated upon the Drac river. The same stream also supplies water for the station of Champ, which has already been described. As to the Avignonet plant, the hydraulic work is of considerable importance, and owing to the position of the dam in a deep gorge in the mountains, it has been specially difficult to carry out. The dam is located at a distance of 2,800 feet from the turbine station, and the head of water which has been obtained is about seventy feet. In the rear of the dam the narrow gorge forms a vast basin containing 300,000 cubic yards or more over a length of two miles, which gives a good reserve supply. The dam is built of cement beton and is about 200 feet long and seventy-five feet high. The dam is faced with stone on each side. At one side will be observed the outlet canal for waste water and gravel. It is closed by a heavy iron gate constructed by the Bouvier firm, measuring thirty-five feet high and twenty-five wide. Above the dam opens the offtake canal, which follows along the river to the turbine station. It is cut entirely in tunnel in the rock, and has at total length of 2,800 feet and a section of 150 square feet. The galley ends at a water chamber which is located at a point above the turbine plant. A set of penstocks leads down to the wheels from this point. The net head of water varies from sixty to seventy feet, with some 7,000 horse-power available at the fall. At present four turbine groups have been installed. The turbines, one of which is illustrated herewith, have been furnished by Piccard, Pictet & Company, of Geneva. Three of them are used to drive alternators of the Creusot type, built in France, while the fourth wheel is used with a direct-current generator of the Thury pattern. The latter is used to supply current for the La Mure electric railroad. A long-distance distribution system covering a large extent of territory is supplied by the alternators, at a voltage of 26,000, which is furnished directly by the alternators which are operated on the three-phase system.

The accompanying view shows the substation which has been erected recently in order to supply current for an electric road in Switzerland which runs in the neighborhood of Vevey and Montreux on the shore of Lake Leman. This road is much used by tourists, on account of the picturesque sites which are thus reached, and it now has a good amount of traffic. Swiss material is used in the substation, and the present plant has been erected by one of the leading companies, the Compagnie de l'Industrie Electrique et Mécanique, of Geneva, which operates the well-known Thury direct-current system. Tri-phase current for operating the Vevey system is obtained from the local company from a distant plant at a tension of 4,000 volts at fifty cycles. As the electric railroad uses a working voltage of 750, apparatus had to be installed so as to convert the current above mentioned so as to supply the secondary lines. At present the station contains a number of motor-generator groups. The first series of groups consists of a non-synchronous motor of 100 horse-power, direct coupled to the company's standard type of generator. There are three of these groups installed in the plant at the present time. Another group is a positive and negative booster, which is intended to be used for regulating the voltage of a storage battery which the station contains. The battery consists of 375 cells of a capacity of 391 ampere-hours. The booster consists of a special group formed of a direct-current motor coupled to a generator which supplies a tension of 270 volts at a maximum and has a capacity of 410 amperes. This group is operated at a speed of 600 to 800 revolutions per minute.

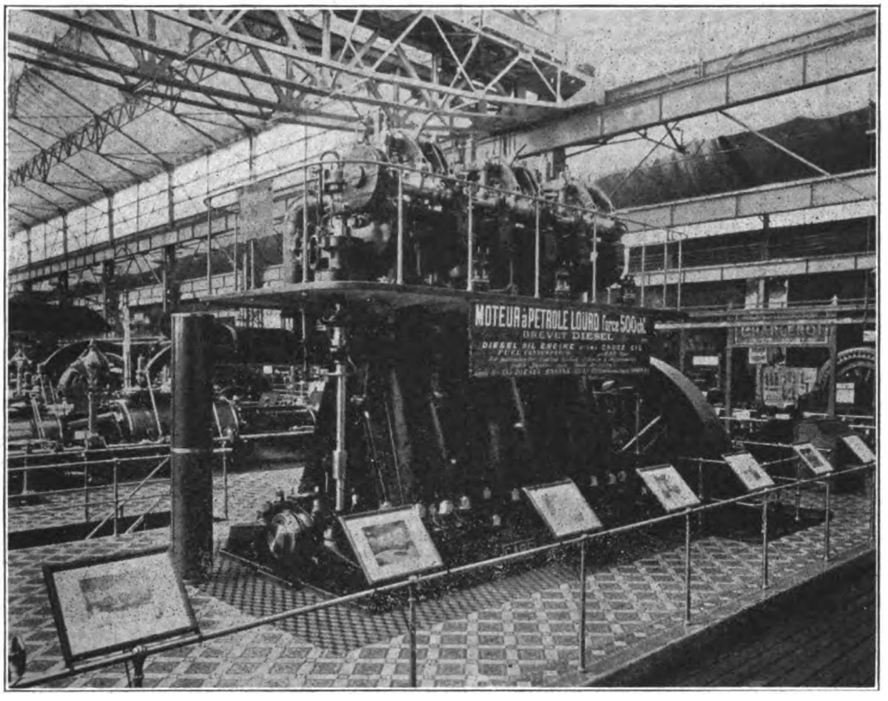
The three motor-generator groups, which are used for converting the high-tension current of the main line, are composed in each case of a three-phase non-synchronous motor which is connected directly with the primary current of 4,000 volts coming into the station. Some 100 to 130 horse-power is given by the above motor, when running at the regular speed of 730 revolutions per minute and fifty cycles. It is of the partially enclosed type, with a series of ventilating holes, and is provided with two self-oiling bearings. The armature contains a winding placed in slots, and has a set of collector rings. Upon the shaft and connected by an elastic disc-coupler is mounted a generator of the Thury six-pole type with consequent poles. The generator is separate from the motor, and is mounted on a separate bed-plate. Porcelain insulators are used to support both these machines. In the engraving two of the groups will be noticed in the background. The generators which are used in this case are designed to receive about 100 horse-power. They furnish a current of 750 volts and ninety amperes when running at a speed of 730 revolutions per minute. On the motor side the group is found to absorb eighty-one kilowatts, while the generator furnishes sixty-six kilowatts. The booster set, which is noticed in the foreground, is designed to operate upon the circuit of the storage battery in such manner that the voltage will be kept at a constant value upon the traction circuit in all cases, during the regular run as well as in the charging of the battery, which works in parallel upon the line. In this way the number of battery cells used on the line is kept constant, and no



SUBSTATION, VEVEY TRACTION LINE, SWITZERLAND.

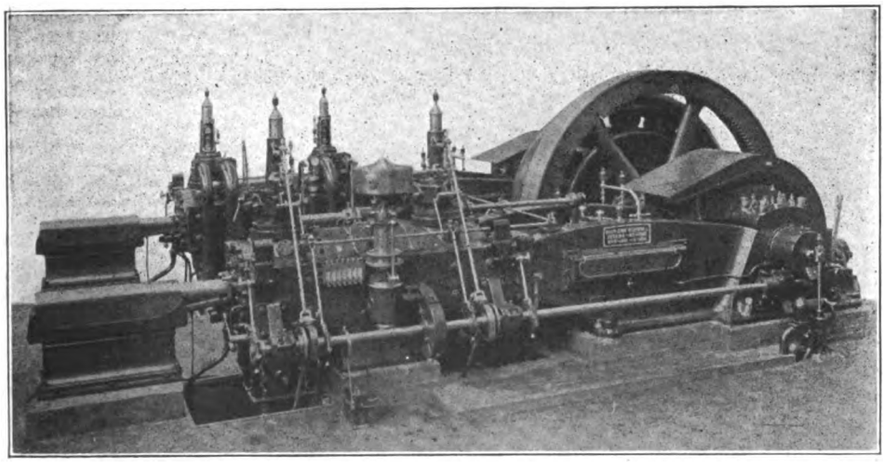
Digitized by Google

change is made in the battery connections. The booster set is made up of a direct-current Thury motor of fifty horse-power, which is run upon the 750-volt bars of the station. It operates between



500-Horse-Power Diesel Engine, Using Crude Oil, at Liege Exposition.

600 and 750 revolutions per minute. Connected to it is a generator of similar appearance, which is connected in the circuit of the storage battery. The generator is provided with an automatic regulation, and its office is to raise the voltage of the battery when the latter is discharging upon the line, or in other cases to raise the voltage of the line current when the latter is needed for the charging of the accumulators. A variable electromotive force is given in this case, as is required, and this changes from a maximum positive to a maximum negative voltage. Under ordinary conditions the generator is made to supply 150 volts, and this is raised to 270 volts toward the end of the charging operation, allowing 2.7 volts per cell of accumulator. A specially designed automatic rheostat regulator is placed in series with the generator field, so as to cause the machine to deliver the proper voltage under all conditions. This form of booster has proved very successful, and works well in all cases where it is required to operate a storage battery in parallel upon the traction line.



500-Horse-Power Twin, Double-Acting Cockerill Gas Engine and Generator.

A type of direct-connected generating group, which is meeting with considerable success on the Continent, is shown in one of the illustrations herewith. It is made up of one of the new crude-oil engines of the Diesel pattern coupled to a Lahmeyer multipolar generator. The oil engine is of the upright three-cylinder type, and is designed to give 500 horse-power. The cylinder diameter is twenty-two inches and stroke thirty inches, with a normal speed of 150 revolutions per minute. The Diesel engine is no doubt one of the heaviest of the crude-oil engines to be found in Europe. As regards the size it may be remarked that the total height, counting from the ends of the cylinder heads above the foundation-plate, is about ten feet. The cylinders and valves are cooled by water circulation. A set of specially designed oil-injectors and valves assures the proper working of the engine, and the valve mechanism has a governor connected with it, which regulates the speed between 145 and 155 revolutions per minute. The Lahmeyer generator is built upon a foundation which lies well below the floor level, so that only half of the machine is visible above the floor. It is designed for 475 kilowatts, and gives 550 volts. The outer diameter of this machine is very nearly ten feet. A set of twelve field poles is mounted upon the ring casting of the field, and contains coils wound with a 3.4-millimetre wire. The armature is of the usual drum-wound slotted pattern. On the tests the Diesel engine, which is built by Carels Brothers, of Ghent, showed a very good performance. The consumption of oil at full load is 0.412 pounds per brake-horse-power, and for half-load it is 0.420 pounds. The heat efficiency of the engine is 39.6 per cent at full load and 44.9 per cent at half-load.

A type of engine which is now coming into use for high-power units is the engine operated by low-carbon or blast-furnace gases. A few years ago such motors were constructed in small units of not more than 100 horse-power, but at present we find a number of factories on the Continent which are building engines of more than 1,000 horse-power, specially designed for use in blast-furnace plants, where they are very economical for operating blowers, dynamos and even for rolling-mills. The great advantage which could be obtained by utilizing the blast-furnace gases in the way led to the design of this type of engine. The John Cockerill Company, of Seraing, Belgium, was one of the first to build such large units successfully. Not long ago they brought out a new form of engine known as double-acting, which is much superior to the former types. At present this firm has constructed or has now in building as many as 150 large engines of the general type, illustrated herewith, giving a total of 105,000 horse-power. They are well adapted for driving dynamos, and on account of their regular running the latter can be mounted direct upon the shaft of the engine, using a heavy flywheel. The engine which is shown here is designed to give 500 horse-power, and is coupled to a multipolar generator.

Digitized by Google

THE NEW ENGINEERING BUILDING OF THE STATE UNIVERSITY OF IOWA.

BY WILLIAM G. RAYMOND.

The first section of the new engineering quadrangle of the State University of Iowa, perhaps one-sixth of the contemplated whole, has been built and occupied. This section, designed to accommodate 130 students, was known to be too small when it was begun, but the money available limited the structure to its present dimensions. As was stated in the previous article, the building is designed to be built in sections, and the next section, though much smaller than the one now built, will duplicate the study and drawing room space, and hence will provide accommodation for double the number of students.

The portion completed contains six rooms for study, drawing and recitation; one room for recitation or lecture only; one room intended for similar use, but used temporarily for the library and desk and recitation room for the senior class; a janitor's room; an executive office and faculty room; eight instructors' offices; toilet rooms; and a basement fan room.

The exterior of the building is Bedford limestone; the interior is in general of pressed brick, the walls of the corridors and some of the offices being plastered. The long corridors between the recitation rooms are well lighted during the day through glass sash, which constitutes the upper portion of the partition walls. The woodwork is oak finished in dark green Flemish style, and the furniture, so far as possible, is early English oak, the whole with the brick or tinted walls giving an effect of harmony quite generally pleasing.

The floors are of cement throughout the building, the baseboards in the plastered rooms and corridors being a combination marbolithic construction; the walls and partitions of the toilet rooms are pink Tennessee marble, and the stairways are of iron with non-slipping, composition treads.

Except the roof, which is wood covered with red tile, the entire building is fireproof; and since the ceiling under the roof is of the same concrete steel construction as the floors—made so with a view of some time adding a story—little is to be feared from fire.

The heating is by a combination of direct and indirect steam radiation, warm, tempered or cold air being forced over the building by blowers installed by the Buffalo Forge Company. No system of automatic regulation has been placed, but such a system may be put in.

The lighting is by electricity, incandescent clusters in the main offices and lecture rooms and arc lamps in the drawing-study-recitation rooms. A good many tests have been made to determine the best method of lighting; various reflectors and lamps have been tried, and further experiments are yet to be made before the most satisfactory light will be determined.

One of the chief features of the building is the furnishing, which gives each student a study desk and drawing table in a room in which, so far as possible, all his work is done. There is a recitation space with blackboards at one end of the room designed to comfortably accommodate twenty-two men, this being the largest number deemed wise to include in one section. Chairs are provided for the recitation hour. For chemistry, physics and the like, the student must go to the laboratory, but for all work requiring no laboratory demonstration, he may remain in the one room, and, during such periods as are not occupied by recitation or laboratory practice, he may study at his desk. This feature has been much appreciated by many students. The building is open from a little after seven in the morning until ten o'clock at night, and there is scarcely an hour between these limits when there are not a number of men at work at desk or drawing table.

Some little difficulty was feared in the matter of arranging sections of students so as to have the same men always in the same room, but it has been found that with a little care sections can be satisfactorily arranged. There is an occasional case when a student who is self-supporting finds it necessary to do some work with one section and some with another, but no serious inconvenience has as yet arisen with a freshman class of three sections and a sophomore class of two sections.

The arrangement of the rooms will lend itself well to the experiment that is to be tried with the incoming class. One section of this class is to be started working as individuals, each being permitted to advance as rapidly as possible and to complete his course in such time as he may find necessary. It is confidently expected that a number of the men in this section will complete the work in three years, showing great economy of time. It is also confidently expected that some men who would otherwise fail will be carried successfully through the course.

The result of this experiment will be watched with much interest, not only here in Iowa, but all over the country, since it surely means if successful a remodeling of our present methods of teaching.

During the present summer the first of the laboratories planned for the space surrounded by the main building is to be erected. This will be a steam laboratory, forty feet by eighty feet, built of brick, with saw-tooth roof construction. The plans for this structure are under way at the time of this writing.—*Transit.*

Electric Generating Equipment for a Gold Mine.

The application of electricity to the operation of gold mines has added, in no small degree, to the efficient production of the present day. The electric generating plant recently completed by the Palmer Mountain Tunnel and Power Company may be considered as a typical modern hydroelectric power installation for a gold mine. The power station is located on the Toats Coulee Creek, in the Palmer Mountains, near the town of Loomis, Washington, about twelve miles south of the international boundary line between the United States and British Columbia.

The intake of the flume, which, with the gate, is constructed of heavy material, is located a little over one mile from the power station, and consists of a heavy concrete pier abutting solid granite bedrock and anchored thereto, running out into the bed of the creek about fourteen feet. The mud sills are all six-inch by six-inch material, six feet long laid crosswise of the grade, four feet apart from centre to centre. On these sills three stringers of three-inch by four-inch material, two feet apart, are placed for the entire length of the flume and over these ties the flume bottom is laid, consisting of four two-inch planks twelve inches in width, making the bottom four feet wide. For the support of the sides, uprights of three-inch by four-inch material are set into the four-inch by four-inch ties, which are allowed to project outside of the bottom. The sides of the flume, one and one-half-inch planks, two feet high, are spiked to the uprights. On the top of the uprights across the flume is spiked a three-inch by four-inch cap, which binds this structure together. On the tangent every other tie has been allowed to project two feet beyond the bottom of the flume. From this projection to the upright, a brace is fitted in at an angle of forty-five degrees. On the curves this bracing is on every tie, thus making it impossible to rack the flume at any point. On the top of the caps a cover has been laid, which also answers

Digitized by Google

the purpose of a floor, over which all the materials for the construction were run as the building progressed. About one-half of the sills are on bedrock, the balance being on earth. Those on the earth are the only part of the work subject to decay, and can be renewed at any time without disturbing the remaining portions. Very little trestling was necessary, and what has been constructed was built very substantially. Culverts have been put in at all points where the least possible chance of damage from snow and water might occur. Overflow and safety gates are at convenient points, and three large sand boxes have been constructed to trap any grit that the water may carry during high water, thus insuring the turbine wheel against wear by sand cutting. The construction is so well made throughout that there is no leakage whatever, which is very remarkable for a flume of this length.

The penstock, which runs down the mountain side, connecting the flume with the turbine wheel, is 576.8 feet in length. Beginning at the top it is thirty-four inches in diameter and is gradually reduced to twenty-seven inches. From twenty-seven inches it is gradually reduced to twenty-four inches in diameter. The upper part is constructed of three-sixteenth-inch steel and the lower part one-quarter-inch steel. The seams are all double-riveted, while the turns are single-riveted, five-eighth-inch rivets being used throughout. It is made up in thirty-two-foot sections with steel flange joints bolted together.

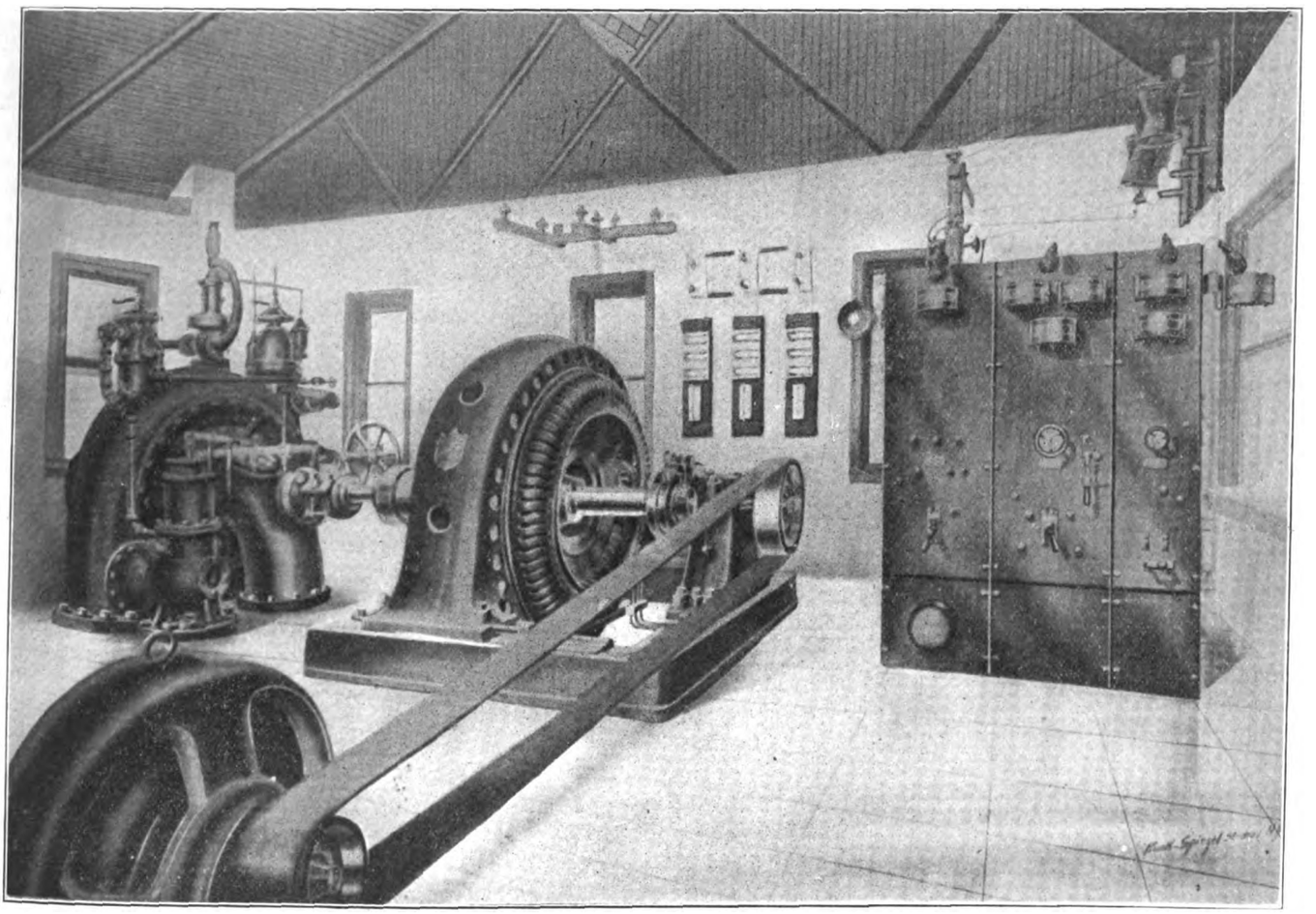
The power-house is thirty-six feet and constructed of concrete, with walls twelve inches and foundations twenty-four inches in thickness. The floor is of cement and the machinery foundations and tailrace, which extends twelve feet below the floor, are all of concrete.

The turbine is of the Allis-Chalmers type, designed especially for this installation. All of the turbine is above the floor of the power-house and the working parts are directly under the eye of the operator. The turbine has a working head of 365 feet and runs at 600 revolutions per minute.

Directly connected to the turbine is a 450-kilowatt, 6,600-volt, three-phase, sixty-cycle generator, of the revolving field type. The exciter is bolted to the shaft of the generator and also supplies electricity for lighting the power-house and the operator's cottage.

The transmission line running from the power-house to the mine is 11,554 feet in length. The poles, which are of tamarack, are forty feet in length, and are set five feet in the ground. That portion of the pole which is under ground has been treated with a creosote asphaltum preparation for preservation against decay. The wire used is seven-strand aluminum cable mounted on Locke porcelain insulators. A secondary distributing circuit for which the electromotive force is reduced by transformers to 110 volts is run from the mine to the town of Loomis. All of the business houses and many of the residences of this town are now using the current for arc and incandescent lamps. A modern 300-ton mill, equipped with automatic appliances throughout for quick and economical handling of the ores, will be installed in the near future.

Both the hydraulic and the electric equipment of the plant were supplied by the Allis-Chalmers Company, of Milwaukee.



PALMER MOUNTAIN TUNNEL AND POWER COMPANY, PALMER MOUNTAIN, OKOUAGON COUNTY, WASHINGTON. 750-HORSE-POWER SELF-CONTAINED FRANCIS SCROLL CASE HIGH-PRESSURE TURBINE, WITH GOVERNOR MOUNTED ON CASING, DIRECT-CONNECTED TO ALLIS-CHALMERS 400-KILOWATT ALTERNATING-CURRENT GENERATOR WITH EXCITER.

Digitized by Google

THE SPOKANE & INLAND RAILWAY.

SOME OF THE PRINCIPAL FEATURES, AND A BRIEF DESCRIPTION OF THE ELECTRICAL EQUIPMENT.

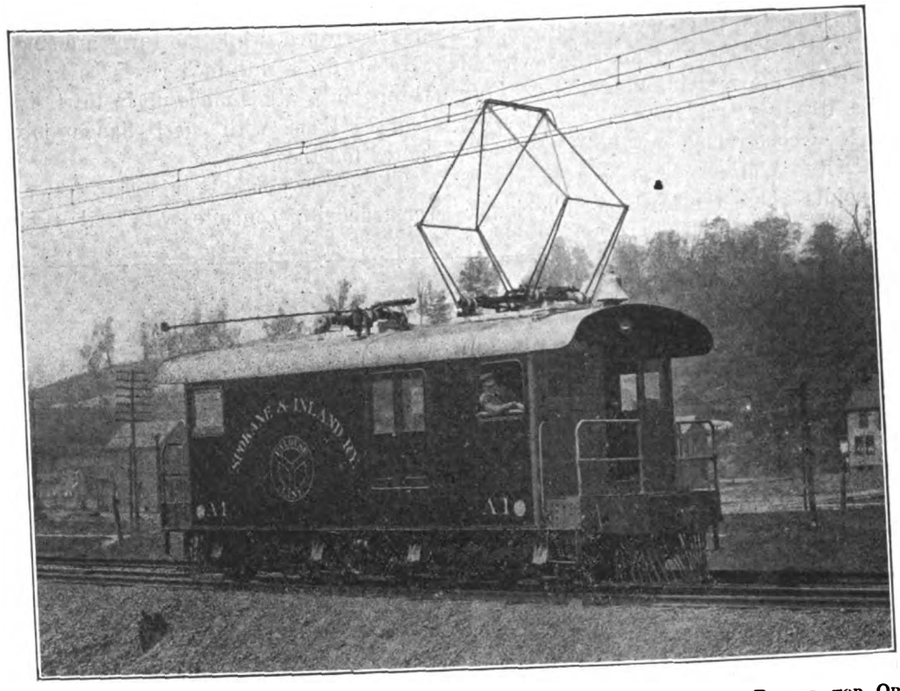
Some months ago announcement was made of a new single-phase railway which was projected to run between Spokane, Wash., and several neighboring cities, and since that time the general plans of the system have been completed, contracts for the equipment let, and the construction work is now practically finished. As this road embodies a number of entirely new features in electric railway work, an outline of some of its important characteristics will be of interest at this time.

The railway was originally incorporated under the name of the Spokane Interurban System with a capital of $3,500,000, the incorporators being well-known local capitalists. The principal terminal of the road is Spokane, from which the line runs south through Waverly, Rosalie, Thornton and Colfax, which is the southern terminus at present, although the road has been surveyed and will be eventually extended to Penawawa, Wash., or Lewiston, Idaho. A branch leaves the main road approximately midway between Spokane and Colfax, and extends to Palouse City. The Y-connected system between Spokane, Colfax and Palouse City is about 106 miles in length. The roadway and overhead construction has already been completed.

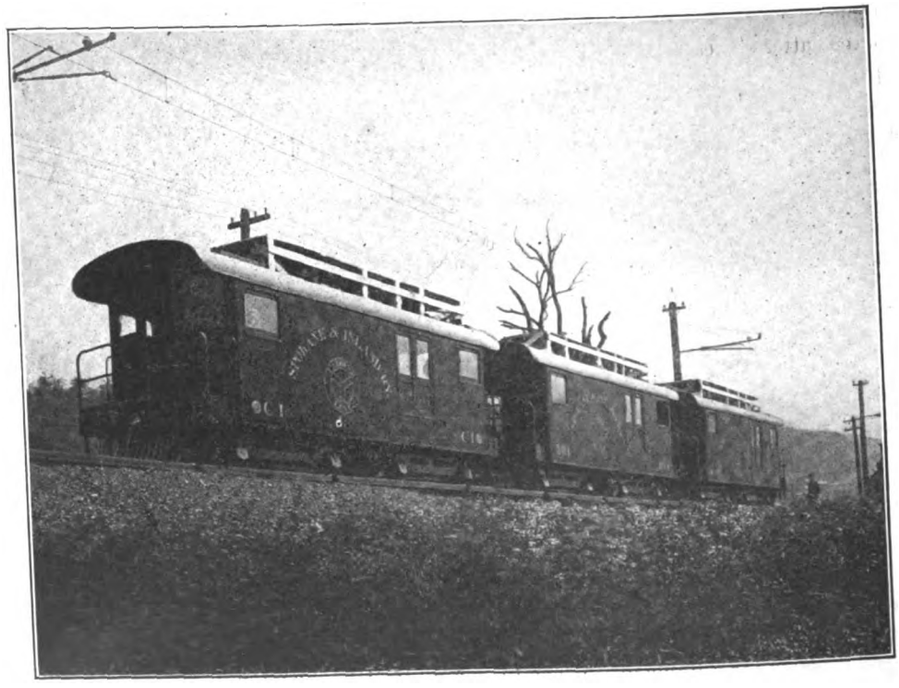
In addition to its railway business the company proposes to transmit and distribute electric current for lighting and power both in the city of Spokane and in the towns through which its lines pass. The country traversed by this road produces large quantities of wheat and fruit and is not provided with any railroad transportation. This insures a large freight business for the new road, as the long wagon haul to the steam railroads will be avoided. For this reason the electric road is receiving the hearty support of the farming interests along its route.

There are three classes of service to be maintained—passenger, mail and express, and car-load freight; and after a careful consideration of the various systems had been made, the Westinghouse single-phase, alternating-current system was adopted. The cars of the Spokane & Inland enter Spokane over the tracks of the Spokane Traction Company, which operates a 600-volt direct-current system, and this requires the use of both direct and alternating current on the interurban cars.

Power purchased from the Washington Water Power Company is used for the operation of this road. It is delivered as 4,000-volt, three-phase current of 7,200 alternations to a frequency-changing station about ten miles south of Spokane. This station will contain four motor-generator or frequency-changing sets, each of a normal rating of 1,000 kilowatts, consisting of a 1,000-horse-power, sixty-cycle, three-phase, 4,000-volt induction motor; a 1,000-kilowatt, twenty-five-cycle, 2,200-volt single-phase alternator of the revolving-field type, and a 750-horse-power, 550-volt direct-current generator which is to float on a storage battery, acting alternately as a motor and as a generator. These three machines will be mounted upon a single bed-plate and will be provided with ample bearings. There are three exciter sets for the alternators, each consisting of a seventy-five horse-power, three-phase, 4,000-volt induction



SPOKANE & INLAND ELECTRIC LOCOMOTIVE, WITH PANTAGRAPH COLLECTOR RAISED FOR OPERATING ON 6,600-VOLT ALTERNATING-CURRENT LINE; WHEEL AND ROD COLLECTOR IS USED FOR 700-VOLT ALTERNATING-CURRENT AND FOR DIRECT-CURRENT LINES.



SPOKANE & INLAND ELECTRIC LOCOMOTIVES READY FOR SHIPMENT.

Digitized by Google

motor and a fifty-kilowatt direct-current generator. A twenty-panel switchboard, electrically-operated oil circuit-breakers, and lightning protective apparatus complete the equipment of the frequency-changing station.

The 2,200-volt, twenty-five-cycle current is stepped up to 45,000 volts by means of four 1,250-kilowatt, oil-insulated, water-cooled transformers, and at this pressure is transmitted to fifteen static transformer substations. Each substation is equipped with two 375-kilowatt transformers of the oil-insulated, self-cooling type which step down the current from 45,000 volts to 6,600 volts, which is the trolley line voltage. The cars and locomotives operate under three different potentials—6,600 volts alternating current in the country, 700 volts alternating current in the small towns, and 600 volts direct current in the city of Spokane.

The trolley line is of the Westinghouse standard catenary construction with a No. 000 wire carrying 6,600-volt alternating current. The high-tension transmission lines are No. 2 copper wires.

The electrical equipment of both the passenger and the express cars is identical and consists of four Westinghouse 100-horse-power, alternating-current railway motors per car, which will maintain a schedule speed of from thirty-five to forty miles per hour. The locomotives are equipped with the same type of motors but the latter are each of 150-horse-power capacity. Both the motor-cars and the locomotives are operated on the Westinghouse multiple-unit control system.

These locomotives are designed to handle a general car-load freight business and are capable of hauling seven standard freight cars fully loaded at about thirty miles per hour on a level track. They will operate on the 6,600-volt and 700-volt alternating-current lines and on the 600-volt direct-current line. Both pantagraph and wheel trolleys are used, as shown in the accompanying illustrations, the pantagraph trolley being for operation on the 6,600-volt circuit and the wheel trolley for the 700-volt alternating and the 600-volt direct-current circuits.

The cab of the locomotive serves to enclose the auxiliary apparatus and is constructed entirely of steel. Its total weight is forty-nine tons and its length over bumpers is twenty-nine feet. It has two swivel trucks with thirty-eight-inch driving wheels, and two motors are mounted on each truck and are geared to the axles.

Both straight and automatic air-brakes are used, the compressed air for which is supplied by two Westinghouse Air Brake Company compressors, each driven by a five-horse-power Westinghouse single-phase motor.

The motors are arranged in two groups, each group consisting of two motors connected permanently in series; so for the purpose of control these groups may be considered as single units in a two-motor equipment. Two auto-transformers are used in the locomotives and an automatic overload and no-voltage circuit-breaker is placed between the trolley and the transformers, which operates on either overload or no-voltage by breaking the current supply to the control magnets, thus automatically opening all the switches. This circuit-breaker must always be closed by hand, and it will not stay closed unless the trolley is up and current is on the line.

When the circuit-breaker is thrown in the circuit is completed through the auto-transformers to ground. A commutating switch is automatically shifted to the alternating-current position, and the small transformer furnishing current to the control system is cut into circuit, leaving the locomotive ready to start.

The unit switches are essentially similar to those used on direct-current systems. The control magnets are of the alternating-current type wound for 200 volts and operate on about eight volts direct current, but in both cases will operate down to about one-half voltage. These magnets serve to admit air under heavy pressure to the cylinders which operate the unit switches.

These switches are assembled into a compact unit known as a switch group and the group is protected by an iron case, in which it is mounted, from the severe exposure to which a locomotive or a street-car equipment is subjected.

Interlock contact blocks are provided which make it impossible for a switch to close or remain closed unless all the other switches operate according to their predetermined cycle. This assures the proper order of switch operation.

The alternating current for the operation of the magnets by the master controller is obtained from the secondary of a small transformer which is connected to the 500-volt point of the main auto-transformer. When operating on direct current a resistance is placed in series with this auxiliary transformer across the 600-volt mains, and direct current is taken from a suitable tap on this resistance. This dispenses with the use of a storage battery for direct-current operation.

The only mechanical operation in changing from alternating current to direct current is to change the trolleys; the control is changed automatically by the commutating switch, which is a small pneumatically-operated drum for shifting the control circuits. This drum is operated by a magnet connected directly to a 200-volt tap on the main auto-transformer and has no direct-current connection. The switch has one position for direct-current operation and another for alternating-current operation, and it can not be thrown to the alternating-current position unless alternating current is flowing through the magnet coil. If it should remain in the direct-current position no harm would be done.

The reversing switch is similar to the commutating switch in its operation but is furnished with two magnets and air cylinders, one for each position.

The preliminary order on this contract specifies fifteen passenger cars, six express cars and six locomotives.

Extension of Southern Power Company's System to Concord, N. C.

The Southern Power Company now furnishes light to the city of Charlotte and also the power to operate a number of manufacturing plants there, among these being the Highland Park mill, two miles north of Charlotte. The town of Concord is only eighteen miles further on and lines are to be run to enable the company to operate there. The work on the survey will commence at once and it is expected that within eight months from this time many spindles in Concord will be turned by Catawba river power. Two thousand horse-power is needed for this purpose to begin with, and the Odell mills will need 1,500 of that. It is understood that J. W. Cannon agrees to take this power also to operate some of his mills.

Dr. W. Gill Wylie and Chief Engineer W. S. Lee, of the Southern Power Company, were in Concord recently making contracts with presidents of factories and other plants to be operated by the Southern Power Company. Recently the Odell Manufacturing Company opened negotiations with the power company, resulting in the visit of Dr. Wylie, who virtually made a contract with the Odell Manufacturing Company to furnish the 1,500 horse-power necessary to operate its mills.

Independent Telephone Officers Elected.

The Vermont & New Hampshire Independent Telephone Association, at a recent meeting held at Woodsville, N. H., elected the following officers: president, H. W. Buchanan, Barton Landing; vice-president, O. E. Eaton, Woodsville, N. H.; secretary, G. W. Buzzel, St. Johnsbury; executive committee, H. W. Buchanan, O. E. Eaton, G. W. Buzzel, F. C. Gleason and D. L. McGuire.

Digitized by Google

SOME NOTES ON THE MECHANICAL EQUIPMENT OF COLLIERIES.[1]

BY E. M. HANN.

At the Bargoed colliery of the Powell Duffryn Steam Coal Company the boiler power consists of sixteen Babcock boilers, 180 horse-power rated, 1,826 square feet heating surface, each with its own superheater, the steam pressure being 120 pounds and the average superheat ninety degrees Fahrenheit. At an early stage, about 1898, it was decided to work all the smaller machinery on the surface by electricity, and a Marshall compound engine of 300 horse-power, with three 100-horse-power dynamos, were installed for the purpose, which supply at present about forty-one motors, ranging from one to fifty horse-power and aggregating 453 horse-power. Latterly an alternating plant for larger work and for underground haulage and pumping has been installed, of which some notes will be given further on.

One disadvantage frequently found in colliery arrangements is noticeable here, namely, the distances to which steam has to be carried to the various engines, and the narrowness of the site in this instance considerably increased that bad feature. The introduction of electric power will greatly modify this, by enabling the necessary power for subsidiary engines to be conveyed by wires instead of by pipes. In illustration of this the Powell Duffryn Steam Coal Company's electric installation at Aberdare has caused the removal of 2,830 yards of steam mains of all sizes, from twelve inches downward.

On the subject of electric winding, the author can not add much, but his view is that, in case of deep shafts and heavy loads, the difference in the economy of the engines can not repay the following disadvantages: either the size of the generating sets required at a colliery must be greatly modify this, by enabling the neing engine in the electrical equipment, or some storage or equalizing system must be introduced, which adds greatly to the capital cost and the complication of machinery, and is itself a source of waste. Whereas 750-kilowatt sets might be very suitable for the hauling and other machines if an electric winding engine be added, which runs up to 2,000 horse-power, it becomes necessary to have a 3,000-kilowatt set and in duplicate unless the balance be introduced.

The mode for unloading adopted for the Penalltau pits of the same company is on generally similar lines to many others in use; the floors of the cage upon which the empty trams stand are raised from a horizontal to an inclined position by a compressed-air cylinder, the cage floors being similarly inclined when dropped upon the keps, star wheels being untrigged and letting out the full and arresting the empty trams. The upper of the two decks is the main pit-top level and the empties are dropped to the lower one by a balance lift, while the lower ones are brought up from it by a creeper chain driven by an electric motor.

The more usual practice at collieries is to get the pit top at the same level as that at which the coal is tipped into the wagons, and in many instances very considerable expense has been incurred to accomplish this object. In this case it would have added very greatly to the cost of the engine houses and workshops and instead of doing so the pit-top level was fixed at the most economical level in first cost, and the trams containing coal and rubbish are taken up an incline of one in six, ninety feet in length, to the level convenient for the tipping and screening plant, the power being got from a ten-horse-power motor, geared down, and driving a slow-moving creeper-chain on to which the trams pass and are taken by it to the top level where they release themselves.

It was considered advisable to delay the introduction of electricity on a large scale, until the colliery was more fully developed, and an air-compressor was provided to supply power below ground for haulage.

Bargoed was chosen as the most suitable place for central engineering shops for this group of collieries and a fitting shop, smiths' shop, foundry and pattern shop have been erected a quarter of a mile away from the colliery buildings. The various machinery at these shops is also driven by electricity derived from the continuous-current system already mentioned.

In the new pits to be sunk at Penalltau, it is proposed to use electrical centrifugal pumps for dealing with the water during the sinking of the shafts. The pumps, which are to be employed raising the water from the shaft bottom, will be vertical, and will be suspended on steel-wire ropes running from an electrical winch on the surface, the rising main being also carried on the same ropes, so that the whole can be raised or lowered as required. These pumps are to be capable of raising 35,000 gallons per hour 120 yards high, and the motors, which are to be totally enclosed and watertight, will be cooled by the water being conveyed in pipes around the coils of the motor. When the head gets excessive for these pumps, larger horizontal pumps will be fixed in the shafts, up to which sinking pumps will have to deliver the water. Should water persist down to the same horizon in the strata as at Bargoed, the lift will be 700 yards and will be divided into two of 350 yards each, and permanent pumps placed at these levels.

To minimize the effect of stoppages of any of the electric plant, this colliery is connected by a transmission line with the system supplying the company's two collieries lying northward, that is, the Elliot colliery, one and three-quarters miles distant, and New Tredegar, one and one-quarter miles north of Elliot colliery, where, at the Elliot collieries, there is a 750-kilowatt set generating at 3,000 volts, fifty cycles, three-phase, and further, is provided with a motor generator of 300 horse-power, capable of converting from alternate to continuous current or *vice versa*. At the Elliot pits there is also being erected an exhaust-steam-utilization plant, which will use the steam exhausted by the two large winding engines there, and a Rateau turbine and generator of 500 kilowatts to run in parallel with the 750-kilowatt set. The electric power was put in particularly to reduce the requirements of compressed air, which were becoming too heavy for the existing plant, and because it could supply Bargoed temporarily until that place got its own gas-driven plant erected, and also as a permanent reserve. Seven important underground haulages and some pumps are already at work from it, and more will be added as soon as the gas-driven generators are started, and the demand from Bargoed is relieved or the Rateau turbine started. There are two aerial ropeways in use, both very short; one is for the removal of the rubbish unavoidably raised from the mine and that washed out of the coal, which, for want of other space, has to be taken up the hillside, and the other is for transporting the coal from the washery to the coke ovens.

As previously mentioned, there is an electric installation at the company's Aberdare group of collieries, which is on the same lines electrically, that is, 3,000 volts, fifty cycles, three-phase, and is centrally situated so as to supply seven collieries, with the probability of adding two more. This was mainly to replace old steam machinery with long ranges of pipes and compressed-air power. A full account of it has been published in a paper by C. P. Sparks, which was read before the Institution of Electrical Engineers, and the author will therefore only say that for a

[1] Abstracted from a paper read at the recent meeting of the Institution of Mechanical Engineers of Great Britain.

Digitized by Google

plant involving the removal of old machinery, and consequently a much larger ratio of capital to power than in a new installation, it has yielded very satisfactory results, though not by any means the phenomenal savings frequently claimed for this mode of transmission. There are, however, several important advantages which it is not possible to put into figures, such as these: the savings are far greater *pro rata* when the collieries are idle than when at work, and it removes one great restriction upon the location of any power that may be needed in the future. A colliery plant suffers from the same drawback experienced in so many cases, the day load is greatly in excess of the night load; ventilators do not assist this, and pumping is about the only thing on a large scale that is available. In the case of the Bargoed and Elliot collieries, where there are large quantities of water to be pumped, it is proposed to pump the whole of the water by night by means of centrifugal pumps placed underground, which will greatly improve the load-factor of the power station.

The Cosmopolitanism of Science.

Science and commerce, which are closely interrelated under modern conditions of keen competition, both owe one feature of their development to our present state of civilization, namely, the broad cosmopolitan spirit which makes little of the accident of geographic position. In the British engineering world, says the *Engineering Times,* of London, the summer of 1906 will be looked upon primarily as a "visitors' year." Hardly have the guests—American, German, Italian and Swiss—of the Institution of Electrical Engineers completed their tour around our factories and electricity supply stations when their place has been taken by the guests of the Iron and Steel Institute—the American Institute of Mining Engineers. Civic and social festivities in London alternated with international discussions in the lecture theatre of the Institution of Civil Engineers. We say international, for in addition to the American delegates, the leading continental metallurgists are members of the Iron and Steel Institute, and papers were contributed by Messrs. F. Osmond and G. Cartaud, of Paris; by Monsieur Ph. Bonvillian, also of Paris; by Herr K. Reinhardt, of Dortmund, and by Professor H. Hubert, of Liège.

As compared with the noted conferences and councils of mediæval Europe, such meetings as these are of striking interest. Previously, international gatherings were either those of diplomats negotiating treaties and apportioning kingdoms, or of prelates settling dogmatic questions of faith. The merchants' and other mediæval guilds had quite enough to do in propitiating their local rulers. Trade secrets, moreover, were closely guarded. The isolated scientist, primarily an alchemist, did indeed migrate from land to land. Not, however, for the purpose of frank interchanges of views and discussions of methods with his rivals (for jealousy exceeded knowledge), but for the purpose of securing the favor of princes and the gold which his blind gropings in chemistry did not provide.

But iron has superseded gold in its value to the race, and its transformations, when alloyed in certain proportions with other metals, and subjected to certain heat treatments, surpass in value all that the old alchemist could hope to obtain. Indeed, were the transmutation of gold from commoner metals an assured fact to-morrow, it would, after a period of financial upheaval, merely result in the selection of another token for exchange purposes.

The spirit of the alchemist rested for many years upon the workers in other metals. Mr. Hadfield, in his presidential address last year to the Iron and Steel Institute, pointed out that a writer in 1557 spoke of the heating and quenching of steel "three or four times in equal parts of extract of radishes and water which had contained earth worms." With such views solemnly put on paper only 350 years ago, it is indubitable that a number of secret and special processes of various localities were attributed to jugglery of the extract of radishes and earth worms order, while the reason for special repute often lay in some then unknown particular constituent of the one used.

We have not the space for a lengthy disquisition upon changes of mental attitude to scientific problems, but would note in passing that the domain of law ruling through every sphere of nature and of manufacturing art, mystic incantation and haphazard quackery have disappeared. In their place rests the insatiable desire to ascertain the laws governing every phenomena within our acquaintance. Nobody believes in secret processes, for there are none of a chemical and few of a physical character which would prevent the production of a similar product by an intelligent firm, none of whose stuff had the slightest inkling of their rivals' methods. Everything is a matter of law, and the answer from a scientist that such and such a method is insoluble in our present state of knowledge merely means that our known laws and proved hypotheses do not fit the case, and that by experiment other hypotheses will be advanced and, if not disproved, be accepted as laws.

Confronted by such immense problems, the first step has been for individual workers in different countries to band together for concerted study. The second step has been for international cooperation, for the problems are too many for any one tribe of the human race.

We commenced by saying that science and commerce were both sharers in a spirit of cosmopolitanism—commerce, because of the interchanges necessary in the barter which exchanges manufactures for foodstuffs, clothing and luxuries; and science, because of the necessity of concerted work in endeavoring to express phenomena in terms of the appalling number of unknown laws confronting it.

A 50,000-Volt Transmission for Seville.

A scheme which is in progress for supplying the town of Seville from a generating station at El Carchado, about eighty miles from the town, by means of a three-phase transmission at 50,000 volts, is described in a European contemporary. Three 1,500 horse-power turbines, running at 400 revolutions per minute, will form the first instalment of generating plant, and these will drive alternators, generating at 5,000 volts forty cycles. In order to step up to the line voltage, seven single-phase 600-kilovolt ampere transformers will be provided (one as spare), and another group of transformers in the substation at Seville will reduce the pressure to 3,500 volts. The work is being carried out by the Spanish Oerlikon Company.

Submarine Telephone Tests.

A dispatch from Berlin, Germany, dated August 9, states that experiments began on that date at Lake Constance with a submarine telephone cable constructed under Professor Pupin's system. The cable connects Friederichshafen on the north shore of the lake in Wurtenburg, and Romanshorn on the opposite southern shore in Switzerland, about seven miles distant, the cable reaching a maximum depth of 820 feet. The cable was laid by the Siemens & Halske Company for the Bavaria, Wurtenburg and Swiss telegraph departments.

Digitized by Google

Electrochemical Papers Before the American Chemical Society.

At the recent meeting of the American Chemical Society, held at Cornell University, Ithaca, N. Y., several papers on electrochemical topics were read. They are noted below.

"The Electrical Conductivity of Solutions of the Alcohols in Liquid Hydrobromic Acids." E. H. Archibald. The conductivities of solutions of some fourteen of the alcohol bodies have been measured quantitatively over a considerable range of dilution. The molecular conductivity in nearly all cases increases rapidly with the concentration. As far as these investigations have extended, those bodies which dissolve conduct the electric current.

"The Electrical Conductivity of Solutions of the Organic Acids in Liquid Hydrobromic and Hydrochloric Acids." E. H. Archibald. As far as can be ascertained, those acids which dissolve to any extent give solutions which will conduct. The hydrochloric acid solutions have by far the greater conducting power. The molecular conductivity for both solvents, except in a few cases for the very dilute solutions, increases with the concentration.

"The Electrode Capacity of Iron and its Bearing on Passivity." C. McC. Gordon and Friend E. Clark. The most commonly accepted explanation of the passivity of iron is that it is due to a very thin oxide sheet, the passive iron acting as an electric condenser; the conducting iron and the conducting solution being separated by insulating oxide, similar to films on aluminum anodes. Measurements of this capacity—comparing it on the Wheatstone bridge with a metallic condenser of known capacity—have been made for iron electrodes in various solutions, with the following results: (1) Passive iron (electrodes) acts as if covered with a sheet of oxide, as is evidenced by the following facts: (*a*) The electrodes have a capacity easily measured while active electrodes (that is, iron in dilute nitric acid or freshly deposited electrolytic iron) show no signs of such capacities. (*b*) The capacity values are about of the same order of magnitude as those of aluminum, where we certainly know there is such capacity. (*c*) Electrodes oxidized in a Bunsen burner flame give a similar capacity. The oxidized sheet, so formed, appears to be five or six times as thick as that of the electrodes made passive by the concentrated nitric acid. It is notably different, too, in that it has a small resistance. It acts like a leaky condenser, or a condenser in parallel with a resistance. (2) Iron transferred from the air to neutral solutions behaves qualitatively exactly like iron oxidized in the flame. Its capacity, however, is somewhat larger than that of the passive iron, indicating a thin film or sheet. The resistance of this sheet is relatively smaller, due, probably, to small holes or crevasses in the sheet.

"The Electrical Conductivity of Tungstate Solutions." Roger Clark Wells. A study of the conductivity of various tungstates showed that in the case of sodium metatungstate and ammonium paratungstate a partial transposition begins to take place as soon as those salts are dissolved in water. Although the rate of this transformation is very slow at twenty-five degrees centigrade, it increases rapidly with rising temperature. This fact will undoubtedly explain the queer solubility determinations which several investigators have found for these salts without considering the time factor.

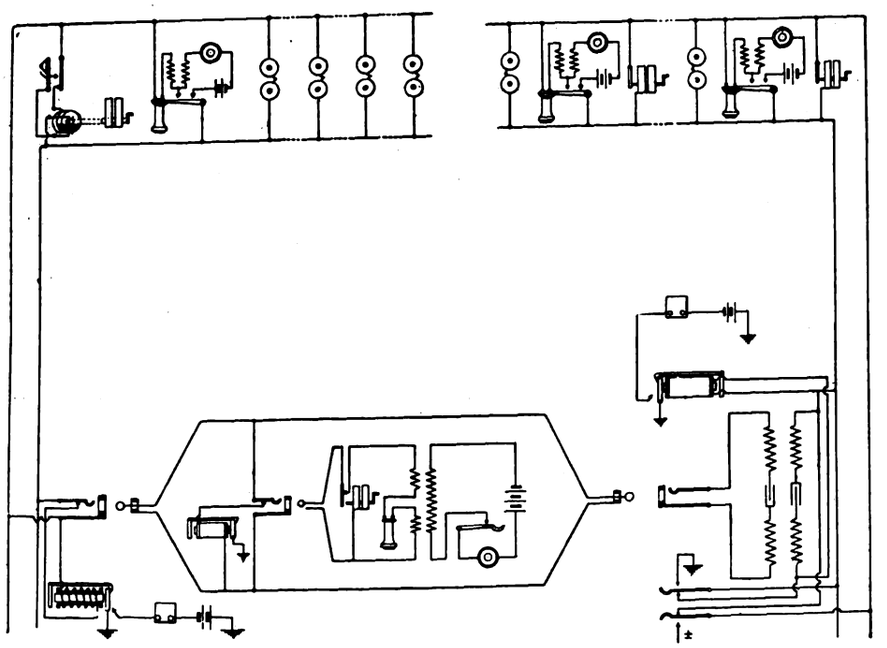
Greenock, Scotland, Electricity Works Extensions.

The municipal electric power system of Greenock, Scotland, possesses some interest since this town was one of the first to install such a plant. As far back as 1883 a provisional order was obtained by the municipality with a supply of electricity within a small area. Greenock possessing the questionable distinction of being the wettest town in Great Britain, it was but natural that the town council of that territory should have turned its attention to water power, and the first installation, which was erected the latter part of the year mentioned, consisted of a 140-horse-power water turbine driving four generators of the old Gramme ring type. A few public lamps were installed, in order to show the possibilities of the new illuminant, but the only important customer appears to have been a neighboring sugar refiner. The supply pressure was 100 volts, and, as there were no other large consumers near the station, the cost of distribution was prohibitive. After a considerable amount of money had been spent the station was shut down. The matter was not taken up again until 1897, when the company proposed appealing for powers to supply electricity. The council was, therefore, obliged either to hand over its powers to the new company, or to restart the work itself. The latter plan was adopted, and plans for a station to cost $165,000 were drawn up. The station was built and equipped and the supply of current restarted in the fall of 1899. The equipment at this time consisted of three steam dynamos with a total output of 400 kilowatts and a storage battery. Supply mains were laid on the solid system. At this time the British Electric Traction Company acquired interest in the old horse-car system and applied for a renewal of the lease which was about to expire. This was done on condition that the energy necessary for working the tramways should be purchased from the corporation, the minimum guarantee being 500,000 kilowatt-hours per annum at the rate of three cents per kilowatt-hour. In 1901 two additional generating sets were installed to meet the demands of the tramway company. A further addition to the plant was soon made in the form of a 300-kilowatt generator. In 1903 a controversy arose between the corporation and the tramway company regarding the price to be paid for energy in excess of the guaranteed amount. The arbiter, a lawyer, reduced the price of the excess energy to one and one-half cents, bringing down the average of the whole supply to two cents per kilowatt-hour. The immediate result was a serious deficit in the financial returns of the undertaking, as the award was retrospective. To meet the new conditions, prices were reduced for both lighting and power purposes, a condensing plant was installed and a system of free wiring and hiring out of motors was begun to encourage and popularize the use of electricity. The result was the brisk demand for power from the local ship-builders and engineers, and the lighting business made steady headway, with the result that the output of the station doubled itself in a short time. The motors installed rose from 670 horse-power at the end of 1903 to 3,100 horse-power in 1905. The equivalent number of eight-candle-power lamps jumped from 42,000 to 85,000 during the same period. Notwithstanding the reduced prices, the plant showed a surplus of $8,000 last year. The plant at present consists of two 400-kilowatt, two 300-kilowatt and two 150-kilowatt steam dynamos. There are one 200-kilowatt and one 100-kilowatt steam balancers, bringing the total rating of the plant up to 2,000 kilowatts. In addition to the above, there are two batteries, one for lighting with a normal rating of 400-kilowatt-hours, and one for the railway system having a rating of 450 kilowatt-hours. Although at the time the latter was installed the traction allowed was only about three-eighths of the total output of the station, the result of putting the battery into service was to bring down the coal consumption from six and one-quarter to five pounds per kilowatt-hour generated. The average traction load was about 360 amperes and the maximum 1,000 kilowatts—*Electrical Review* (*London*), *August* 3.

Digitized by Google

Electrical Patents.

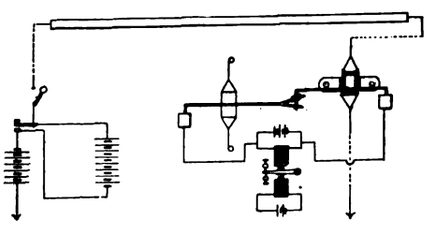
Charles E. Scribner, Jericho, Vt., has obtained a patent (828,061, August 7). for an improved telephone exchange system, which he has assigned to the Western Electric Company, of Chicago, Ill. This



TELEPHONE EXCHANGE SYSTEM (SCRIBNER).

invention relates to a telephone exchange system, and has for its object to provide an improved system, wherein telephone lines on which toll is to be charged for each use may be interconnected or connected with lines of other types and the subscriber of one of the connected lines prevented from signaling the subscriber of the other line without the intervention of the central operator, so that the operator may keep an accurate check or supervision on the number of conversations which any line may have with another. In a telephone exchange system embodying the invention, a telephone line extends from a number of substations to a central office, a call indicator being associated with the line at the central office. At each of the substations of the line is provided signaling mechanism adapted to signal any one of the other substations of the line without affecting the central office call indicator and a device is also provided at each station adapted to cooperate with the signaling mechanism thereat to actuate the call indicator at the central office without disturbing or signaling the other substations on the line. Another telephone line extends from one or more substations to the central office, and the operator is provided with means for connecting the lines together for conversation. When the lines are connected by the operator, a device is interposed between them which is adapted to permit the passage of telephonic voice currents, but to bar signaling currents, so that while the subscribers of the connected lines may converse with one another they are not able to signal each other. The operator is provided with means for applying ringing current directly to either line, and after a conversation is finished between the two connected lines a subscriber of one line can not signal a subscriber on the other line and obtain another conversation without the intervention of the central office operator, who is thus enabled to keep an accurate check on all conversations for the purpose of charging toll.

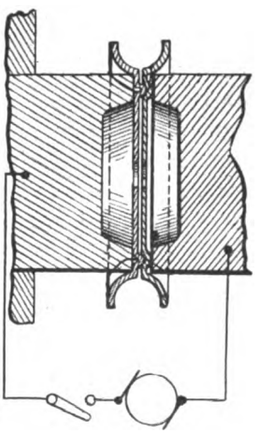
Isidor Kitsee, Philadelphia, Pa., has obtained a patent (827,916, August 7) for an improved submarine telegraph system. This invention relates to an improvement in submarine telegraphy; but it is also applicable to long-distance telegraphy on land. The object of the invention is to supply the submarine cable with a device with the aid of which sounders or other electromagnetic devices may be actuated, and incidentally thereby to increase the receiving capacity



SUBMARINE TELEGRAPHY (KITSEE).

of the cable. The invention consists of means to relay a telegraphic receiving device, embracing the receiving device proper, a mechanical relay provided with contacting means, adapted to move in unison with the movable part of the receiving device, a local circuit containing one coil of a translating device, a second local circuit containing the second coil of the translating device, a shunt for one of these coils, one terminal of the shunt connected electrically with part of the receiving device, the second terminal connected with part of the relaying device, and means whereby through the contact of part of the receiving device with part of the relaying device, the shunt-circuit is closed.

An improved process of electric welding has been invented by Laurence S. Lachman, New York, N. Y. (828,033, August 7). The invention relates to an improved process of electric welding for welding two sheets of metal together. The invention may be applied to the construction of pulleys, wheels, sheaves, pulley frames, and other structures whereby parts may be securely united to each other without the use of rivets, bolts, keys and without interlocking connections. The invention consists of a process of electrically welding one piece of sheet metal to another, and which consists in providing projecting portions upon one of the sheets of metal and depressed portions on the other of the sheets of metal, placing one sheet of metal upon the other with the projecting portions of one in contact with the depressed portions of the other, passing a current of electricity through the sheets of metal and through the cooperating projections and depressions, thereby fusing the portions, and simultaneously forcing the two sheets of metal together to securely weld one to the other.



METHOD OF ELECTRICAL WELDING.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Magnetic Testing for Faults and Gas Bubbles in Iron.

A simple method of testing sheet iron for faults and air bubbles is described by Herr L. Kann. This consists in making use of the change in permeability of the material produced by such a fault. The iron is passed over the poles of an electromagnet and a small test coil is placed either on the tip of the magnet poles or on the other side of the sheet of iron. In the first instance, a fault passing over the poles changed the leakage lines by alternating the permeability of the magnetic circuit. With the latter arrangement, a similar action takes place, changing the number of magnetic lines which pass through the sheet and into the test coil. This change in permeability sets up a secondary current in the test coil, thus producing a galvanometer deflection.—*Translated and abstracted from Physikalische Zeitschrift (Leipzig), August* 1.

Oils for High-Tension Switches.

Some extended tests of oils used for high-tension oil break-switches have been made by J. H. Bolam. He here describes his method and gives some of the results. The requisites of a good oil for such use are as follows: It should have a high insulation resistance; it should be capable of quickly extinguishing the arc; it should be free from acids or other compounds liable to corrode the switches; it should not gum; it should be as fluid as is consistent with a quick extinguishing of the arc; it should have a high flash point, and it should be transparent. The method of testing consisted in determining the breakdown point of thin layers of oil between small terminals. An alternator was used for this purpose, the necessary high potential being secured by a step-up transformer and the regulation being effected by first lowering the potential to a fairly low value so that a convenient amount of resistance might be employed. Nearly all oils are good insulators when pure, but the action of the arc alters the aspect, for some of them are decomposed. Castor oil has a high insulating value, but does not extinguish the arc. The oils used for switch work are generally mineral or resin oil, but the latter has fallen into disfavor recently. The insulation properties of the two oils are similar, the resin oil being possibly slightly the better. As a general thing, a mineral oil should be used, because in the preparation of vegetable and animal oils chemicals must be used which are apt to leave undesirable materials in the oil. Tests show that the highest insulation resistance was given by a resin oil. Then followed several mineral oils, the one having the lowest flash point being the best. An ordinary mineral engine oil gave fairly good results, the breakdown voltage being 18,000 for a spark-gap one-sixth of an inch. The resin oil, with the same spark-gap, required a breakdown voltage of 32,000. This resin oil was in every way the most satisfactory of all the oils tested.—*Abstracted from the Electrician (London), August* 3.

The Positive Charge Carried by the α Particles.

It was suggested some time ago by F. Soddy that the α particle was initially uncharged on expulsion and that it gained its charge subsequently by collision with atoms in its path. This suggestion is based on the work of Bragg, who showed that the α particle passes through rather than collides with the atoms of solid or gaseous matter in its path, and that whether uncharged or not initially, it must equally with the atom struck become charged positively after the encounter by the detachment of a negative electron. Recently, P. Ewers, employing for this purpose polonium, attempted to put the idea to an experimental test, but with negative results. Bragg, however, pointed out that Ewers' experiments did not settle the question, and he evidently believes that it can not be settled experimentally. The requisite conditions to be fulfilled for a positive result are held to be so rigorous that no one could be certain that they had been fulfilled, and it is impossible to disprove the view by a negative result. But it is obvious that a positive result would settle the question, and the author has made a number of experiments in the endeavor to obtain such a result. After a long experience of negative results, one at last seemed to give an indication of a positive result. The conditions under which this had been conducted were carefully examined, and the experiment was finally conducted in such a way as to give definite positive results. The method of the experiment consisted in allowing the α particles upon expulsion to pass through a capillary tube. This tube and the tube containing the radioactive matter were highly exhausted so as to give a fairly long path of travel before a collision took place. A magnetic field set up across the capillary tube would then cause the particles to be deflected and to collide with the tube if they carried a charge. If, on the other hand, they were uncharged, the path of the discharge would remain unchanged whether the field were present or not. Another requisite was that the film over which the particles were expelled should not be more than one molecule thick. The experiment consisted in arranging the apparatus so that the rays were completely deviated by the magnetic field when charged, but passed through the tube unaffected when a high vacuum was secured. It was noticed that during the tests, the inner walls of the tube darkened, due it was thought to the collision of α particles. The radioactive material used was radium C. The author believes that there is no doubt that the α particle emerges uncharged. If so, it would appear that the influence of electricity in radioactive change and its importance generally in its relation to matter could be overestimated.—*Abstracted from Nature (London), August* 2.

Propulsion of Vessels by Irreversible Engines.

A novel scheme for propelling vessels due to Monsieur C_1 Del Proposto is discussed at some length here by Monsieur A. Lecointe. In brief the plan contemplates using Diesel engines, connected to the propeller shaft by a clutch. The engine shaft, in addition, contains a dynamo, while on the propeller shaft there is a motor, having a normal rating of about one-half that of the engine. The object of this arrangement is to give the engineer control over the speed of the propeller and over the direction of rotation, thus enabling him to manœuvre the vessel. For steady running, after the propeller has been brought up to full speed, the coupling is thrown in gear and the electrical connections opened, the engine driving the propeller directly. Besides the advantages, mentioned above, gained through the use of the electric drive, this plan also makes it possible to put the control of the driving mechanism in the hands of the steersman. The advantages of the drive are given as follows: a number of propeller shafts may be adopted, power to any one of which may be supplied from any generator. Each propeller is under individual control, making manœuvres rapid and even possi-

Digitized by Google

ble should the rudder be disabled. The motors may be controlled from any part of the vessel. An important question is whether Diesel engines can be constructed of sufficient power for large vessels. At the present time engines of this type, having four cylinders each rated at 250 horse-power, have been constructed. This gives 1,000 horse-power per engine, and by using three propellers we obtain 3,000 horse-power. Attaching two engines to each propeller shaft, this figure is doubled. By operating the engines on the two-cycle, instead of four-cycle, principle, and by making them double-acting, each engine may be rated at 3,000 horse-power, thus making 18,000 horse-power available for a triple-screw equipment. The article then goes on to discuss several installations of this system, one on the steamer Sarinat and one on the Barndale. The former has two propellers, two engines rated at 180 horse-power each, two dynamos rated at 125 kilowatts and two motors rated at 112 kilowatts each. The latter vessel has three propellers and three driving sets. The engines are rated at 120 horse-power, the dynamos at eighty-seven kilowatts and the motors at seventy-five kilowatts.—*Abstracted from the Bulletin Société Belge d'Électriciens (Brussels), July.*

The Nature and Origin of Volcanic Heat.

The hypothesis that the interior of the earth, while in the main solid, has cavities containing melted matter which occasionally is forced out in the form of eruptive outbursts, does not seem probable to Dr. Elihu Thomson, and the hypothesis of a molten or more or less fluid interior of the earth has practically been abandoned. Nor does the recently proposed theory which attributes the energy causing volcanic outbreaks to radium satisfy Dr. Thomson. He holds there is no need of recourse to an assumption of the existence of large localized bodies and radium minerals to explain such action. To say the least, such an assumed store of this rare element is improbable. The idea which he advances here seeks the expansion of volcanic action in the great and unequal pressure brought to bear at certain points. Primarily, it will be admitted that any substance, gas, liquid or solid, upon which work is done acquires heat in proportion to the energy expended upon it, which heat, if prevented from escaping, at once results in an increase of temperature of the substance. If air at ordinary temperature under high pressure escapes through a tortuous or frictional passage, surrounded by a good heat non-conductor, it emerges hot. The higher the pressure and the greater the friction met in the passage, the greater the increase. If liquid be substituted for the air, the general result is the same, and the liquid may be made to boil upon its escape. If a somewhat plastic solid like hard pitch be subjected to the process, the energy required will be greatly increased, or the pressure required to force it through the tortuous passage of some length would be great. It may emerge hot and melted if the conditions be properly selected. If now we assume that any solid be subjected to a pressure such as to cause it to flow in a tortuous or restricted channel, it will, in so moving, rise in temperature and continue to rise until it has reached a degree of fluidity such as to lessen or practically to stop the absorption of energy in the moving mass, or until it escapes from the passage through which it is being impelled. The idea thus outlined may now be applied as an expansion of volcanic phenomena. For example, a hot water spring may be the result of the water having been forced by high pressure to traverse somewhat porous rock, or to pass through narrow but long fissures in which it is churned for a long time before escaping. In like manner, any rock mass which, subjected to very high pressure, begins to flow must become heated. If its distance of traverse be great enough in a restricted fissure or channel, it must melt or even become so heated as partially to vaporize when the pressure is relieved. Let it be admitted that the flexures taking place in the earth's crust, or in the outer portions of its crust, may bring to bear upon deep-seated, and perhaps already heated, solid rock masses a sufficient pressure to cause them to readjust their positions, and the condition demanded by this theory is present.—*Abstracted from Science (New York), August* 10.

Wood Preservation.

The increasing necessity for adopting some method of preserving wood is emphasized here by Bohumil Shimek. The rapid exhaustion of our forests is making this matter imperative, and although something may be done by proper cutting and seasoning, special treatment of the wood prolongs its life considerably. Whether special methods of preservation are employed or not, the wood should be well seasoned. To this end, if kiln-drying is impossible, the wood should be cut in the fall in order that it may have a longer time to dry slowly in the colder part of the year. If kiln-drying is practised, the wood may be cut at any season of the year. There is some advantage in using wood which has been rafted, or allowed to remain in water for some time, as this treatment dissolves out certain of the soluble organic materials. As a result, fungi find less available food material. The same result is secured by first steaming the wood. For railway ties, the steaming may be done in the open air without shelter. They should be piled in a place well drained and exposed to winds rather than the sun, and not more than two ties should come in contact with the ground. In piling, ample space should be left between the ties for ventilation. Hewn ties have smoother surfaces than sawn ties, and are, therefore, better. Charring and coating with paint or tar have some merit. The latter methods are effective only when they wholly exclude air. They are scarcely to be considered as methods of drying ties. The various preserving materials now used are given, and this is followed by a description of the methods and apparatus employed at the Alamogordo (New Mexico) Timber Preserving Plant. The plant is located in a territory in which practically only coniferous wood is available. The method employed is the Wellhouse zinc-tannin process, but the plant is also used for simple Burnettizing, in which only zinc chloride is used. The impregnating fluids are stored in large tanks from which they are drawn and to which they are returned by means of pumps. There are two retorts, each 106 feet long, having a capacity of 546 eight-foot six by eight-inch ties. The ties are placed on steel cars and run into the retort in which they are steamed under pressure of twenty pounds for four or five hours. A vacuum of twenty-two inches is then created, and a four per cent solution of zinc chloride is introduced under 100 pounds pressure for four hours. The amount of pure chloride consumed per cubic foot of wood varies for the material here employed from 0.29 to 0.33 pound. The chloride is then followed by tannin, of which a sixth of a pound per cubic foot is employed for about one and one-half hours, and this in turn is followed by a one-half per cent solution of glue. The entire run consumes from eleven to eleven and one-half hours. If green wood be used, the time required for steaming and impregnation must be extended from one to one and one-half hours each. The process darkens the ties somewhat. After the treatment, the ties should again be thoroughly seasoned for several months before they are used.—*Abstracted from the "Transit," State University of Iowa, Iowa City.*

Digitized by Google

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

THE WINNING OF POWER BUSINESS.

BY S. M. KENNEDY.

It would seem as if there were now no excuse for the existence of an electric company, if its object is to sell light only. It is probably true that there are scores of such companies operating all over the United States, but, after all, they are only existing. If they sell light only, they have no day load. If they have no day load, then they are not getting proper returns out of their investments—for day load is the "velvet" of the central station business. The "peak" of lighting load makes a profitable day load possible, because it means that there is so much installation ready for use at any time. And here it may be noted that it is a poor rule that does not work both ways. For the profitable day load makes it possible to sell the lighting current at lower rates. And low lighting rates mean long-hour load, increased consumption, and less liability of competition.

But I can imagine the remarks of some central station managers who are operating in smaller cities and towns: "It is all very well for you to talk about day load, but there is no power business here." Well, in answer I would ask: "How do you know? Have you investigated the possibilities?"

There is one important difference between selling light and selling power. A certain amount of lighting business will come without asking. But, it may be accepted as an axiom that power business does not come; it must be sought. It must be sought; not carelessly, but intelligently; not irregularly, but systematically; not spasmodically, but persistently.

But, still we can hear doubtful ones cry: "Where shall we seek?" Well, let us take a look over your city. Let us ride together through its streets and, maybe, we will see where they are using some kinds of power now, and would probably use yours, if you would let them know they could have it.

Here is a machine shop. What is the matter with trying a motor in place of that evil-smelling gas engine. No, not one motor, but a number of small ones, on lathes, saws, blowers, drills, hoists, welding machines, etc.; and why not electricity for the soldering irons and brazers?

There is a printing establishment. Those presses need motors more than anything else. Electricity is the only power for such work.

How about that planing mill? Just look at the reckless waste of power in that shafting and belting. Ever talk to the owner? Just once! Well, go at him again. He wants your energy worse than he knows—just because some one has not told him how much he would save in time and money.

That ice factory and cold storage plant were made for electric power, if anything ever was. You say you never thought of them! Well, give that concern some absent treatment, and then go after them with hammer and tongs. Why, with one or two motors in that place, the owner could leave his plant and forget it. It could run itself most of the day. But not so with the steam engine.

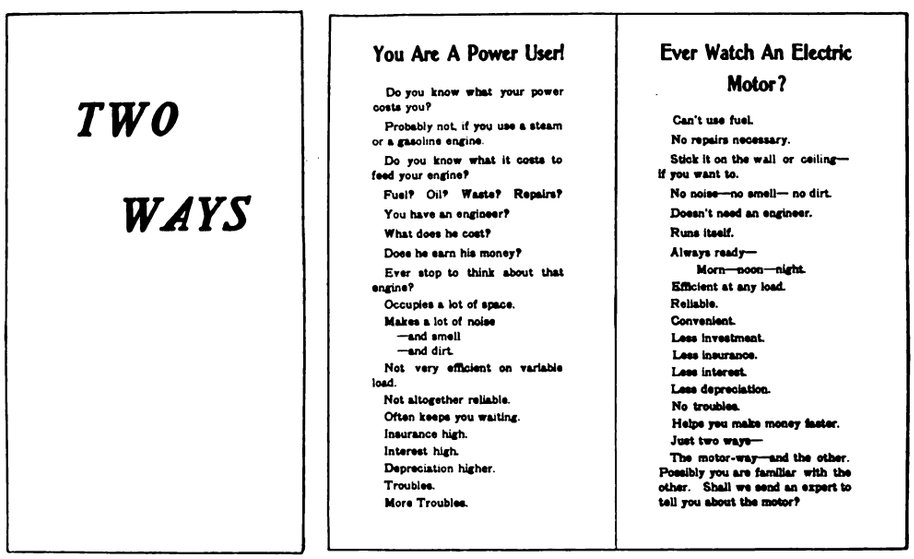
By the way, there is a church. No motor on the organ blower. No fan for making the air circulate. All your fault!

That's a dairy and creamery. There is such a thing as a motor which could operate that churn and cream separator. Another for the refrigerating machine and ice-cream freezer. Probably there is one which could milk the cows. Why don't you give that man a chance to make money?

But why recite a long list of instances. It really does not matter where you investigate in your city or town—in every nook and corner, in every store, factory, office, hotel and dwelling—there is a place for day power, and a real desire for it, only most people don't know they have the desire until you show them how it can be created and satisfied at the same time. Then they will tell you that they have always wanted just such a thing as the electric motor.

We have stated that power business must be sought, and it would appear as if this condition will always exist. But as your power business increases in importance and volume, the new business will not require to be coaxed as hard as in the early stages of its growth. Regarding the manner of seeking. The best of all is by means of trained solicitors, aided by judicious and careful advertising.

In ordinary electric light soliciting, an expert in the line is advantageous, but not absolutely necessary. In ordinary or extraordinary power soliciting, an expert is not only advantageous, but necessary. Much electric lighting business may be obtained by talking generalities, by pointing out the decorative features, and the adaptability to various conditions. But with power it is different, and the solicitor must get down to brass tacks. He must know of the comparative advantages of electrically driven power over steam and


TWO
WAYS
You Are A Power User!
Do you know what your power costs you?
Probably not, if you use a steam or a gasoline engine.
Do you know what it costs to feed your engine?
Fuel? Oil? Waste? Repairs?
You have an engineer?
What does he cost?
Does he earn his money?
Ever stop to think about that engine?
Occupies a lot of space.
Makes a lot of noise
—and smell
—and dirt.
Not very efficient on variable load.
Not altogether reliable.
Often keeps you waiting.
Insurance high.
Interest high.
Depreciation higher.
Troubles.
More Troubles.
Ever Watch An Electric Motor?
Can't use fuel.
No repairs necessary.
Stick it on the wall or ceiling—if you want to.
No noise—no smell— no dirt.
Doesn't need an engineer.
Runs itself.
Always ready—
Morn—noon—night.
Efficient at any load.
Reliable.
Convenient.
Less investment.
Less insurance.
Less interest.
Less depreciation.
No troubles.
Helps you make money faster.
Just two ways—
The motor-way—and the other.
Possibly you are familiar with the other. Shall we send an expert to tell you about the motor?

Digitized by Google

gasolene engines. He must be able to point out to the prospective consumer where a saving of investment, energy, time and money may be made by adopting the motor in place of the engine. As a rule the power user is a hard-headed business man. The solicitor drops in and tells him a fascinating story about the utility, flexibility and reliability of the electric motor. After he has finished his story the power user will ask: "Well, what will it cost?" That's the first question, and the solicitor must not hesitate or show any weakness in his answer. He must know what will be the cost, under given conditions, and how to explain it so that the advantages will be apparent. A successful power solicitor must be a man who knows both sides of his subject, who knows the advantages and disadvantages of steam and gasolene, and who knows the advantages, and what are erroneously called the weaknesses, of electric power service. It takes persistent soliciting to close power contracts. It is the only certain way to obtain this kind of business, and power solicitors must of necessity receive instruction and education of an exact nature, so that they may be able to talk intelligently and accurately about what they have to sell.

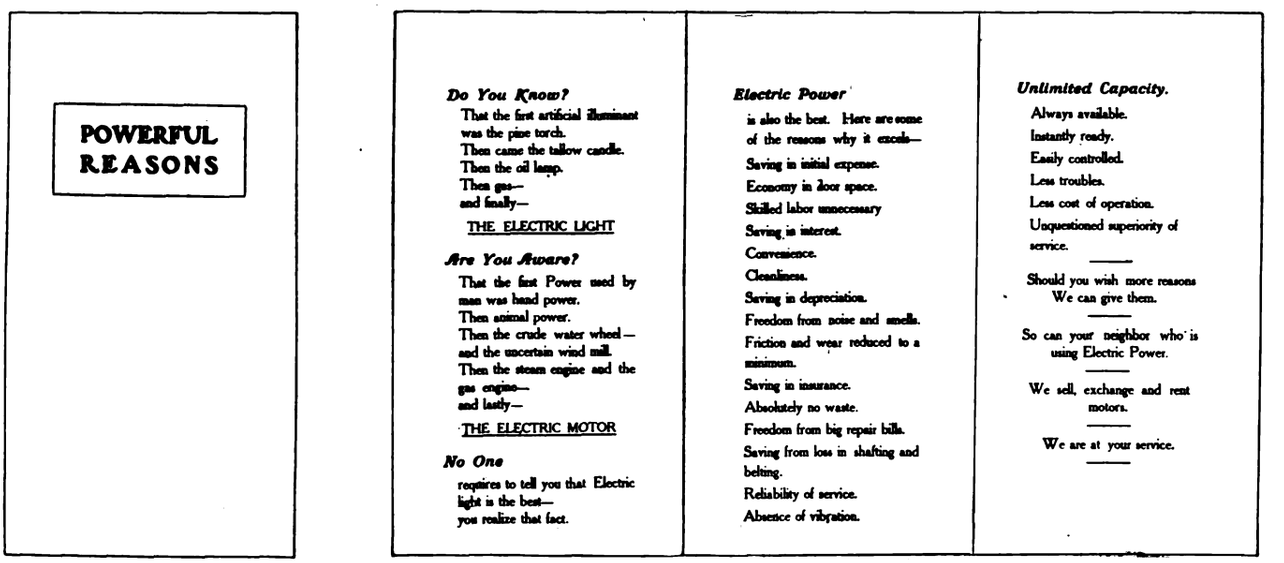
When the solicitor has a prospective power customer, the first thing for him to do is to find out what the man needs—then sell it to him. There is no use trying to sell the man more than he needs—but do not stop at less. It may be that to start the consumer will feel his way with a smaller amount than he really requires, but the solicitor must keep at him until he has all. The "all" will come if the "sample" is satisfactory, and the solicitor can see that things run so smoothly that there will be no complaint.

There is one class of power business which needs careful handling. I refer to power users who already have energy other than electric. It often happens that a power user may be interested in electricity, but has his money tied up in a steam or gasolene engine, and does not wish or thinks he can not afford to invest more. This condition might bar such a man from using electric energy for a long time, unless he is shown a way to dispose of his old plant. A solicitor who is well informed can usually find a place to put the old machine. There are dealers in second-hand engines, who at times may not offer very much for a plant, but who will give something, and this "something" is usually enough to lay the foundation for closing a bargain and signing a contract. Owing to the low cost of motors, most of such exchanges can be made without loss to the electric company, although in some cases it may be figured that an initial loss must be met in order to obtain permanent and profitable power business.

But let the solicitor remember that there is nothing to be gained in such transactions, by speaking in a disparaging manner of the old plant. It may be the prospective consumer has a real affection for his engine. He may have had it when he could not obtain your electric power, and it may have stood him good service in the past. Further, it represents an investment, and it does not put him in a pleasant state of mind to be told that his plant is not worth anything. Praise the motor, say all you can for it, but in most cases, where a man has an old engine, let him realize his disadvantage without rubbing it in too hard.

Another important matter in developing power load is to obtain the "entering wedge." Many power users—such as factories, planing mills, laundries and others—have their own plants, but a day comes when their business demands more power, and they do not wish to increase the boiler capacity, give up more space, or spend much money. This is the power solicitor's opportunity. If he has kept in touch with such concerns, they will send for him to talk it over. That should settle it for the motor, and all additional power for that concern thereafter.

The man going out after electric power business needs to be well loaded with suitable ammunition. It goes without saying that all the peculiar advantages of motor-driven power should be at the tip of his tongue, and he should be able to parallel them with the disadvantages of other power schemes. He should have a carefully prepared list of these pros and cons in his pocket-book, so that as he is talking to a man he may cast his eye over the list to see that he has omitted no points which might be useful in gaining his object. The point or advantage which will appeal to one man may not touch another; but there are always some items which interest, and these are the ones to dwell on the most. The central station manager should keep his power solicitors well supplied with folders and booklets, telling in a concise way the adaptability of electric energy for different kinds of power in general, and of some cases in particular. The solicitor can regularly leave one of these on a man's desk, or mail it to him. If sent before a call, it will open up the way; if sent after a call, it will help to drive home some of the things talked of during the interview. An up-to-date list should always be handy, showing the electric power consumers in your city. If a man


POWERFUL REASONS
Do You Know?
That the first artificial illuminant was the pine torch.
Then came the tallow candle.
Then the oil lamp.
Then gas—
and finally—
THE ELECTRIC LIGHT
Are You Aware?
That the first Power used by man was hand power.
Then animal power.
Then the crude water wheel—
and the uncertain wind mill.
Then the steam engine and the gas engine—
and lastly—
THE ELECTRIC MOTOR
No One
requires to tell you that Electric light is the best—
you realize that fact.
Electric Power
is also the best. Here are some of the reasons why it excels—
Saving in initial expense.
Economy in floor space.
Skilled labor unnecessary
Saving in interest.
Convenience.
Cleanliness.
Saving in depreciation.
Freedom from noise and smells.
Friction and wear reduced to a minimum.
Saving in insurance.
Absolutely no waste.
Freedom from big repair bills.
Saving from loss in shafting and belting.
Reliability of service.
Absence of vibration.
Unlimited Capacity.
Always available.
Instantly ready.
Easily controlled.
Less troubles.
Less cost of operation.
Unquestioned superiority of service.
Should you wish more reasons We can give them.
So can your neighbor who is using Electric Power.
We sell, exchange and rent motors.
We are at your service.

Digitized by Google

is considering the use of electric energy, one of the most convincing arguments a solicitor can use is to refer him to others who are doing similar work by means of electricity. The prospective consumer can eliminate all doubt and guesswork, by seeing the people he is referred to. He can watch the operation, and learn the cost from a disinterested party who probably has used other power as well as electricity, and who can explain why he commenced using the motor, and why he would not change.

In the smaller cities the newspapers may be used with advantage in advertising electric power. Not so much in space advertising as in reading notices, announcing the fact when a well-known firm, company or corporation installs electric energy for operating their machinery. This makes good reading for all parties.

The central station manager, looking towards the upbuilding of the power end, must do everything possible to nurse the business as it comes on. There will be more or less difficulty at first with each new consumer, mostly arising from inexperience in handling motors. But whether a man is a new consumer or an old one, if he is in trouble with his power service in any way, he should have immediate attention. As a matter of fact, one power customer will give more trouble than twenty lighting customers. Why is this? Just because the power is used mostly in the daytime, by people who are making a living from their daily work. The power being off stops work, and means loss of time—maybe for many employés. But it often happens that a temporary interruption of light may occur without much annoyance. Light is usually required at night—but most of the world's labor stops by the time darkness comes on. The power business is exacting, and its big and little troubles demand prompt action.

In cities where an electric company has a number of solicitors, it has been found an excellent plan to arrange a series of competitive prizes for the obtaining of new power business. Say, for instance, there are six solicitors. The territory for each man's work can be so arranged that his district will include part of the business area and part of the residence section. This arrangement will likely give each man a fair chance. Then, on the results of a stated period, say three or six months, offer a first and second prize for the following:

1. New Power Customers Added;
2. Number of Motors Added;
3. Additional Horse-Power Added;
4. Percentage of Increase in Power Income.

A competition of this sort creates a spirit of healthy emulation among the men, and the cash prizes are incentives for increased work.

Power business is contagious. It will be found that the first score of customers and the first hundred horse-power will be the hardest to obtain. But after that the same amount of work will produce greater results, and by keeping constantly at it, a profitable day load will surely be obtained, and better returns on the company's investment will result therefrom.

NOVEL GAS ADVERTISING AT PUEBLO, COLORADO.

D. S. Greenwood, manager of the commercial department of the Pueblo-Colorado Gas and Fuel Company, describes an amusing method of advertising in the August issue of *Progressive Age*. Upon the occasion of the visit of a large circus to the town, the company advertised for as many dogs as they could secure. Some 600 boys turned up with dogs of every description, and at the tail-end of the circus parade these 600 dogs were either led or dragged, each bearing a blanket upon which was an inscription, "Cook with Gas." Mr. Greenwood states that the parade was immediately forgotten, and that "Cook with Gas" was impressed upon the entire population in Pueblo in fifteen minutes. Every one said that "it was grand" and that the gas company was the talk of the town. The morning papers were full of advertisements concerning lost dogs, and there was also considerable gratuitous matter concerning the enterprise of the company.

Municipal Ownership Abroad.

A despatch from Berlin, Germany, to the Chicago *Daily News* says:

"Mayor McClellan, of New York, who has been in Berlin for the last five days incognito, to-day expressed the opinion that much of Europe's vaunted municipal superiority is a delusion and a snare. In an interview to-day he said:

"'I have kept my eyes wide open for evidence of successful municipal operation, particularly in Germany, which is constantly held up as an example, but I have failed to find it. I have discovered conditions in cities like Frankfort and Dresden, which own their street railroads, which no American community of second-rate importance, to say nothing of New York or Chicago, would tolerate. Not only is the traffic of these places insignificant, judged by American standards, but it is handled inadequately and inefficiently.

"'The conditions in Great Britain, with the possible exception of Glasgow, where our cousin Mayor Dunne, of Chicago, has been taking lessons, are even worse than on the Continent. The British tramways act of 1873 gives municipalities options upon franchises before the franchises exist and the result has been perpetuation of old fogyism and the stunting of private enterprise. My European observations convince me more than ever that municipal operation is the last desperate means which ought to be resorted to only when private enterprise has absolutely failed.'

Belmont Tunnel Terminus.

The New York & Long Island Railroad Company, the builder of the so-called Belmont tunnel, has purchased the Kelley property at the corner of Fourth street and Jackson avenue, Long Island City, and it is understood that the terminus of the tunnel under the East river will be at that point. The price paid is said to have been $240,000. The company had to have the corner for its first outlet on the Long Island side. The tunnel will not come to the surface at that point, but the station there will probably have direct connection with the Long Island Railroad and the Pennsylvania terminus nearby. The property purchased comprises about four city lots.

New York & Ontario Power Company.

The New York state commission of gas and electricity has received the application of the New York & Ontario Power Company, to Waddington, St. Lawrence county, for a certificate of authority to transact business and to issue $2,000,000 bonds and $2,000,000 stock. The company proposes to purchase and develop a dam and water power across and adjacent to a branch of the St. Lawrence river, from the Isle au Rapids plant to the south side of the St. Lawrence river, in order to furnish light and power to Waddington and Ogdensburg.

The Tunnel of the Electrical Development Company, of Ontario, Completed.

The announcement is made that the tunnel of the Electrical Development Company, of Ontario, at Niagara Falls, has been completed. It has taken three years to build, and is credited as one of the greatest achievements in the history of the Niagara falls electrical development. The tunnel extends from the power-house several hundred feet above the Horseshoe falls to a point under the cataract. On October 1 a banquet will be given at the Clifton House, Niagara Falls, Ontario, to celebrate the completion of the works.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

G. I. Outlet Boxes.

The accompanying illustrations show the new G. I. adjustable water-tight floor outlet box and the P. R. floor outlet box, manufactured by the Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass.

FIG. 1.—WATER-TIGHT FLOOR OUTLET BOX (ADJUSTABLE).

Fig 1. shows the G. I. water-tight floor outlet box (adjustable) equipped with double outlet nozzle. Fig. 2 shows the receptacle and plug in outlet box.

The body of the box is drawn in one piece from one-eighth-inch cold-rolled steel of the best grade, and the adjustable collar is made of the same material in one piece. The threaded portion is designed to give an adjustment of one inch so that the depth of the box may be increased from three and three-eighths inches to four and three-eighths inches.

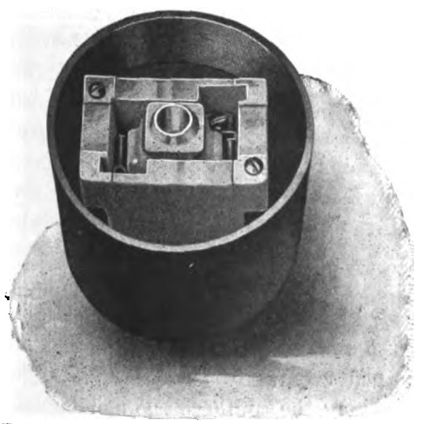


FIG. 2.—RECEPTACLE AND PLUG IN OUTLET BOX.

The floor-plate is made of heavy brass and is fastened to the iron collar by screws, a rubber gasket being provided to ensure a water-tight joint.

The exposed surfaces of the plate and nozzle have a polished brass finish, and the steel body is heavily japanned inside and out. It is substantially built and will not sink in the floor when subjected to heavy weight.

By the use of a new type of outlet nozzle it is not necessary to remove the floor-plate when inserting or removing the plug. When not in use both nozzle and plug can be readily removed and the box closed by means of a brass flush sealing plug (see Fig. 3). Both nozzle and sealing plug are provided with rubber gaskets to ensure a water-tight joint. The conduit holes can also be closed, when necessary, by brass plugs.

FIG. 3.—OUTLET BOX WITH SEALING PLUG INSERTED.

Various forms of attachment plugs and receptacles may be used with this box. The hole in the outlet nozzle is of such a diameter that reenforced cord may be used when desired.

The boxes are furnished with either round or square floor-plates. The adjustable iron collars to which the plates are secured are also furnished with round or square flanges to fit the plates. If boxes are purchased separately from the plates care should be taken to specify whether the flanges on the adjustable collars should be round or square to fit the plates.

In installing, the box or lower part (the collar and plate being removed) should be set level from one to one and one-half inches below the upper surface of the floor. This should be done when the conduit is run. The box should be filled with excelsior or paper to prevent the entrance of plaster or rubbish before the floor is laid.

The adjustable collar with floor-plate attached can be set in place when the floor is laid or afterwards. The thread of the steel collar should be well leaded before screwing it into place so as to make the joint thoroughly water-tight. If set in marble or tile floor, the rough edges around the brass floor-plate should be filled with cement. The socket or receptacle can be connected either before or after the floor-plate is set.

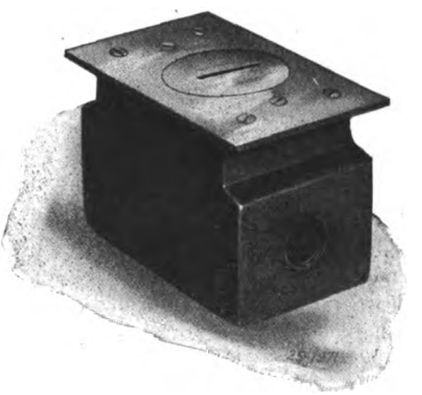


FIG. 4.—P. R. OUTLET BOX.

The dimensions of the box are as follows: diameter across floor-plate, five inches; diameter lower body, four inches; height, adjustable from three and three-eighths inches to four and three-eighths inches; weight, complete with nozzle, three and one-quarter pounds.

The P. R. outlet box, Fig. 4, is designed for use with either iron or flexible conduit.

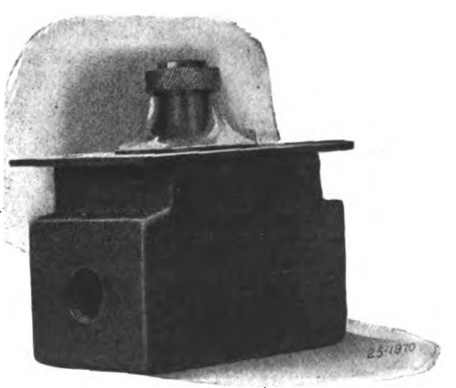


FIG. 5.—P. R. OUTLET BOX, WITH NOZZLE.

It encloses a porcelain receptacle and an attaching plug to which a flexible lamp cord is attached (Fig. 5). When the receptacle is not in use the hole in the floor-plate is closed by means of a flush sealing plug. Both nozzle and sealing plug are

Digitized by Google

provided with rubber gaskets to ensure a water-tight joint and are the same as the nozzle and sealing plug used with the G. I. outlet box.

The box is rugged in construction, the exposed portion being finished in polished brass, and the body finished in black japan. A feature of these boxes is the ease with which they may be installed.

The dimensions of the box are as follows: length of box, four and one-quarter inches; width of box, two and three-quarters inches; depth under face-plate, two and seven-eighths inches; floor-plate, four and three-quarters inches by three inches; weight, complete with plug and receptacle, three and three-eighths pounds.

Power-Operated Hatches.

Armor hatches have been a problem ever since the protective deck was introduced. Means must be provided for raising and lowering the hatch plate quickly and safely under all circumstances, and as the plate weighs sometimes as much as half a ton, the problem is by no means a simple one.

Block and tackle which has been used in the past is inconvenient and dangerous because the plate is likely to become unmanageable when the ship is rolling. Accidents from this cause have been frequent. The one thing essential to the safe handling of these heavy plates is that they be mechanically held at all times so that they can not drop or swing back. This result has been accomplished in the "long-arm" electrically operated hatch gear, of which a new model has recently been approved by the Bureau of Construction and Repair of the United States Navy Department.

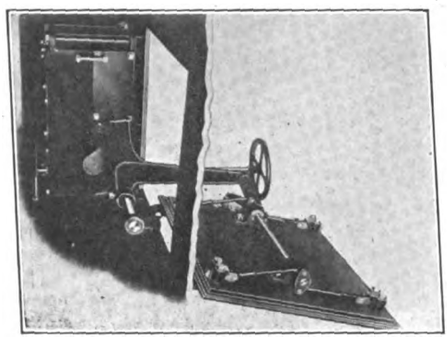
This gear is so designed that the hatch plate while being operated is always under control and held firmly, at whatever angle the plate may be to the deck.

The two essential parts of this apparatus are the hatch lift, a cast-steel box containing the motor, controller and gearing; and the lever system for connecting the hatch lift with the plate, for operation and for locking the plate watertight when closed.

The hatch lift is secured under the deck by the side of the opening. Projecting from the side of the hatch lift is a heavy crank which can be rotated either by the motor or by an auxiliary hand-wheel, above or below deck. From this crank power is derived to open, close and lock the hatch plate. The lever system consists of a substantial fulcrum shaft rotating in a bearing bolted to the underside of the protective deck, almost under the hinges of the plate. This fulcrum shaft carries a bent lever standing out beneath the hatch plate and connected to the locking mechanism on the hatch plate by a substantial link. The bent lever does not obstruct the clearway when the hatch is open.

The locking mechanism is an important feature, consisting of a number of bars all connected to one shaft across the centre of the plate and so arranged that when the shaft is rotated the bars are forced out beneath the deck and draw the hatch plate firmly down to its seat. The mechanism is actuated by the lift, and does not require separate manipulation. When the hatch is closed and locked and the operator starts to open either by hand or power, the lift first unlocks the plate, after which it opens to any desired extent. A mechanically operated stop prevents the locking gear from throwing out the bars except when the hatch plate is completely closed.

The motor and controller of the hatch



Long-Arm Hatch Gear.

lift are connected with a central emergency station located above deck, and form a part of the system by which the main bulkhead doors of United States warships are controlled from the central station. The hatch lift, in common with the "long-arm" system doors, possesses a "liberty action" which enables a man who may desire to pass through the hatch while it is being closed from the central station or after it is completely closed, to arrest and reverse the power action. This is accomplished easily and safely simply by turning the controller handle. When the lever is manipulated the closing operation is suspended and the hatch opens sufficiently to allow passage through the opening. As soon as the controller handle is released the hatch automatically closes again, as though no interruption of the emergency closing had taken place.

The great importance of this feature of the mechanism is that it eliminates danger and gives freedom to those who may be compelled to pass through the hatchway while it is being closed from the emergency station.

In common also with the "long-arm" doors, the hatch lift is provided with an automatic cutout so that in case an obstruction prevents the complete closure of the hatch plate, the current to the motor is cut off, preventing injury. After the obstruction is removed, the motor is automatically started, this follow-down action doing away with the possibility either that the apparatus will be injured or that, after an emergency closure is interrupted, the hatch will be left open by some one passing through it.

The "long-arm" hatch-gear thus offers three methods of operation—at the hatch, both above and below deck, by power which is brought into action by means of the controller handle; above and below deck by means of the hand gear intended for use in case the electric power should fail, and from the emergency station on the bridge by means of which the closing of all power-operated hatches on the ship is always instantly possible.

Forty Thousand Horse-Power in Hydraulic Turbines for Duluth.

The plans of the Great Northern Power Company, of Duluth, Minn., for the development of water power in the Northwest, when they are brought to full completion, will provide for the transmission of 200,000 horse-power. The power plant which is now under construction will have an initial equipment for the generation of 40,000 horse-power, with an ultimate capacity in this one station of 80,000 horse-power. It is located three miles from the city limits of Duluth, on the St. Louis river, the distance for transmission to the distributing centre being fourteen miles, to the cities of Duluth and Superior, where substation equipment will be provided. From the strategic position of the generating stations the future possibililties of the development may readily be surmised. The Mesabi and Vermillion iron ranges, in which the greatest iron mines of the world are located, lie from fifty to seventy-five miles to the northward of the plant and are destined eventually to be operated from it. Along the southern shore of the lake to the westward and within transmission distance are the Gogebic Crystal falls and Gogebic iron ranges and the copper mines of the Calumet district. The railway and lighting interests of Duluth and Superior have already contracted for electricity from the new source, and the long harbor frontage of docks and warehouses offers great opportunities for the use of electric hoists, lamps, etc. The transfer

Digitized by Google

of freight at the head of the lake between steamships and railroads reaches an enormous figure. For the year 1905 the tonnage entering Duluth, Superior and Twin Harbor amounted to 25,000,000 tons, or more than that from the port of New York.

The distance from the head-gates to the power-house is 2.8 miles, about two miles of which is canal and forebay. Over the remaining distance the water is carried through about 3,800 feet of wood-stave pipe and about 1,000 feet of seven-foot steel pipe for each water-wheel unit. The difference in elevation between forebay and power-house is 378 feet. The building, which for the present will be 181.5 feet long and seventy-seven feet wide, will be constructed of brick masonry with framing. The initial hydraulic apparatus consists of three turbine water-wheel units, each designed for a capacity of 13,000 horse-power. They will operate at a speed of 375 revolutions per minute from a fall of 389 feet. The wheels are furnished by the Allis-Chalmers Company, Milwaukee, Wis., and are of the single vertical Francis type. The exciter outfit will comprise two single vertical impulse exciter wheels, each one developing 350 horse-power at 500 revolutions per minute from a 336-foot head. The general scheme of the Great Northern development was originated by T. A. Cokefair, of Duluth, and was executed by the National Contracting Company under Mr. Cokefair's direction as chief engineer.

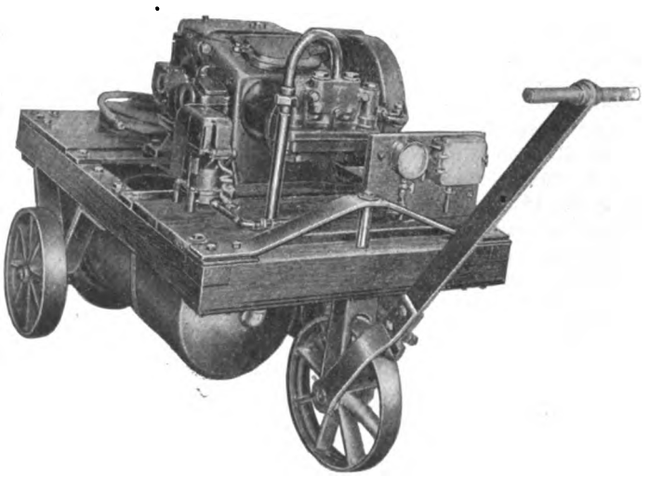
Portable Air-Compressor Outfit.

An especially neat and compact portable air-compressor outfit has recently been placed on the market by the General Electric Company, Schenectady, N. Y. A convenient means of obtaining a supply of compressed air for various purposes about power-houses and car barns is in demand and the new outfit meets the requirements of such service. Compressed air is used in the power-house for cleaning generators, rotary converters and switchboards, and it has a wide application in car barns for cleaning dust from cars and trucks and removing copper and carbon particles from armature windings and controllers. In addition to the more apparent use of this compressed-air outfit, small tools such as drills and chisels can be operated by such a compressed-air supply. Being portable the entire set can be drawn to different parts of the power-house or shop or put on cars and transported to sub-stations; the electrical connection with the trolley circuit is quickly made through a contactor box on the truck and a convenient length of hose used to convey the compressed air to the work. This eliminates waste of air due to unnecessarily long hose or leaky pipe connections.

The portable air-compressor set manufactured by the General Electric Company consists of a standard CP 22 (twenty-four-foot) air compressor similar to that used in the company's air-brake systems, a governor, insulating connector, safety valve, gauge, combined switch and fuse, two reservoirs sixteen inches by forty-eight inches, hose, contactor box, and stop-cock, all mounted compactly on a three-wheel truck, as shown in the illustration. In the centre of the truck is placed the air compressor and motor with the governor at one side and the gauge and circuit-breaker mounted on a small board in front. The two steel reservoirs are carried beneath the truck floor, keeping the centre of gravity of the outfit very low. The framework and tongue are of wrought iron and the front wheel is hung in a pivoted fork of the same material.

The various parts of this outfit are of the same standard and durability as the regular General Electric Company air-brake equipments for cars. The compressor consists of a 500-volt motor of the railway type connected by a herring-bone gear drive to a double-cylinder air compressor. The complete unit is entirely enclosed with provision for thorough lubrication. The gearing runs in oil, making it as noiseless as possible. The governor is entirely automatic and thoroughly protected, and adjustments are provided so that the pressure at which it will act can be varied to open at any point between 60 and 100 pounds per square inch of pressure in the steel reservoir. In addition to the governor an adjustable pop safety valve is provided which prevents the possibility of an excessive pressure on the reservoirs. In the combined switch and fuse, mounted vertically with the gauge, all current-carrying parts are enclosed in moulded insulation, and a powerful magnetic blowout is provided for extinguishing the arc. With each machine twenty-five feet of special armored air hose is furnished complete with stop-cock, coupling and nozzle for connection to machines or for cleaning purposes.

The general dimensions of the General Electric Company's portable air compressor are as follows: height, three feet seven inches; width, three feet eleven inches; length, five feet eight inches.



PORTABLE AIR-COMPRESSOR OUTFIT.

Power Machinery Exportations.

The Westinghouse Machine Company, East Pittsburg, Pa., has recently sold to the United States government for use in connection with the Panama Railroad two compound steam engines; one direct-connected to a 325-kilowatt, 250-volt engine-type generator, and the other to a 200-kilowatt, sixty-cycle, alternating-current, two-phase, 220-volt generator. Both operate under a steam pressure of 150 pounds.

Two 165-brake-horsepower producer gas engines are to be installed in the plant of the Calgary Milling Company, at Calgary, Alberta, Canada. The engines operate at an altitude of 3,000 feet, using anthracite coal for fuel, with a possibility of a change to natural gas as soon as supply is obtained.

G. & O. Braniff & Company have ordered a 300-kilowatt Westinghouse-Parsons steam turbo-generator unit. The turbine will operate on 150 pounds of steam pressure and twenty-seven inches vacuum, and will be installed in the plant of S. Roberts & Company, Mexico City, Mexico, generating fifty-cycle current at 6,000 alternations.

The Rio Janeiro Tramway, Light and Power Company will install at Rio Janeiro, Brazil, a 300-kilowatt Westinghouse compound engine unit operating under a steam pressure of 150 pounds and direct-connected to an alternating-current generator.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TROLLEY FOR MISSOURI TOWNS—The promoters of the interurban electric railway between Jefferson City and Sedalia have decided to incorporate a company at once to build the line, and a committee consisting of C. W. Thomas, of Jefferson City; Nelson Leonard, of Bunceton, and J. H. Decker, of Sedalia, has been appointed to look after the details of incorporation. It is estimated that the line, eighty-three miles in length, can be built and equipped for about $1,500,000. It will open up some rich agricultural sections

HALF A MILLION FOR IMPROVEMENTS—The Terre Haute Traction and Light Company has decided on improvements to the extent of half a million dollars, and it has been announced that work is to begin at once. The improvements will include the enlarging of the Water street power station to twice its present size, the building of a substation at Brazil, the straightening and leveling of the Brazil Interurban line and a general improvement of the local station. Plans for the work on the Water street station have almost been completed while the plans for the other work are under way.

BELL TELEPHONE COMPANY OF CANADA—The directors of the Bell Telephone Company, of Canada, have decided to increase the capital stock of the company from $9,000,000 to $10,000,000. Stockholders of record August 31 will be entitled to one share of the new stock for every nine shares held at $125 per share. The right to subscribe will expire at 1 P. M. on September 15. Payment for the new stock may be made in full on October 1, or in four payments as follows: $50 on October 1, 1906, being $25 on account of stock and $25 on account of premium; $25 on November 1, 1906, $25 on December 1, 1906, and $25 on January 2, 1907.

MORE HUNTINGTON POWER PLANTS—H. E. Huntington and his Fresno and Los Angeles associates have decided to increase their electric power generating system in the mountains east of Fresno. Altogether they are to have four electric power plants on the San Joaquin and two on the Tulare river, which will give a total of between 35,000 and 40,000 horse-power. Part of the system is already finished and the remaining part will require a year and a half of work and an expenditure of over $1,000,000. The two Tulare river plants will have respectively 4,000 and 6,000 horse-power. Eventually much of this electric power will be used to operate an electric suburban and interurban railroad system of 200 miles which Huntington and his associates have planned with Fresno as the hub.

MAHONING & SHENANGO MERGER—The Youngstown Park & Falls Railway Company has been formally merged with the Mahoning & Shenango Railway and Light Company, completing the great system of the two valleys, which controls 125 miles of trolley lines as well as lighting franchises in Youngstown, New Castle, Sharon, South Sharon and Sharpsville. The status of the two companies is as follows: Youngstown-Sharon Railway and Light Company bonds, $3,500,000; preferred stock, $3,000,000; common stock, $5,000,000; floating debt, $750,000; total bonds, $6,375,000; preferred stock, $3,000,000; common stock, $7,500,000; floating debt, $1,050,000. The condition of each company as it existed July 1, 1905, is to be the basis of its merger, as of which date both companies will be free from floating debt. The bonded indebtedness of the Youngstown & Sharon Railway and Light Company shall be reduced to $2,800,000.

NEW YORK-CHICAGO AIR LINE—Joseph Ramsey, Jr., Pittsburg, Pa., formerly president of the Wabash, announces that he will build a new trunk line railroad from New York to Pittsburg and thence to Chicago, the project to be financed by foreign bankers, and the road to cost $150,000,000. Surveys for the road have been completed and show that it will be eighty-five miles shorter than the Pennsylvania between Pittsburg and New York and 108 miles shorter than the present shortest line between New York and Chicago. It is proposed to operate the line with electric locomotives, and as the surveys give the new line a maximum grade of twenty feet to the mile, in comparison to the maximum grade of sixty-five feet to the mile on the Pennsylvania system, the new line will be able to develop high speed. The air line will run through both the bituminous and anthracite coal regions and numerous branch lines are planned as feeders. It will not touch Philadelphia, going through the northern part of Pennsylvania. After leaving Pittsburg the road will touch at the following towns in Pennsylvania: Freeport, Leechburg, South Bend, Shelocta, Cherrytree, Irvona, Dix, Loveville, Pine Grove Mills, Shingleton, Tusseyville, Coburn, New Berlin, Northumberland, Sunbury, Ashland, Mahanoy City, Tamaqua, Allentown and Easton. Preliminary work will be begun this fall on the line to New York, and actual grading will begin in the spring. The line west will be started as soon as the Pittsburg-New York line is completed. The surveys west are not final, and the promoters expect to lower the grade further and to shorten the distance before the road is laid out. The road to New York has been surveyed three times. Rights in the state will be got by merging the Indiana, Clearfield & Easton, the Allentown, Tamaqua & Ashland, and the Brush Creek & Crows Run Railroads. The foreign syndicate will build the road and turn it over completed to the New York, Pittsburg & Chicago Air Line, which will be capitalized at first at $1,000,000. The route west of Pennsylvania is to be kept secret, but it is stated positively that the Lorain, Ashtabula & Southern Railroad, which is now nearing completion, will be one of the many feeders in the West. Joseph Ramsey, who was in New York last week, has made the following statement relative to the new project: "We expect to make a start this fall and begin work next spring, hoping to complete the line between Pittsburg and New York within three years. The cost of the line between Pittsburg and New York is estimated at between $75,000,000 and $100,000,000, all of which has been pledged, the bulk of it by foreign capitalists. It would not be wise for me to give details or names now. The line is not merely a preliminary survey, but a final location that has been revised three times. Three corps of engineers have been busy for three years. It is the best possible short low-grade line to be had through Pennsylvania between Pittsburg and New York. The extension of the road west to Chicago from Pittsburg will be taken up when the line east to New York is completed."

NEW PUBLICATION.

THE ENGINEERS' CLUB OF PHILADELPHIA—The July number of the proceedings of the Engineers' Club of Philadelphia contains an article by Edwin A. Moore entitled "By-Product Coke Ovens," an article by Harrison W. Latta entitled "New Sea Wall at Annapolis," and an article by D. Robert Yarnall entitled "Garbage Disposal by Reduction." In addition to this material there are abstracts of the minutes of the club and the minutes of the board of directors, the additions to the general library, and two very interesting memoirs to Herman Haupt and Max Livingston.

NEW MANUFACTURING COMPANY.

PITTSBURG, PA.—A new $10,000 stock company known as the Pittsburg Electric Sign Company, with headquarters at 220 Collins avenue, secured a charter at Wilmington, Del., which also covers electrical manufacturing and the company will erect electric signs, heating appliances and irons. The new company willl make a specialty of arranging special lighting effects for socials, weddings, banquets, lawn fetes and church affairs. The officers and incorporators are: F. M. Kattenstroth, president; C. H. Brown, treasurer; Robert F. Miller, secretary, and E. E. Parsons, general manager.

LEGAL NOTE.

SUSPENDED SWITCH CASE—In the case of the Thomson-Houston Company, complainant, *versus* Sunday Creek Company, defendant, an opinion was filed on August 1, 1906, in the United States Circuit Court, District of New Jersey, by Joseph Cross, district judge, granting a preliminary injunction. The patent involved is the Van Depoele patent No. 424,695.

Digitized by Google

TELEPHONE AND TELEGRAPH.

PLAINVILLE, KAN.—The Plainville telephone system, established in 1901 by C. N. Gordman, is being entirely rebuilt.

WARREN, N. H.—The Bakers River Telephone Company at a recent meeting voted to increase its capital stock to $8,000.

ALLENSVILLE, KY.—The Todd County Home Telephone Company has been organized with $35,000 capital. Exchanges will be built at once in Elkton, Trenton and Allensville, Ky. Ben Petrie is president of the company, and it will be represented at Allensville by B. C. Carvell.

ROMEO, MICH.—The Home Telephone Company, of Romeo, organized in 1901 by ex-Postmaster James B. Lucas, has been purchased by the Michigan Telephone Company. The plant has not been in operation since 1904, owing to lack of patronage and the inability of the owners to get Detroit connections.

PHILADELPHIA, PA.—The Keystone Telephone Company is increasing the capacity of its main central station to its full capacity of 7,200 lines. This has been made necessary by the addition of subscribers and increased business from long-distance lines recently absorbed by the company.

RAVENA, N. Y.—The representatives of the Home Telephone Company have been securing contracts and about fifty telephones have been installed and a thoroughly up-to-date central office has been established. The company asserts that it will give an efficient service at all hours of the day and night.

FOXCROFT, ME.—Poles for an independent farmers' telephone line between Foxcroft and the neighborhood of McNaughton's in Sebec have been set and wires will soon be strung. There are fourteen subscribers there. There are now 100 lines verging from the central office; the number of patrons is 384.

SPOKANE, WASH.—Not satisfied with the prices charged by the through lines, the Farmers' Mutual Telephone Company has been organized at Granger, Wash., with a capital of $50,000, and it is announced that connections will be made with the Spokane Home Telephone Company's lines. Work is to begin in two weeks.

SPOKANE, WASH.—Negotiations are making by the completion of which the Pacific States Telephone Company will gain control of all the territory in the Palouse country, south of Spokane. The company has made offers in various towns in the district to cut the present rate of $18 a year to $1 and put in the instruments at actual cost.

SPOKANE, WASH.—Farmers at Rock Island, west of Spokane, are organizing a mutual company to run a telephone line from that city to Wenatchee and to Badger Mountain, connecting also with Waterville, giving it connection with every town in the Wenatchee valley. It is purposed to extend the line into the Big Bend country before the end of the year.

SPOKANE, WASH.—The Kerr-Gifford Grain Company is installing a line from Walla Walla to Spofford, south of Spokane, and it is announced that four other farmer lines are building into the first-named city to make connections with the Pacific States system, which has also just taken over the rural lines at Milton, Wash., where a night service is to be added.

SPOKANE, WASH.—H. W. Kent, of Vancouver, secretary of the British Columbia Telephone Company, Limited, has announced that the central offices at Greenwood and Grand Forks will be rebuilt at a cost of $25,000, also that the company will extend a line direct from the boundary to Rossland, thus eliminating the detour into the state of Washington *via* Bossburg and Northport, as at present.

MARYSVILLE, CAL.—The telephone franchise asked for by F. W. Anderson, of Wheatland, for his farmers' line has been bid in by Attorney E. B. Stanwood, it being the general supposition that he acted for the Sunset company. Attorney E. T. Manwell, representing the independent concern, gave notice that he will at the next meeting of the supervisors again apply for a franchise.

SUTTON, MASS.—The selectmen have granted a franchise to the New England Telephone and Telegraph Company to erect poles and string wires for private telephones to a number of residences. It is expected that the telephone company will put in a telephone for the use of the town, and the location, instead of being at the town hall, will either be at the home of the chairman of the selectmen, Tyler Stockwell, or at the office of the town clerk, Henry C. Batcheller. This telephone will be put in without any expense to the town.

SPOKANE, WASH.—Three million dollars is the extent of the trust deed filed in Spokane county by the Home Telephone and Telegraph Company, of Spokane, in favor of the Title Insurance and Trust Company, of Los Angeles, Cal., the document being signed by Charles E. Sumner, president. It covers in blanket all the real and personal property, franchises, lines and extensions owned by the company. The company has bought a site for $25,000 in the business district, and it is announced a $60,000 office building will be erected the coming fall. The company will operate the automatic system, for which it has already signed 5,000 contracts in Spokane.

HOUSTON, TEX.—Papers of incorporation have been filed in Austin and a charter asked for the Southern Telegraph and Telephone Company, with a capital stock of $100,000. The headquarters of the new company will be Houston, the directors being George W. Burkitt, Louis J. Barnes, J. M. Reagan, Edward Kennedy and A. S. Fisher. It is stated that everything was in shape to begin the construction of the line at an early date. It will be a long-distance throughout the southern portion of the state, with local exchanges in the towns through which it will run, such as Richmond, Rosenberg, Wharton, Victoria, Yoakum and other places. It will run through the following counties: Harris, Galveston, Fort Bend, Wharton, Matagorda, Colorado, Austin, Brazoria, Waller, De Witt, Lavaca, Bee, Victoria, Jackson, Goliad, Gonzales, Nueces, Wilson and Bexar. The line will connect in San Antonio with the Citizens' company lines.

MEADVILLE, PA.—The Central District and Printing Telegraph Company has concluded a contract with the Crawford Telephone Company, a regularly incorporated concern, by which the latter becomes a sublicensee under the Central District and Printing Telegraph Company. There has been quite a contest for this business between the independent telephone people, operating the Eastern Crawford Telephone Company, and the Bell interests, for the contract with the Crawford Telephone Company. The Crawford Telephone Company is composed of a number of persons in Guys Mills, Townville and vicinity, who formed a company some time ago and who already have ten miles of line built. They propose to extend this line to make about fifty miles in all. At present it will serve Guys Mills, Lyona and Towneville and intermediate territory, and from the present indications have about seventy-five subscribers. The extension of the line when made will include Black Ash, Sugar Lake, New Richmond, Little Cooley and other points. The officers of the Crawford Telephone Company are: F. C. Bannister, of Guys Mills, president; W. C. Parker, of Randolph, secretary; Willis Waid, of Guys Mills, treasurer, E. C. Utley, of Randolph, general manager.

SOUTH BEND, IND.—By the recent action of the holders of four-fifths of the capital stock of $200,000 of the South Bend Home Telephone Company's independent plant, this property will soon pass to the possession of Joseph Harris, vice-president of the Automatic Electric Company, of Chicago, at $25 a share. This stock was bonus given with bonds to the original builders, and the consideration is therefore "velvet," as the builders hold the bonds to the value of $350,000 sixes, which sell above par. The buyers agree to assume the floating debt of $60,000 and invest $100,000 in the plant within twenty months in order to sustain security for the bonds. They gave a bond of $75,000 to perform the contract. The exchange includes substations at South Bend, Mishawaka, New Carlisle, Granger, River Park and Lapaz, including 800 farmer telephones and 200 miles of wire. The first result of the sale, it is declared, will be a toll line connection with Chicago, giving that city its first independent toll line service. South Bend will be made a distributing point for the independent toll lines in Indiana, Michigan and eastern points. The deal was effected through President Theodore Thorward, who will be retained as manager. The plant was built four years ago, and besides earning money for extensions it has paid interest on bonds and one per cent semi-annually on stock, but the local telephone investors, who built it over the opposition of South Bend's millionaires, faced the necessity of investing another $100,000 to meet the demands for new instruments and shaved their profit to escape further liability. The sale of the property involves the expenditure by the new owners of $500,000.

Digitized by Google

ELECTRIC RAILWAYS.

SEATTLE, WASH.—An electric railroad is to be built from Ketchikaw, Alaska, to Unuk River next year by the Unuk River Mining and Smelting Company. J. W. Daly is manager of the company.

AUGUSTA, GA.—The city council has given to the Anthony Shoals Power Company the right to use the streets of the city for its lines for a period of thirty years. The company is to pay the city one per cent on the gross earnings.

SUMMIT, N. J.—The city council has granted to the Morris County Traction Company a thirty-year franchise for a trolley road through the city. Under the present laws the question must be placed before the people at a special election and the ordinance ratified before it can become effective. Such an election can not now be held before December.

PITTSBURG, PA.—Edwin K. Morse, Harrison M. Williamson, Coleman E. Andel, Horace F. Baker and Martin Marshall have made application for charters for two corporations to be known as the Rebecca Street Railway Company and the Lawrenceville Street Railway Company, which are to be formed in connection with the Pittsburg Subway Company.

CARBONDALE, ILL.—Citizens of Carbondale are being urged to subscribe $1,500 as part of a $4,000 fund to be raised by Carbondale, Carterville, Murphysboro, Herrin and Johnson City, to be expended in making a preliminary survey for an electric road to run through all these towns. The sum of $4,000 is to be expended in a preliminary survey and to learn what the probable revenue for such a line would be. It is understood, of course, that the contributors shall have shares in the railroad in case it is built.

SPRINGFIELD, MASS.—Two petitions have been filed with the state railroad commissioners at Boston by the Springfield & Eastern Railway Company. If granted they will mean the connection of the road with the Worcester & Southbridge Street Railway Company, completing the link between Worcester and Springfield, and shorten the running time between the two cities. One petition asks the approval of the location granted by the Brimfield selectmen and the other asks the approval of the location granted in Monson.

RICHMOND, IND.—Charles L. Henry, receiver for the Indianapolis & Cincinnati Traction Company, has been authorized by the court to proceed with the construction and equipment of the Rushville-Connersville and the Shelbyville-Greensburg extensions. For this purpose an order was made for the issue of receiver's certificates to the amount of $900,000. These certificates will bear interest at the rate of six per cent, and will fall due August 1, 1907. It has been decided to build the extension of the Muncie & Portland Traction line from Portland to Celine, Ohio, and work is expected to begin soon.

NEWTOWN, PA.—The Newtown Electric Street Railway, a trolley line of fourteen miles, operated between Doylestown and Newtown by the Newtown Electric Street Railway Company, with certain rights on the Newtown, Langhorne & Bristol trolley lines, was sold at public sale to-day by Sheriff Albert S. Paxon on an execution for $650 issued by James and Mary Murphy, of Morrisville, who some time ago obtained a judgment in the Court of Common Pleas for damages sustained by the latter in being thrown down in a car at Hulmesville about three years ago. H. E. Woodman, president of the Union Railway Supplies Company, was the purchaser at $1,010.

JENNINGS, MO.—An application for a franchise to construct a double-track electric railway from the city limits of St. Louis and the Hall's Ferry road to Jennings has been made by the North St. Louis & Suburban Railway Company, of which James Scullin is the head. The company was recently granted permission by the city to build from the Broadway line to the city limits. It was stated that the present intention is to build only to Jennings, but later to extend the line to Ferguson and Florisant. The Florisant Valley Street Railway Company recently secured a franchise from the county court to construct a road from the city limits over practically the same route. It was granted, however, on condition that the company secure a franchise in St. Louis to connect with some line of street cars down-town.

ELECTRIC LIGHTING.

LEADVILLE, COL.—A franchise has been granted to Walter W. Davis to construct and operate an electric power plant and system.

GLENS FALLS, N. Y.—The franchise of the Hudson River Electric Company to operate in the village of Glens Falls has been extended for a year.

UTICA, N. Y.—The statement of the Hudson River Electric Power Company for June, 1906, shows gross earnings of $69,147.35, an increase over the same month of the previous year of 27.94 per cent. The operating expenses were $40,186.43, and the net earnings were $28,960.92.

SPRINGFIELD, MO.—Dr. B. E. Joseph has a charter granted under the laws of Arkansas to establish a power plant on the White river in Boone county, Ark. It is thought that several Springfield people will be interested in the scheme, which purposes the development of possibly 10,000 horse-power for distribution in both states.

MADISONVILLE, KY.—At a recent meeting of the city council, ordinances were passed requiring the Bailey Light and Water Company to remove all poles, wires, etc., from the streets and alleys of the city on or before September 2. An ordinance was also passed revoking any agreement with the company for the lighting of the streets of the city.

CHESTER, PA.—Capitalists, represented by John L. Garrett, a local attorney, desire to erect a $100,000 electric light plant in this city, and in a proposition to the light committee of councils they offer to turn the plant over to the city at the expiration of ten years. The Beacon Light Company, a private corporation, now has the contract for lighting the city.

HENRICO, VA.—By a unanimous vote the Henrico county board of commissioners have formally refused the application of the Passenger and Power Company for the rights of way in Highland Park and Chestnut Hill and other privileges necessary to the installation of an electric lighting system. The commissioners decided that the concessions asked by the company were unreasonable and excessive.

DURANGO, COL.—Durango taxpayers have voted to grant an electric light franchise to Tom Loftus and partners. The vote was 240 for and ten against. The new company proposes to erect a $25,000 plant. They have located a reservoir site four miles from town, from which they will obtain water power. The reservoir will be filled from Junction and Hermosa creeks. The new company promises to furnish light much cheaper than the old company.

STILL RIVER, MASS.—Indications now point strongly that the Boston Light, Heat and Power Company is planning to put its consolidated power plant on land now owned by Herbert W. Atherton, between the Boston & Maine Railroad and the Nashua river, on the west side of the railroad. Some time ago the company bought the land owned by the Union Paving Company, Worcester, but as this contained but half an acre, they needed more, and have been trying to get Mr. Atherton to sell the land adjoining.

COLUMBUS, OHIO—The Little Miami Light, Heat and Power Company, which was incorporated at Columbus recently, with a capital of $10,000, will utilize the water power of the Little Miami river by constructing a series of dams between the junction of the Little Miami and Morrow and placing a power-house at each dam. It is proposed to supply the following towns with current: Morrow, Lebanon, South Lebanon, Kings Mills, Hopkinsville, Foster's Crossing, Miamiville, Mason, Epworth Heights, Branch Hill, Camp Denison, Milford, Terrace Park, Plainville, Batavia and numerous other smaller towns which lie close along the shores of the Miami.

CANON CITY, COL.—The Colorado Light and Power Company has acquired a controlling interest in the La Bella Mill, Water and Power Company of Goldfield, which for several years has been one of the largest distributors of electric power in the Cripple Creek district supplying much of the motive force used in mining operations and for lighting purposes in Cripple Creek, Victor and surrounding towns. The absorption of the La Bella plant by the Colorado Light and Power Company will give that company a dominating influence in the electrical business of the district and will necessitate an enlargement of the Canon City plant to double its present capacity, rendering it one of the largest concerns of its character in the state. The local plant has a capacity of 2,000 horse-power, but this will be doubled in order to meet the needs of its wider field of operations.

Digitized by Google

PERSONAL MENTION.

MR. ELMER E. DAICY, of Auburn, Me., has been elected treasurer of the Maine Independent Telephone Association. Mr. Daicy is manager of the Lewiston & Auburn Telephone Company.

MR. FREDERICH SONNENSCHEIN, who has had charge of the West Point exchange of the Nebraska Telephone Company since its inception, has been succeeded by Mr. William Busch, of Omaha.

MR. WILLIAM MARCONI, it is announced, has joined the experimental staff of the Columbia Phonograph Company. His inventions in the talking machine art will be the property of the company.

MR. A. P. MULVEY, formerly with the Davis Electric Manufacturing Company, Springfield, Mass., is now associated with the H. Krantz Manufacturing Company, Brooklyn, N. Y., manufacturer of switchboards, switches, panel-boards and outlet boxes.

MR. RALPH W. POPE, secretary of the American Institute of Electrical Engineers, arrived at Montreal, August 11, on the turbine steamer Victoria of the Allan line. He has resumed his duties at 95 Liberty street, New York, after an absence of two months in England and Scotland.

MR. WILLIAM J. BARKER, who for the past twenty-five years has been in the operating department of the Denver Gas and Electric Company, Denver, Col., will retire on September 1 to assume the post of executive operating manager of the Northern Colorado Power Company. Mr. Barker will superintend the construction of the Northern Colorado Power Company's plant at Boulder.

MR. NICHOLAS F. BRADY, vice-president of the New York Edison Company, was married by Bishop Tierney in St. Joseph's Cathedral, Hartford, Ct., on the morning of August 11, to Miss Genevieve F. Garvan, daughter of former State Senator Patrick Garvan, and a sister of Assistant District-Attorney Garvan, of New York city. Many New York and Albany guests were present. Mr. and Mrs. Brady will tour Europe in an automobile, returning to New York in December.

OBITUARY NOTICE.

MR. E. B. C. HAMBLEY, vice-president and general manager of the Whitney Company, which is planning the extensive development on the Yadkin river in North Carolina, died on August 14 at Salisbury, N. C.

NEW INCORPORATIONS.

PIERRE, S. D.—South Dakota Union Telephone Company, Northville. $50,000.

MILLBURY, MASS.—Millbury Electric Company. $53,080.75. President, C. W. Mood; treasurer, Herbert A. Ryan.

JULIAN, NEB.—Farmers and Merchants' Mutual. $5,000. George F. Conlon, James Lockwood, C. L. Misnet, E. C. Ferguson and H. A. Hauptman.

OTTERBEIN, IND.—Lafayette & Hoopestown Interurban Railway. $10,000. Incorporators: Isaac E. Switzen, W. Walsh and Elmer Hawkins.

BOSTON, MASS.—Boston & Eastern Electric Railroad Company. Twenty miles, with a main line from Beverley to Sullivan Square, and a branch to Peabody and Danvers. $250,000.

DALLAS, TEX.—The Dallas Light and Equipment Company. $100,000. Incorporators: T. L. Camp, J. B. Nabors, C. E. Bird, J. A. Barnhard, of Dallas, and A. P. McArthur, of New York city.

DE KALB, ILL.—De Kalb Fuel, Light and Power Company. To construct, equip, operate and promote street and interurban railways. $100,000. J. Ross McCulloch, Olaf N. Guildlin and Charles H. Printz.

HARRISBURG, PA.—Brady's Bend & Butler Street Railway Company. To build a line from Brady's Bend through Kayler and Chicora to Butler. Incorporators: W. J. Horgan, E. W. Dewey, William Criswell, John Dady and W. G. Stern.

DES MOINES, IOWA—Boone, Webster City & Fort Dodge Interurban Railway Company. Incorporators: John C. Regan, of Des Moines; E. E. Hughes, John S. Crooks, J. H. Herman, M. J. Railly, T. L. Jones and John L. Gaephinger, of Boone; Frank A. Sackett, of Webster City. Officers: president, E. E. Hughes; vice-president, John C. Regan; secretary, John S. Crooks; treasurer, J. H. Herman.

ELECTRICAL SECURITIES.

The stock market early in the week entered upon a session of fluctuations, the like of which has not been witnessed for some time. The sensational announcement of the advances in the dividends on the Union Pacific and Southern Pacific stocks created almost panicky conditions. Along with the selling movement which this announcement caused, a great many other stocks took part in a sharp rally. However, at the end of the week a number of the leading stocks had fallen off, declining to practically the same level as existed a week previous. Concerning the general state of trade, the iron and steel industries show no evidence of abatement in activity. Railroad earnings are showing weekly increases of 13 or 14 per cent for gross, and it is stated that the net gains for the first half of the year amount to between 23 and 28 per cent. The announcements concerning the Ramsey air line between New York and Chicago were received in the financial community with more or less skepticism. It is thought that the $150,000,000 which it is announced is available would not more than buy the terminal facilities, if that amount really could accomplish so much. The engineering and rolling stock would necessitate an investment which would multiply many times that amount of money.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 18.

New York:	*Closing.*
Allis-Chalmers common	18
Allis-Chalmers preferred	48½
Brooklyn Rapid Transit	78
Consolidated Gas	139⅞
General Electric	170⅜
Interborough-Metropolitan common	37½
Interborough-Metropolitan preferred	78½
Kings County Electric	155
Mackay Companies (Postal Telegraph and Cables) common	73⅞
Mackay Companies (Postal Telegraph and Cables) preferred	72⅞
Manhattan Elevated	149¾
Metropolitan Street Railway	106
New York & New Jersey Telephone	127½
Western Union	92¼
Westinghouse Manufacturing Company	155

The Consolidated Gas Company has declared a regular quarterly dividend of 1 per cent, payable September 15.

The Brooklyn Heights and the Nassau Electric, the two principal operating companies of the Brooklyn Rapid Transit Company, have filed at Albany their income accounts for all the four quarters of the fiscal year to June 30. The former shows a gain for the year of $1,397,594 in gross earnings. Together they show a gain of $1,880,434 in gross and $1,233,380 in net.

Boston:	*Closing.*
American Telephone and Telegraph	133½
Edison Electric Illuminating	237
Massachusetts Electric	70
New England Telephone	131½
Western Telephone and Telegraph preferred	85

The instrument statement of the American Telephone and Telegraph Company for July is as follows: gross output, 227,755; returned, 70,757; net output, 156,998. For the seven months of the current fiscal year the net output has been 960,520. The total number now outstanding is 6,658.778.

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	74
Electric Storage Battery preferred	74
Philadelphia Electric	8⅜
Philadelphia Rapid Transit	30¼
United Gas Improvement	88
Chicago:	*Closing.*
Chicago Telephone	119
Chicago Edison Light	137
Metropolitan Elevated preferred	67
National Carbon common	86½
National Carbon preferred	119½
Union Traction common	4
Union Traction preferred	14

Digitized by Google

INDUSTRIAL ITEMS.

MR. H. DENNER, Apartado 63, Mexico City, Mexico, is looking for manufacturers who desire representation in Mexico.

THE C. W. HUNT COMPANY, West New Brighton, Staten Island, N. Y., has published a new bulletin descriptive of Hunt industrial railways. This will be mailed to any one interested upon request.

THE CAMBRIDGE SCIENTIFIC INSTRUMENT COMPANY, LIMITED, Cambridge, England, has issued catalogue No. 39, illustrating and describing instruments and apparatus used in technical thermometry.

THE HOMER W. HEDGE COMPANY, New York, N. Y., announces that Walter W. Griffith, for the past five years eastern manager for Lord & Thomas, Chicago, Ill., has associated himself with the company.

THE AITON MACHINE COMPANY, New York, N. Y., announces the following changes in the names of the officials of the company: president, Arthur S. Beves; vice-president, Thomas A. Aiton; secretary, John S. Showell.

THE AJAX LINE MATERIAL COMPANY, Chicago, Ill., announces a new line of mast arms, to be ready about September 15, in lengths ranging from six to twenty feet overhang, all fitted with a new type of safety pulley.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., in bulletin No. 34 describes and illustrates plug cutouts, panel cutouts for rotary switches, tablets and attachment plugs. This literature will be sent to any one interested upon request.

H. M. BYLLESBY & COMPANY, INCORPORATED, engineers, Chicago, have been appointed engineers and managers of the Mobile Electric Company, of Mobile, Ala. A new modern power-house will be erected immediately and the lines of the company extended and rebuilt.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, has issued a new catalogue descriptive of insulation of underground pipes conveying steam and hot water by the Portland conduit system. This system consists of the sectional installation of conduit sections supported upon specially adapted frames.

THE H. KRANTZ MANUFACTURING COMPANY, 160-166 Seventh street, Brooklyn, N. Y., has ready for distribution bulletin No. 18. This describes and illustrates type "H. K." knife switches for all circuits, fuse blocks, triple-throw switches and other electrical specialties.

GEORGE P. HUTCHINS, 120 Liberty street, New York city, has been appointed advertising agent for the Illuminating Engineering Society. The monthly proceedings of the society will carry a limited amount of advertising bearing directly and exclusively upon problems of scientific illumination.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., announces the sale of a complete automatic telephone exchange of 2,600 lines, for immediate installation, to the Richmond Home Telephone Company, Richmond, Ind. The automatic equipment will replace the manual apparatus now in use by the Richmond company.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Port Byron, N. Y.; Shickshinny, Pa.; Packwaukee, Wis.; Knoxville, Tenn.; Port Williams, Wash.; Waterport, N. Y.; Sioux City, Iowa; St. Marys, W. Va.; Shell Mound, Tenn.; Bridgeport, Minn.; Kentwood, La.; Palouse, Wash.

THE DEVEAU TELEPHONE MANUFACTURING COMPANY, New York, N. Y., has issued another of its unique little folders on the advantages of the DeVeau type of intercommunicating telephone. This company has developed this apparatus to such a point that it is practically perfect in all its operations, and is so constructed that it is most permanent for the service and artistic in design.

THE CRESCENT COMPANY, Valparaiso, Ind., has recently purchased the machinery and business of the P. R. Wagor Company, Springfield, Mass., and has moved the machinery to Valparaiso, Ind., and is now manufacturing the Wagor company's well-known line of protector lamp guards. The company has recently published a circular describing this line of guards. The literature and full information will be furnished upon request.

THE GOULD STORAGE BATTERY COMPANY, New York, N. Y., has ready for distribution a new booklet descriptive of Gould telephone batteries. After September 1 the company will have permanent San Francisco, Cal., headquarters in the restored Monadnock Building. Previous to the earthquake and fire the company had offices in the Crossley Building which was destroyed, while for the last four months temporary offices at 1701 Geary street have been occupied.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is calling attention to the features of type M and type MH transformers with an attractive mailing folder. Bulletin No. 72 gives more complete information concerning the apparatus. Type M transformers are designed for heavy continuous service, for combined motor and lighting duty. Type MH transformers are designed for lighting duty. Both of these are of an improved type of shell construction.

THE BALL ENGINE COMPANY, Erie, Pa., reports a very brisk demand for the Corliss four-valve type of engine. Among the recent orders are the following: one 700-horse-power cross-compound for the city of Aurora, Ill.; one 800-horse-power cross-compound for the National Tube Company, Pittsburg, Pa.; two 700-horse-power cross-compound for the Duluth & Iron Range Railway, Duluth, Minn.; one 600-horse-power cross-compound for the Flint Light and Power Company, Flint, Mich.; one 700-horse-power cross-compound for the Pennsylvania Railroad Company, Altoona, Pa.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, has struck a unique method of calling attention to its type U controllers. The company is sending out a handsomely printed booklet showing forth some of the features of this apparatus, and an addressed postal card calling for bulletin No. 102. The new catalogues which this company has prepared describing the "Dinkey" ventilated controllers and type U controllers are very complete and well worth any trouble it might take to secure them. The company will be pleased to send full information to any one who may have been missed in the distribution of the company's most recent advertising literature.

THE GENERAL RAILWAY SIGNAL COMPANY, New York city, has been awarded the contract for the complete automatic block signaling system for the Nankai Railway Company, Japan. This is the first high-speed railway in Japan to be electrified. The signal system to be installed is known as the "Young" system, and is the same as is being installed by the company for the electric zone of the New York Central & Hudson River Railroad Company, the New York, New Haven & Hartford Railroad and other high-speed lines. The Nankai railway will be a direct-current proposition. The track circuits for controlling the signals will be operated by alternating current supplied from a special single-phase transmission line. The signal line will be supplied from steam-driven, alternating-current generators delivering 2,200 volts at sixty cycles. The blocks will average about a half-mile in length. Each block will be provided with a home and distant signal. The signals will be operated by alternating-current motors taking current from the special signal line. Transformers stepping down from 2,200 to fifty volts will be employed. The lamps and the signals will also be served from the same transformers. The two-rail system will be used. Both of the traffic rails will be used for the return of the propulsion current. This is accomplished by the use of reactance bonds, which, while maintaining the requisite difference of alternating-current potentials between the rails, freely permit the passage of the direct propulsion current. The entire contract for the equipment of the road has been awarded to Takata & Company.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 9. NEW YORK, SATURDAY, SEPTEMBER 1, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Manhattan Bldg., Chicago, Ill., L. W. MARSHALL, Manager
BOSTON OFFICE: Delta Bldg., 10 Post Office Square, M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad St., London, E. C., HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.
Copyright, 1906, by Electrical Review Publishing Co.
Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

CONTENTS.

EDITORIAL:
Electrical Means of Measurement ... 313
Ohio Electric Light Association Convention ... 313
Educating the Public in Science ... 314
A Condemnation of the Electric Drill ... 315
Ohio Electric Light Association ... 316
Electric Power to Rid London of Smoke ... 325
A Visit to the Power-Houses of the Brooklyn Edison Electric Illuminating Company ... 326
The Convention of the Association of Edison Illuminating Companies ... 327
The Convention of the American Street and Interurban Railway Association ... 328
New York, New Haven & Hartford Railroad Trolleys Sold ... 328
A New Ozone Water-Sterilizing Equipment ... 329
International Association of Municipal Electricians ... 331
Telephones in Japan ... 332
The Committee on Standard Rules of the American Street and Interurban Railway Association ... 332
ELECTRICAL PATENTS ... 333
A Low-Resistance Glass ... 333
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE ... 334
Society to Abate Smoke ... 335
METHODS OF GETTING NEW BUSINESS—"Organization and Conduct of a New-Business Department Suitable for Central Stations in Cities of 50,000 Population and Under," by J. M. Robb ... 336
INDUSTRIAL SECTION:
Polyphase Revolving-Field Engine-Type Generators ... 340
A Voltage Regulator for Both Alternating and Direct-Current Systems ... 341
Commutating-Pole Variable-Speed Motors ... 342
A Rythmic Regulating Socket Plug for Fan Motors ... 343
The "Peerless" Switch ... 343
A New Company to Manufacture Incandescent Lamps ... 343
An Interesting Suggestion for the Electrical Contractor ... 343
New System of Railway Signaling ... 343
CURRENT ELECTRICAL NEWS ... 344

ELECTRICAL MEANS OF MEASUREMENT.

Attention has been called upon many occasions to the powerful tool which electrical methods of measuring put into the hands of workers in their fields. For example; possibly the most important advance of recent times in furnace operations has been the adaptation of electrical methods of temperature measurement. Heretofore, the temperature of a furnace has been determined by guess and satisfactory working has been dependent to a large degree upon the experience of the man in charge. Now, while the value of experience has not been in any way diminished, electrical pyrometry has made possible accurate temperature determination and control. Only recently was noted the employment of an electrical method in another art, that of testing materials, which promises to be of great importance. Not infrequently other new uses are pointed out.

There are several reasons for this. One is the highly developed state of the art of electrical measurement. This started first with the physicist and then has been followed up by the engineer, who was forced to it since the commodity in which he deals is unweighable and invisible, and he was forced to develop satisfactory measuring apparatus. Later he became aware of the great importance of the accuracy of his instruments and this carried the art to a high degree of perfection, and has not been without influence on methods of measurements used in other branches of science and engineering, even when the measurements are made by other means.

Another reason for the increasing use of electrical means for measurement is the exceeding sensitiveness of certain of these means. For example, the spectroscope is frequently referred to as the most sensitive scientific instrument. By means of it, the chemist can detect the presence of elements in quantities far too small to be weighed, but a delicate electroscope may be several hundred thousand times more sensitive than the spectroscope, and besides this, it is a quantitative instrument, while the spectroscope is only qualitative.

But one feature of electrical methods of measuring which will surely have great influence in extending them is the fact that the effect to be measured may be produced at one point and measured accurately and conveniently at another. The effect on a thermocouple placed in a furnace is measured by a galvanometer set off at a distance. The lengthening of a sample of metal under test is determined by measuring its resistance by an instrument placed where it is out of the way and unaffected by any happening at the testing machine. The speed and even the acceleration of a railway car are read directly without necessitating the use of a watch by an observer seated comfortably at a table in the car itself. This feature, the ease with which the action to be observed can be made to produce an effect some distance away, is one which is sure to lead to a wide extension of electrical methods of measuring into many new fields.

OHIO ELECTRIC LIGHT ASSOCIATION CONVENTION.

The twelfth annual convention of the Ohio Electric Light Association, held last week at the Hotel Victory, Put-in-Bay, was notable in several respects. Primarily, it showed the healthy condition of central station growth throughout Ohio and the loyal and active interest which the central station representatives are taking in their organization. The Ohio Electric Light Association is supported by a very fair proportion of all the central stations throughout the state. Out of some sixty central

Digitized by Google

stations affiliating with the association, there were representatives from forty odd central stations. The interest manifested in the reading of the papers and in the discussion was proof against the distressing hot-weather conditions which prevailed during the three days of the meeting. Outside of the weather, however, the other features were, on the whole, satisfactory. In fact, the island appears to be an almost ideal place for a convention of this nature. There was a fraternizing of the central station men that could hardly obtain in a large city, where other attractions would be such as to divert attention from the business and executive sessions, and invite the scattering of the delegates. The presence of a large number of ladies, and the generosity of the manufacturers in making available a number of valuable trophies, lent a grace and charm to the meeting which helped markedly toward its success.

As usual, the list of papers presented was considerably above the average, and it is to be regretted that space can not be given to a more complete presentation of the subjects under discussion. The symposium upon the subject, "High-Efficiency Lighting Units in Ohio," brought out a valuable lot of information and showed that the Ohio central stations are on the firing line in introducing these units. The paper by F. W. Willcox, on "New Lamps and New Opportunities," was well received, the departure in the form of the illustrations creating considerable amusement, and, it seems, not in any way detracting from the ethical and technical value of the treatise. The discussion following the reading of the papers on the new high-efficiency units and upon the Nernst lamps clearly indicated the closeness of the competition in the lighting field. The nip-and-tuck debate of the representatives of the manufacturing companies, and the informal discussion which took place beyond the confines of the assembly room opened up a mine of information which was just what the central station manager was looking for.

An important feature of the programme was the presentation of papers dealing with the commercial side of central station development. This feature is becoming of greater importance and more time is being given to its deliberation. The papers presented at this session were very helpful, and clearly indicated the awakening which is taking place throughout the entire country in the direction of stimulating the demand for current and in creating an interest in the subject of electrical supply. For the Cooperative Electrical Development Association, Mr. J. Robert Crouse addressed the convention, outlining the comprehensive plans of this organization and giving an idea concerning the work which had already been accomplished. Considerable interest was manifested in Mr. Crouse's remarks, and the Ohio men apparently are enthusiastic over the possibilities of this enterprise.

EDUCATING THE PUBLIC IN SCIENCE.

An appetite on the part of the reading public for scientific stories is a healthy sign, for just as industrial progress, and therefore civilization, are dependent upon scientific advance and application, so is science itself dependent upon public sympathy for its support. The prosperity of a country depends, to a considerable degree, upon its keeping in the front rank of scientific advance, and also upon the degree to which it adopts scientific methods in all its work. To interest the public in science and to assist in spreading scientific knowledge accomplishes a double result, for, by encouraging the use of scientific methods, it increases present prosperity, and, by encouraging scientific research, it provides for the future. The rapid rise of Germany in the industrial world is largely to be attributed to her devotion to science, pure and applied. On the other hand, while England does not yield to any other country, as far as pure science is concerned, we have heard of late a great deal about her backwardness in making use of the knowledge which she and others have acquired. Only last fall was an association formed, known as the British Science Guild, the object of which is to popularize science; to make the average Englishman see how important it is that he adopt scientific methods; to show him how beneficial it will be for his pocket, and to warn him that only in this way can he hope to maintain a leading place in the world. Still more recently the matter was brought up in two addresses before the British Association. The president, E. R. Lankester, in the annual address, said that it is unfortunately true that successful political administrators of the affairs of England, as well as permanent officials, are altogether unaware to-day, as they were twenty-five years ago, of the vital importance of that knowledge called science, and of the urgent need for making use of it in a variety of public affairs. Whole departments of governments in which scientific knowledge is the one thing needful are carried on by men wholly ignorant of science. The only remedy which he could see for this unfortunate condition is in improving education for the upper classes, and a continued effort to spread a knowledge of the result of science and a love for it among all members of the community. He pointed to the not infrequent dedication of large sums of money in the United States as a solid test of the esteem and value attached to scientific progress in this country.

Dr. E. H. Griffiths, president of the mathematical and physical section of the association, also touched upon this subject. He believes, however, that the fault is not entirely with the British manufacturers, so far as the application of scientific methods is concerned, but thinks that the greatest need there is for missionaries to preach the doctrine that one of the greatest national assets is scientific discovery. Dr. Griffiths deprecated also the decreasing interest in science evidenced by the British layman. Sports of various kinds seem to occupy to-day the time which twenty-five years ago was given to study and investigation. This condition may be due partly to the excitement furnished by certain of the new amusements, but he thinks that a large part of it must be attributed to the system of education in vogue. It is impossible to-day for any individual to have more than a superficial knowledge of general science, for facts have accumulated so rapidly that science must be divided into many sections, and these sections subdivided, if a satisfactory study is to be made. Moreover, this rapid accumulation of knowledge is having a detrimental effect in another way, for the student of science is attracted by the novelty of recent work and gives his

Digitized by Google

time to reading about new investigations, when he should be studying the underlying principles. One, for example, will discourse fluently upon the mass of an electron and the nature of Roentgen rays, without being able to give satisfactory illustrations of Newton's laws. He shows familiarity with the recent developments, but a lamentable ignorance of the simple phenomena and principles they illustrate.

While possibly the conditions in this country are more satisfactory than in England, one can still find much room for improvement. A great deal of popular scientific matter is published which, even though it lack the accuracy and the reserved method of a truly scientific discussion, still has the virtue of being readable by the layman and of awakening or maintaining his interest in science.

In the system of scientific instruction in our schools we find, however, the faults noted by Dr. Griffiths, but we find also other unfortunate features. Our educators are so thoroughly convinced of the value of teaching science that they begin it in the elementary schools and continue it through all grades. The little tot who has just learned to read is taught science in one syllable. The next year perhaps he gets the same thing in two, and so on. This would be all very well, were it not true that it is the method of teaching which advances, and not the subject. Each succeeding year the student is carried over the same ground he covered the year before, getting, perhaps, but little further. Such a method necessarily involves a great waste of time. The subject should either not be taught in the lower grades, or else omitted from the higher ones. All admit the desirability of teaching some science, but the instruction should be given in the proper place, and other subjects equally as important should not be allowed to suffer.

We find, even, some openings for criticism in the methods pursued at certain of the colleges. In nearly all of them all students are required to do some work in science. Courses available for those whose time is mainly given to other fields must therefore be offered; but these, too frequently, seem to be designed more to interest the student than to instruct him. More thought is given to amusing him than to teaching him what is meant by science. Such courses frequently consist of more or less popular talks, profusely illustrated by means of the lantern. They soon become known as "snap" courses, and are taken because the student must take some such course, and he is told that this one will give him the least trouble. In this way the very object for which the course is designed is defeated, and all that is carried away from the lecture-room is a hazy jumble of names and pictures. And what is the value to a man of a few ideas scattered throughout a broad science, since they are apt to be obsolete in a few years? What he should have ground into him are a few, and perhaps only a few, principles; but these should be ground in in a scientific manner. It is not the actual knowledge of any science that he should have, but some conception of what a science is and what is meant by a scientific method.

In this country, fortunately, we are beginning to get out of the backward condition we have been in respecting scientific advance. Noble gifts by individuals, and generous appropriations by state authorities, are beginning to bring their rewards. While, possibly, we have been more ready to grasp industrial opportunities which science has made, we have not done our share in the pioneer work; nor can we do this until better conditions obtain at the large institutions of learning. There those who have the ability to do the work are so tied down with other duties that no time is left. This phase of university administration was recently discussed by President David Starr Jordan, of Leland Stanford University. He knows from experience, because he himself is eminent in scientific fields, the needs, and he also knows the difficulties. The way out seems to be to encourage those who show aptitude for research, relieving them of some of the other duties and assisting them to secure adequate apparatus; but, in all cases, the investigator should retain certain of his classes, for nothing gives one a clearer and more logical knowledge of a subject than the teaching of it. And, in the mean time, while these university reforms are being carried out, let the instruction of the public through popular writings go on. Such science, unless it be very bad, does good.

A CONDEMNATION OF THE ELECTRIC ROCK DRILL.

In the *Engineering and Mining Journal* for August 18, Mr. G. E. Palmer discusses rather briefly the merits of the electric drill for piercing rock, and comes to the conclusion that it is not a satisfactory device. Although he gives much credit to the inventors and designers of such drills, he seems to think that the character of the work is not at all suitable for electrical methods. The success of the compressed-air and steam drills lies in their very ruggedness, for they probably may be classed among the most inefficient of modern tools. The greatest difficulty with the electric drill seems to be in maintaining the insulation, for it is admitted that it cuts a straighter and smoother hole, is more efficient, is cheaper and more flexible. But, in the language of the street, "it won't stand the racket."

Possibly Mr. Palmer's conclusions are entirely justified. It does not follow that the best means of transmitting energy is always the best method of applying it, and there is no disgrace if it can be proved that the older devices are, in the end, the better. But would it not be possible to better the conditions under which the electric drills are used, and thus obtain the advantages with which they are credited? Electric motors are doing good service in coal mines, where the conditions are certainly severe. Perhaps a little higher grade of labor would throw the balance the other way. One of the necessary consequences of the introduction of more perfect devices is the employment of better-trained labor to take care of them. It ought to be possible to-day—and we do not doubt that it is—to turn out an electric drill that would stand any service that it could justly be called upon for; but it does not follow from this that such a drill will be the most satisfactory. We have heard a good deal about the beauties of the combined electric-compressed-air drills, in which the flexibility and economy of the one are made use of for transmitting the power, while the ruggedness of the other enables this to be applied without danger. If such a combination should prove to be the best all-around tool, the electrician has nothing to be ashamed of; but we are not yet ready to admit that a satisfactory electric drill is an impossibility.

Digitized by Google

Ohio Electric Light Association.

Twelfth Annual Convention, Put-in-Bay Island, Ohio, August 21, 22 and 23.

THE annual meeting of the Ohio Electric Light Association, held at Put-in-Bay island, lake Erie, Ohio, on August 21, 22 and 23, was well attended by central station men as well as manufacturers' representatives. It is the rule at these outings for members and guests to bring with them their ladies and families, and considerable attention is paid to the social as well as the business side of the convention. The innovation introduced last year of distributing prizes to the ladies was continued at this meeting, and a number of the companies contributed electric fans, cooking utensils, fixtures and other articles of domestic use or ornament.

TUESDAY AFTERNOON SESSION.

The first business session was called to order at 2 P. M., Tuesday, August 21, by Secretary-Treasurer D. L. Gaskill, of the Greenville Electric Light and Power Company, who announced that owing to the fact that President Valentine had during the year taken up other business, and severed his connection with electric lighting interests, his duties had devolved upon Vice-President W. E. Russell (Massillon Light, Heat and Power Company), who would preside over the convention, and had been the acting president since Mr. Valentine's retirement.

Mr. Russell delivered the annual address of the president, in which he referred to the fact that during the year the business of electric lighting has shown a healthy growth in Ohio, although prices have ranged downward and gas competition met. The address emphasized the necessity of careful attention to cost of production in the direction of which practical work has heretofore been done by this association. A recent decision in a case tending to establish greater certainty in the construction of the law as applying to the rights of the companies in fixing rates based upon equitable considerations was favorably approved.

The court decided that the municipality must recognize the equity of considering the maximum cost of service to any substantial class of users as being based on hours of use. Acting-President Russell commended the determination of the association to expend its effort in conventions more to the practical side of the central station business from the standpoint of new business, and how best to get and keep it. In closing, the necessity of united effort was spoken of, the recent great improvements in lamp-making approved, and further advances hoped for. The absence of President Valentine from the association membership and convention was greatly regretted. Acting-President Russell paid his compliments to all who had assisted the work of the association during the year past.

The following new members were elected:

Active—Toledo Gas, Electric and Heating Company, J. E. Lockwood, manager electrical department; Bucyrus Gas and Electric Light Company, H. O. Dutter, manager; Citizens' Gas and Electric Company, Wm. M. Adams, general manager, Elyria; the United Electric Company, Denison, O. B. Welch, general manager; the Dayton Lighting Company, F. M. Tait, general manager; the Bellevue Illuminating and Power Company, F. B. Carr, secretary-treasurer; Salineville Electric Light, Heat and Power Company, Salineville.

Associate—Illinois Electric Company, Chicago, F. D. Rusling, Ohio representative; Pittsburg Transformer Company, H. G. Steele, secretary, Pittsburg, Pa.; C. W. Lee Company, Newark, N. J., Frank B. Rae, Jr., secretary.

The remainder of the afternoon was given over to reading of papers, discussion of same being deferred until next day, owing to the excessive heat. All of the papers were printed and distributed to the audience so that the speaker might be intelligently followed and points for discussion noted.

On the general subject of high-efficiency lighting units in Ohio three papers were contributed by central station men, one of these being the joint production of two authors.

The first of these was by A. N. Cope, of the Public Service Company, Columbus, Ohio, who announced as his text "Progress in High Efficiency." His paper, he stated, had for its purpose a relation of the experience of his company in the operation of the Nernst lamp in a commercial field, in which its success had not been due entirely to its own high-efficiency feature but also to the contributing effort of the central station in its introduction and exploitation. This necessitates a careful study of the needs of the customer, especially where strong competition from electricity or gas or both must be met. When the Nernst was first installed by this company it was not satisfactory, but this the writer thought due to the then poor regulation existing and to deficient knowledge of the lamp and its capabilities. About April, 1905, conditions changed; the regulation improved and the demand for the Nernst continuing, it was adopted as the sole means of securing business from gas users, in which field it has since proved amply successful and satisfactory.

The larger introduction of the Nernst lamp was facilitated by an exchange of accumulating old stock of arc lamps which had begun to cumber the company's storeroom. The writer gives statistics showing as the result of his company's experience that the average kilowatt-hours' return per kilowatt connected to a classified and miscellaneous list of consumers was 70.47 for the arc, while for the same unit in Nernst it was 84.75 kilowatts, or twenty per cent more; sixteen and two-thirds per cent less connected load with the Nernst lamps therefore giving the same revenue, with the additional benefit of a better power-factor, an increase in burning hours and a better station load-factor. The flexibility of the system is especially appreciated; with the Nernst it is an easy matter to drop out a glower in each lamp and reduce the current consumption twenty-five to thirty-three and one-third per cent, and retain the good will of the kicker.

A feature of the Nernst lamp that must not be overlooked is, that with the same current density as in the 110-volt circuit, twice the amount of watts may be distributed, or the same energy with half the drop—a decided advantage in overloaded circuits in old installations. It is a panacea for unbalanced three-wire distribution. The writer thought that the lamps are defective in one point, that it is too hard to get at the ballasts to see their condition. The system of maintenance will depend upon the number of lamps installed. The number of ballasts burned out will indicate how well the glower voltage is adapted to the light voltage. The right kind of a maintenance man will get his glower instruction from the ballast condition. In conclusion the writer says, "I firmly believe that, had our electric competition been less keen, central station conservatism would have had less general progress of high-efficiency lighting units to report."

The next paper of this series was jointly

Digitized by Google

written by T. D. Buckwell and John Gilmartin, both of the Toledo Railway and Light Company. They hold that the introduction of these high-efficiency lighting units has been beneficial to the central station man in broadening the field for the employment of electricity as a lighting agent. The central station man is thus better able to meet competition and satisfy the most exacting as to the quantity and quality of illumination.

F. W. Willcox, of the General Electric Company, Harrison, N. J., read his paper on "New Lamps and New Opportunities," which was a vigorous and clear presentation of the subject from the writer's standpoint. Mr. Willcox believes in no halfway measures, but that central station managers should boldly put out the highest-efficiency lamps found feasible, with the design of giving to their customers the very best service possible in pursuance of a policy of liberal progressiveness which he thinks will be surely profitable in the long run.

The last paper of the afternoon was that by Max Harris, of the Nernst Lamp Company, Pittsburg, Pa., entitled "Some Notes on High-Efficiency Units by the Manufacturer." This paper was written by Mr. Harris in response to an invitation extended to him to present the standpoint of the manufacturer in connection with the views expressed in previous papers by central station men as to high-efficiency units.

The convention then adjourned for the afternoon.

WEDNESDAY MORNING SESSION.

The first announcement Wednesday morning was the appointment of the committee on nominations by the executive committee under the rules, *viz.*, Messrs. Rust, Maxon and Hanley.

Under the general subject of "Ways and Means of Increasing Business" the convention listened to a series of papers by central station men, all of which were short, crisp and practical. They will be taken up in their order as read; first, S. M. Rust, of the Greenville Electric Light and Power Company, whose keynote was attention to details and cultivation of the patrons' wants. Summing up, Mr. Rust says, "I would say that the following will increase business in any town: reasonable meter rates; good service; courteous treatment; good wiring at or near cost; free renewals; continuous service; attention to small details; cultivation of acquaintances; careful attention to plant; wiring to be paid for when desired on instalment plan, or on reasonably long time; offering of inducements in the way of labor-saving and comfort-giving appliances as will enlist the interest of the ladies; and at all times work to convince the people that the company is working to their interest and will do everything possible to render the business relations between the company and the patron pleasant, agreeable and profitable to both."

The next contributor to this series was W. C. Anderson, of the Canton Electric Light and Power Company, who, like Mr. Rust, emphasized the factor of good service as the principal one in getting and retaining business for the central station, and the giving of the very best value possible for the money. Every city in Ohio should be lighted by a privately owned electric lighting plant, which such a company can do at the minimum of profit, inasmuch as by installing a proper pole system for the public business it is better equipped to handle the commercial and residence lighting. The consumers must be thoroughly classified and charges established with due regard to investment cost and operating expense that shall be equitable as between the various classes of users and the company. Large consumers must have special rates or isolated plants will result. The residence lighting should be on the two-rate basis, the demand being computed as a certain percentage of the lamps wired. The writer condemns maximum-demand meters. The two-rate system will meet all the prominent classes of customers except small-motor and long-hour users. For these a flat rate may have to be resorted to, especially in small cities. Too much care can not be taken in classifying business to make the rates bear justly as against each particular class.

In connection with the next paper literature was distributed, being the bulletins of the Dayton Lighting Company, designed by the C. W. Lee Company. The third paper of this series takes up the same problem as applied to a large city, and was by Frank M. Tait, manager of the Dayton Lighting Company, one of the new members. His paper first considers the details of soliciting new business, employing a card index and the active work in charge of energetic and capable young men as canvassers, properly superintended and their interest and close attention stimulated by means explained in detail in the paper. The work of the canvassers is supplemented by a follow-up scheme of individual letters. These should be written in a clean-cut style, enclosing stamped envelope or return postal-card and should be sent to a well-selected list and continued at intervals until results are secured. The importance of advertising is referred to, and especially the use of illuminated billboards, which show the public that the company has confidence in its own methods, and merchants having other commodities will not be slow to follow this advertising hint. The offering of electrical appliances of all kinds on free-trial basis is recommended, and particulars given. The paper was entertaining, concise and practical.

J. Robert Crouse, Cleveland, Ohio, addressed the convention briefly in reference to the objects, plans and results of the work of the Cooperative Electrical Development Association, which comprise, as has been heretofore noted in these columns, the promotion of the more extended use of electricity by the public for lighting, heating and power against all competitors for like service, and the establishment of cooperative relations, both morally and financially, among the different electrical interests from the manufacturer to the consumer, to the end that each may contribute in some measure toward bringing about results desired in common by all. Mr. Crouse quoted freely from a paper on the subject of profitable commercial cooperation, which was presented by him before the National Electric Light Association at Atlantic City, in June of this year. He gave a short outline of the plans contemplated for 1907, which are to be submitted in October or November to the joint committee of central stations, manufacturers, jobbers, contractors, etc. He asked that the Ohio Electric Light Association appoint a cooperating committee of two, one of whom shall be a representative of a purely electric and the other of a combination gas and electric company. The suggestion was favorably acted upon, and Frank M. Tait, of the Dayton Lighting Company, and D. W. Low, of the Alliance Gas and Electric Company, were later appointed as such committee.

A further series of papers on "Successful Ways of Increasing Business" were next presented, the first one of them by J. Kermode, of the Cleveland Electric Illuminating Company, who gave attention principally to the exploitation of cooking devices, incidentally suggesting the securing of the cooperation of contractors and architects in providing a proper number of outlets, and in other ways contributing to the improvement of the standards of construction from an electrical standpoint.

J. H. Maxon, of the Gallipolis Light and Coke Company, advocates in his paper

Digitized by Google

the placing of appliances, such as desk fans, laundry irons, small motors, etc., on trial and approval, the consumer to pay for current consumed in the regular way during the period of trial, but is under no obligation to keep the articles unless satisfactory after trial. At the end of the trial period, which should be thirty days, or not to exceed sixty days, to accept and pay for the installation upon such terms as may be agreed upon, or if not satisfied to retain same the customer can have them taken away without expense to him other than for current actually consumed.

D. W. Low, of the Alliance Gas and Electric Company, in his paper on this subject, explains the methods adopted by him to introduce gas stoves for cooking and other appliances. He puts these out for a stated period at customer's option of purchase. Of 500 stoves put out only two have been returned. In introducing motors, small horse-power motors were offered to parties who were using other forms of power, such as gas engines, with the understanding that if not satisfactory they would be removed without expense. At present all the printing in his place is done by electricity, current for telephone batteries is from the lighting plant, and all the ice cream is made by electricity, and part of all the bread mixing. Three or four large factories are entirely equipped with electric power, and the further introduction of motors is a very easy matter, as the public are now quite generally converted to the idea that they can satisfactorily use motors.

The last paper of the morning was by M. E. Turner, of Cleveland, on the same subject. After pointing out considerations which should tend to make the public liberal in their use of electricity for many purposes that add to their comfort and enjoyment of life, this writer says, "Electricity in the home has its most important function in lighting, but not necessarily its largest use. It can, and should even now be used for auxiliary heating and cooking; for cooling in summer, and for running the sewing machine at all times; for grinding the meat and polishing the silver, for ironing, and so on in numerous ways. To secure this business the public must be educated to recognize the value of its convenience to them; and this can best be done by effective advertising. Whether this be by personal solicitation or through literature, or both we must, in order to have our advertising effective, attract attention, arouse interest and create a desire to possess the articles advertised. Further than this, proper wiring at time of construction of modern houses must be looked after. The residence patronage should be the largest and most profitable, yet many houses are not at present equipped with wiring, and therefore do not avail themselves of the convenience of electricity. With all residences properly wired, opportunity for larger demand would exist and be taken advantage of, so that the business would grow to large and profitable proportions. In Cleveland the possibilities in this residence load have been fully recognized, and a plan devised that puts it within the reach of nearly every householder to install electric service. Wiring and fixtures are furnished on the installment plan. Payments are not, however, made direct to the company, nor is it a party to the contract except as an agent soliciting the business for a contractor afterwards named by the company. The writer gives further particulars of the plan followed, and includes with his paper a reduced copy of a residence-wiring contract, which has been adopted after careful study by the Cleveland company.

WEDNESDAY AFTERNOON SESSION.

On Wednesday afternoon discussion of the papers read up to this time was invited. Max Harris objected to the statement made in the paper by Mr. Collins with regard to the comparative merits of the Nernst as opposed to the GEM, with reference to renewal cost, inasmuch as the same writer had stated in the introduction to his paper that his paper would be confined to the GEM units. He asked how many Nernst lamps Mr. Collins had in service at Columbus, of what type, and how he arrived at the figures of cost of maintenance as given in his paper?

Mr. Collins replied that he had been given to understand from what he believed to be a reliable source that the figures quoted were accurate. Mr. Harris stated it as his belief that the experience of a large number of present users of the Nernst lamps would not corroborate the figures referred to, but on the contrary would show a much better record for the Nernst in that particular.

Samuel Scovil, of the Cleveland Illuminating Company, one of the past presidents of the Association, who has not always been able to attend these meetings of later years, and whose presence was much appreciated, rose to enquire what was meant by a "high-efficiency" lamp, referring to the report of progress by T. C. Martin at the National Electric Light convention when he spoke of lamps that some of the Germans were getting out under special circumstances that were claimed to run as low as one watt per candle, and in some cases as low as one-half watt per candle, which he instances as an example of what might be called "high efficiency."

Mr. Kermode referred to the successful performance of both the Nernst and the GEM lamps in Cleveland, especially in competition with thirty-cent natural gas.

Frank Duncan (Salineville) enquired whether in his town of 3,000 to 4,000 inhabitants with not extra good regulation, probably about three per cent, and a variation in voltage of about five per cent, the new high-efficiency units could be used with success?

Mr. Harris stated that the Nernst units could be operated successfully on circuits having a variation averaging within five per cent above or below normal, and all guarantees on the average life are based upon a conditions of that sort.

George C. Osborn, of the General Electric Company, Harrison, N. J., stated with regard to high-efficiency lamps of the GEM type that they can be placed on any circuit where incandescents are used at the present time. Provision has been made to take care of central stations that are using 3.1 or 3.5-watts-per-candle lamps, and by adopting the middle or bottom voltage of the new units it will give them the same life as they are now getting on the 3.5 lamps.

Mr. Turner suggested that the question asked was how to regulate the high-efficiency lamps, for instance, if the average on the circuit is 118 volts, what is the most efficient lamp?

Mr. Osborn replied that with a central station operating 118 volts that has been getting satisfactory service from the 3.1-watt-per-candle lamps they should adopt the new lamps in the middle voltage.

C. E. Inman, Warren Water and Light Company, reported that they had quite a number of Nernst lamps on their circuit, and so far had not found the maintenance cost any greater than renewals of incandescent lamps. He had not figured in the labor in the cost of replacing glowers, but the maintenance on renewal parts is about two mills per kilowatt. His company had purchased their first lot of Nernst lamps two years before they made their further purchase, and are using them now a year and a half since the second purchase was made, and had found them satisfactory. Ordinarily his regulation is about two per cent; not as good in the daytime as at night because they carry sometimes as high as 150 kilowatts on the power circuit in the daytime. It is, however, quite good for a small plant. It is nearly elimi-

Digitized by Google

nated at night, when the Nernst is burning mostly.

J. C. Fish, of the Shelby Electric Company, objected to the term GEM being pronounced G.E.M., holding that so pronounced it gave the impression that the lamp was an exclusive General Electric product; he preferred that it be referred to as the Gem lamp, because there might be some central station men who would want to buy such a high-efficiency lamp, and they should not be led to suppose that they could only obtain it of the General Electric people.

D. L. Gaskill, of the Greenville Electric Light and Power Company, thought that the high-efficiency units were a godsend to the smaller towns especially because they permit the central station to offer a light of great power for the minimum of expense, and the peculiarity of the smaller towns is that the people want the best light, but they do not want to pay a high price for it; in Greenville, a town of some 8,000 population, both the GEM and the Nernst lamps are in use, but the speaker did not care to enter into invidious comparisons or to pass upon the merits of either lamp as opposed to the other. The GEM with reflector behind it has some advantages which the storekeeper appreciates; on the other hand they do not find that the renewal cost of the Nernst is objectionable. The higher-efficiency lamp that can be put out the better for the business in general.

F. W. Willcox, Harrison, N. J., stated that taking the comparison on the basis of mean spherical candle-power the figures as stated by Mr. Osborn would be found correct, and about one-sixth in favor of the GEM on first cost; there is a great difference between claimed candle-power values and actual values. The price of the lamps has been considerably reduced about three months ago.

Mr. Harris said that from the standpoint of practical comparison it has been demonstrated that the two-glower Nernst lamp consuming 176 watts will successfully do the work that the 250-watt high-efficiency GEM lamp accomplishes. The question is, whether the cost of the two-glower or three-glower lamp to the central station is six times as great as the cost of an equivalent unit of the high-efficiency lamp. The chair announced that the discussion of the papers read by Messrs. Rust, Anderson and Tait would be in order. Mr. Scovil (Cleveland), asked Mr. Rust if he would give some further reasons in support of the policy of free lamp renewals.

Mr. Rust stated that he could not give any better reason than that set forth already in the paper, that if the lamps were renewed free patrons would not allow the sockets to be empty, whereas if they had to replace burned-out lamps themselves they would allow their lamps to run out, and many times not use light where otherwise they would do so, and thus affect the monthly bill.

Mr. Inman reported that it was his practice to instruct his repairmen whenever they discover a black lamp to see that same is replaced promptly with a new lamp; he furnishes free renewals.

In response to inquiry from Mr. Scovil as to the method of carrying the free renewal idea into effect, Mr. Rust stated that his company let it be understood that any consumer upon bringing a burned-out lamp to the office could exchange it free for a new lamp. All regular lamps are included under this offer.

Mr. Willcox suggested that a good plan would be to offer a specified number of renewals for a certain number of kilowatt-hours' consumption. This would give to the consumer something in proportion to the amount of revenue derived from him.

W. C. Engel, People's Gas and Electric Company, Defiance, stated that their plan was to have the meter reader carry extra lamps with him in his buggy, and when reading the meter ask the lady of the house if any lamps need renewing, and if so, to supply same free. This had proved satisfactory.

Mr. Scovil stated that in his city, Cleveland, they did not give free renewals, but he thought it was more a question of precedent with them than conviction. They had never given free renewals and as a matter of habit had continued that plan. In the smaller cities the speaker thought that no doubt the furnishing of free renewals was probably all right, but there was something to be said on the other side. He thought if you were going to adopt the free renewal idea the plan suggested by Mr. Willcox was probably a good one. Then the lamp user would be treated equitably according to the light he used.

The convention next listened to a paper by Wm. Wolls, of the Columbus Railway and Light Company, on "Gas Engines in Competition with Electric Motors." Mr. Wolls says, "It is generally a struggle to secure a power customer in the face of the keen competition of to-day, with both gas and steam, but it is a matter of satisfaction to the engineer who is negotiating a commercial power deal to know that if he closes the contract and the customer's building or factory is equipped with motors that the service supplied will be non-intermittent with pressure commercially constant, as there is no better reference than a satisfied customer."

The next paper read was by Charles A. Parker, of Detroit, Mich., upon the title, "Advertising and New Business Getting." In the course of the paper, the title of which is suggestive of its contents, Mr. Parker said: "Why should the central station man, purveyor of one of the most advertisable things in the world shut himself, as he too often does, in a gloomy barracks of a power-house way out on the city limits, and preserve a deadly silence toward the rest of humanity?" And why—when some enterprising soul does brave a two-mile walk to find if he can have a little electricity should he be greeted with a nervous glance as if he were a trespasser or a tramp? The successful central station man of to-day and to-morrow is the man who welcomes and makes much of a possible customer; who keeps his bright, well-trained solicitors constantly busy calling on interested people; who employs good live advertising capable of arousing popular interest, and sends out same to lists of residences, stores and factories situated adjacent to or upon the company's lines; and who has always a broadminded up-to-date business welcome for new business, and a proper fostering care of the business already contracted for. Mr. Parker urges the adoption by central stations of the monthly bulletin to instruct people as to the manifold uses of electricity, and drive home the point. The solicitor whose coming has been heralded by good, forceful, direct-by-mail advertising finds a ready acquaintance with electricity abroad in the land, and he finds the mind of the customer prepared to receive his suggestions favorably. In conclusion, the writer urges that central station men illustrate their own product by employing their own electric signs.

J. R. Cravath, Chicago, Ill., presented his paper on "Wiring and Lighting Equipment of an Eight-room, $3,500 Residence." This was recognized as a practical contribution to literature upon such subjects, and was listened to with a great deal of interest.

By request, Mr. Cravath supplemented the paper as printed and distributed to the convention by some remarks upon the subject of the lighting of small churches, his device explained being, however, applicable to churches of any size, and to all auditoriums. He referred to the fact that lighting units are generally placed in halls and churches where they are visible, or at least the fixtures are visible,

Digitized by Google

and the lights are not turned out during the service usually so that a person must sit and let the light shine in the eyes during the entire service. In the case of people with weak eyes this is very objectionable. Even those with strong eyes will no doubt eventually feel the strain. The speaker then showed blue prints and drawings on blackboard of his device for obviating this bad effect, the fixture being placed at such an angle as to keep the light out of the eyes of the audience or congregation.

The papers read at this session were not discussed at this time.

On motion of B. S. Young, chairman of the publicity committee, the following resolutions reported by him from this committee, were unanimously adopted:

WHEREAS, The Toledo Car Association has recently by resolution as announced by circulars posted reduced the time limit for unloading coal from ninety-six hours to forty-eight hours; and,

WHEREAS, The demurrage charge *per diem* for further delay in unloading is $1 for each twenty-four hours thereafter; and,

WHEREAS, The agreement between railroads or transportation companies is, that a charge of only twenty cents for each twenty-four hours is made for cars while off their right of way; and,

WHEREAS, The demurrage at the rate charged shippers would amount to $300 per annum, approximately one-half of the value of the car, and is in every way unjust and exorbitant; be it

***Resolved*, That this association hereby protest against said action of the Toledo Car Association as being an unjust discrimination against the shipper, and the officers of this association are hereby authorized and instructed to file notice with the said Toledo Car Association of this protest, and to cooperate with all other associations of shippers in an earnest effort to have this resolution rescinded, or to have the demurrage charge reduced to the amount incurred against the railroad delivering the shipment, which is twenty cents per day.**

Also the following:

WHEREAS, It has been the custom of railroads to confiscate coal shipments and to divert them to their own use; and,

WHEREAS, This practice operates to the serious injury of light and public service companies, adds to operating expense and financial loss, creates dissatisfaction among customers or patrons of public service corporations, and seriously interferes with their operation; be it

***Resolved*, That the executive committee of this association be and hereby are authorized to cooperate with the proper officers of public service corporations to the end that proper legislation may be enacted to effectually correct this evil.**

Owing to the excessive heat an adjournment was now taken until Thursday morning.

THURSDAY MORNING SESSION.

The following were admitted to membership:

Associate—The Shelby Electric Company, and the Cooperative Electrical Development Company, of Cleveland, Ohio.

The nominating committee reported the following officers nominated for the ensuing year:

President—W. P. Engel, Defiance.

Vice-president—C. C. Collins, Columbus.

Secretary-treasurer—D. L. Gaskill, Greenville.

Finance committee—E. J. Bechtel, Toledo; B. S. Young, Ada; J. H. Maxon, Gallipolis.

Executive committee—W. E. Russell, Massillon; M. E. Turner, Cleveland; D. W. Low, Alliance; E. H. Beil, Youngstown; F. M. Tait, Dayton.

Advisory committee—Samuel Scovil, Cleveland; W. E. Miller, Mt. Gilead; D. L. Gaskill, Greenville.

After some other routine business, including adoption of the report of Secretary-Treasurer Gaskill, which showed a balance in the treasury, the papers of the day previous were called up for discussion.

Mr. Turner differed with the statements in Mr. Cravath's paper discounting stand lamps as not good reading lamps, but only suited for writing purposes. He thought the discrimination against the stand lamp arose from the fact that many stand lamps are provided with a shade that is so deep that the light is cut off so that a person sitting near the table is unable often to read because of the shade. The speaker prefers a stand lamp, and believes that many others share this preference. A table lamp is an ornament, and the gathering about the table is a social feature of family life that is enjoyable. If a shade is used that will permit the light to spread far enough around a table four or five people may conveniently be seated about the table and all be able to avail themselves of the light for reading. For such purpose it is to be preferred to chandelier lighting.

N. R. Birge read his paper on "The Series Luminous Arc Rectifier System," describing briefly its construction, operation, advantages, efficiency, distribution, color and low maintenance cost. The essential features of the new system are the luminous arc lamp, with absolute cutout on the line and the mercury arc rectifier set in the station. The energy, economy, brilliancy of illumination and character of distribution are the marked advantages of the system. Readings made with a luminometer show that a luminous lamp consuming 310 watts at the terminals gives the same intensity of illumination at a distance of 309 feet that the 480-watt direct-current series enclosed-arc lamp gives at a distance of 275 feet, and that the 480-watt, alternating-current, enclosed-series lamp gives at 247 feet. The maintenance cost is very low; the upper electrode is copper, and the arc burns at a comparatively low temperature, which results in an average life of about 4,500 hours for this electrode, and a practically negligible cost for renewal. The lower electrode has a burning life of 150 to 175 hours, which allows one man to take care of and trim a much greater number of lamps than possible with open or enclosed carbon arc lamps. This long-burning feature and the fact that only one electrode must be removed gives marked economy in maintenance.

In the discussion following Mr. Birge's paper, Mr. Inman enquired whether any more difficulty was experienced with this system from lightning than from any other street-lighting system.

Mr. Birge replied that so far as he knew there had been no trouble reported.

Mr. Tait asked the proper height to hang the lights above the street to get the best results. Mr. Birge replied, twenty feet to twenty-five feet.

In reply to an enquiry, Mr. Birge stated the cost of tubes is $25, with an allowance of $5 for return of old tubes, making the net exchange price $20. Replying to enquiry by Mr. Maxon as to the greatest length of circuit practicable, the speaker stated this was practically the same as with the series alternating-current.

Mr. Custer enquired as to cost of renewals and as to how these compare with cost of renewals with series alternating-current lamps.

Mr. Birge stated that for 480 alternating-current enclosed-arc lamps the cost of maintenance, including trimming, carbons and electrodes, outer and inner globes, is $4.25 per lamp per year. Cost of luminous lamps, $2.95 per lamp per year. Tube renewals, figured on a basis of 700 hours (which figure was arrived at from reports from Glens Falls, N. Y., where five fifty-light outfits had been installed since January 1, 1906) for fifty-light sets, $2.28 per lamp per year. Total cost of maintenance of luminous rectifier system, including tubes, $5.23 per lamp per year. The above figures are based upon the assumption that lamps are operated 4,000 hours per year. Cost of energy will in a great measure depend upon local conditions. Assuming a cost of energy of one and one-half cents per kilowatt-hour, the 480-watt enclosed-arc lamp would cost $33.40 per lamp per year, and luminous lamps $22.14 per lamp per year—showing a saving of

Digitized by Google

$11.26 per lamp per year in favor of the luminous arc system. Deducting from this amount ninety-nine cents from the increased cost in maintenance shows a total saving for the luminous arc rectifier system over series alternating-current system of $10.27 per lamp per year.

Mr. Duncan enquired if the luminous arc could be run on ordinary direct current, to which Mr. Birge replied that a large number of Brush machines have been rewound for four amperes and are operating luminous arc lamps.

Mr. Duncan asked how the cost of rewinding a Brush machine compares with the first cost of installing rectifier outfits.

Mr. Birge stated that the cost of rewinding a No. 9½ or No. 12 Brush arc machine for four amperes will be approximately $1,000 or $1,200. Such Brush machines when rewound will each operate 100 to 125 lamps. The cost of a rectifier outfit of 100 lights' capacity, depending, of course, on the frequency and size of the set, would be approximately $2,300.

Mr. Scovil suggested that in using the old Brush rewound machine the tube renewals would be gotten rid of; to which the speaker agreed, and that this would reduce the operating cost, but added that the expense of maintenance of the Brush machines would in a measure offset that.

Mr. Turner asked whether a higher efficiency would not be obtained with the rectifier system than with the Brush arc machine. The speaker said that the efficiency of the Brush arc would be about eighty per cent, and the efficiency of the rectifier set about ninety per cent.

Mr. Maxon enquired whether in fitting up a new station the speaker would recommend direct current or alternating current. Mr. Birge replied that he would recommend the rectifier. Mr. Scovil asked whether this was for the reason that the same distributing mains would be used for other purposes? Mr. Birge answered for the reason was that it would do away with rotating machinery, and substitute the rectifier set, which could be operated directly from the alternating-current busbars.

Mr. Russell said that he had heard it urged against the magnetite arc lamp, whether justly or not he did not know, that there is a generation of gas that is very destructive to the internal parts of the lamp, and asked the speaker what he had to say as to this.

Mr. Birge replied that some iron fumes are given off by the lamp, which are carried up through a chimney and out into the air; in no way, so far as he knew, had they interfered with the mechanism of the lamp. This chimney has such a good draft that it carries all the fumes away, and none, or at least a very small amount, are deposited on the mechanism. With the first lamp brought out of the luminous type considerable trouble was experienced from this deposit collecting on the outer globe and giving the globe a yellowish appearance. This trouble was overcome by changing the construction of the upper electrode boxes, and the present standard lamp is so designed that no trouble whatever arises from smoked globes.

Acting-President Russell requested Mr. Grabill (of the Ashland Gas and Electric Company) to give the convention the benefit of his experience with an installation of these lamps.

Mr. Grabill stated that they changed at Ashland from Thomson-Houston open arcs to the luminous arc the 1st of last December. Under the former system their carbons cost them about $200 per year, whereas $50 worth of the new electrodes he finds will last about fourteen or fifteen months. As to fumes, has experienced no trouble with the lamps, which were of the first pattern put out, with swinging electrodes. Lamps inspected about twice a week. Of the ninety installed the speaker had not found one out, but all burning nicely and steadily on an inspection trip made just previous to coming to this convention. The policemen at Ashland report outages and the company is docked five cents an hour per lamp. The dockage under the old system used to run as high as $8 or $10, the lamps being inspected every night. It now runs as low as from $1 to $2.50, the latter figure having been reached during a month when the lamps were allowed to burn too long without trimming. Direct current is used. The speaker can drive around and easily trim the ninety lights and clean up globes in a day, and the electrician formerly employed to take care of the lamps has been dispensed with.

Secretary Gaskill, who, in addition to running an electric light and power plant at Greenville, Ohio, is also an attorney-at-law in active practice, presented an interesting paper on "Legislation, Its Uses and Abuses" in connection with the report of the advisory committee.

Mr. Scovil, of the Cleveland Illuminating Company, always a valued counselor, discussed the report and descanted somewhat broadly upon property rights in general, holding that the tendency which has manifested itself too widely of late years to attack these rights indiscriminately oftentimes seemed to discharge without reason its main effort against public service companies; whereas, if the individuals who make these attacks would give a moment's thought to the subject they would find that in attacking the rights of public service companies they are like Samson pulling down the strong columns which support the fabric of civilized society, and would involve all property rights in a common ruin. The ultimate basis for the defense of individual and corporate right to hold property, or even to will it to posterity, arises from the fact that society derives more benefit by individual and corporate possession of these rights than it could otherwise derive; that without the idea of individual ownership of property there would be no incitement to human endeavor.

The paper by Mr. Gaskill and the supplemental remarks by Mr. Scovil were, upon the suggestion of Mr. Low, referred to the executive committee with instructions to arrange for proper publication of the same.

Further discussion followed in the nature of an executive session and the report of the "Committee on Cost Determination" was submitted through E. J. Bechtel, of the Toledo Railway and Light Company, who, however, was unable to be personally present.

The Ohio Association, in common with others, several years ago realized the necessity for definite work along lines of cost determination, and the present committee report is a further contribution to the subject. A synopsis of the last report is given, and reference is made to an interesting paper read before the New England Association of electric light engineers, by J. S. Codman, a feature of which paper is a bibliography of former papers bearing upon this subject.

In discussing the report, Mr. Scovil remarked that companies who might have to go into the question of a maximum rate ordinance would do well to establish charges for current on a basis of standing and running charges, that in order to go into the United States Court on the ground that a given rate would deprive the complainant of its property without due process of law it would be necessary to show that such maximum rate fixed by the ordinance would not give a reasonable return for the use of the property devoted to the public convenience, taking into consideration all of the elements of cost. In

Digitized by Google

this connection, the cost depending upon the use which people made of an installation and investment placed at their disposal and required to be made for their service is an important point which can be applied in two or three different ways.

The convention next listened to the report of T. E. Crawford (Library Bureau, Cleveland, Ohio), of the "Committee on Uniform Accounting and Records."

The chair invited discussion of any papers concerning which members desired to express themselves, in response to which Mr. Low gave some account of his experience in placing small motors, along the same lines as covered in his paper, and Mr. Inman told of his success in installing similar motors, stating that he had in July a continuous output of 24.2 kilowatts on the power circuit, and 38.8 kilowatts on the alternating current, showing that the power circuit was coming up. His rates on the power circuit ranged from four cents per kilowatt down to two and three-quarters cents if the consumer used 1,865 kilowatts per month. He has now two consumers on the line who claim the two and three-quarters cents rate nearly every month. On elevator load for small motors below five horse-power he charges six cents per kilowatt. Upon first establishing these rates he was afraid that the peaks might conflict, but this has not proved to be the case, as the motor load commences to drop off just before the lighting peak comes on.

The paper on "Electrical Heating Devices, Their Latest Commercial Development," by H. J. Mauger, of the General Electric Company, Schenectady, N. Y., was elaborate and handsomely illustrated. The writer identified the activity of the central station in relation to heating devices with the organization of new-business-getting departments and the development of the commercial aspect of the electric lighting business.

Discussing the paper, Mr. Scovil enquired if the writer had calculated the cost of such a simple cooking outfit as a central station man should use in his own kitchen or home. Mr. Mauger replied that they had a tentative outfit, which would cost $55 net. This, however, is not large enough for a large family, the outfit for which is estimated at say $75. These figures are not final, however.

The convention having now completed its regular programme, President-elect Engel took the floor and briefly addressed the meeting. Pledging himself to work throughout his administration for the best interests of the organization, he invited suggestions from all, whether central station managers, supply men or manufacturers. He congratulated the material men and manufacturers on their hearty cooperation with and interest in the Association, and referred approvingly to the handsome exhibits made, which, he stated, were of a very attractive character. He was pleased that so many ladies had attended, and reminded the members that their presence did much to render these annual meetings enjoyable and to cultivate sociability and good feeling.

On motion of Secretary Gaskill, the thanks of the convention were extended to the donors of the several magnificent prizes presented to the ladies.

On motion of Mr. Turner, the committees on "Cost Determination," on "Records" and on "Publicity" were continued, and committees authorized to report on the "Progress of High-Efficiency Lighting Units" and of "Electric Heating Devices," the said committees to be selected later by the president and notified by mail.

Ohio Electric Light Association Convention Notes.

THE twelfth annual convention of the Ohio Electric Light Association was delightfully located at Put-in-Bay island. The central station men, supply men and guests greatly enjoyed the lake trip across from Cleveland, Sandusky, Toledo and Detroit. While the weather was oppressively hot during the business sessions, there was sufficient entertainment provided to offset the physical difficulties under which the attendants labored. The Victory park accommodations and the bathing were especially enjoyed, and the presence of a large number of ladies added very greatly to the attractiveness of this convention season.

Too much can not be said in the way of credit to those who engineered this convention. To Samuel Scovil, J. A. Bendure, D. L. Gaskill, M. E. Turner, E. J. Bechtel, M. C. Hull, W. E. Miller, W. P. Engel, B. S. Young, W. J. Hanley, George B. Dusinberre, A. A. Serva, L. B. Hoit, George Porter, N. C. Cotabish, Elliott Reynolds, F. W. Willcox, A. C. Robeson, Fred Bissell, E. F. Gwynn and E. H. Beil are due the thanks of all those present for the wealth of consideration which left no opportunity for anything but satisfaction.

On the morning of the first day of the convention quite a large group of attendants assembled on the steps leading to the veranda of the Hotel Victory, and a large group photograph was taken, a reproduction of which is given herewith. In this

W. P. ENGEL, PRESIDENT OHIO ELECTRIC LIGHT ASSOCIATION.

group may be recognized many of the men well known to the electrical fraternity, not only of Ohio and the central states, but throughout the country in general. Among the central station men present were the following:

W. E. Russell, Massillon Light, Heat and Power Company.

W. E. Miller, Mt. Gilead Water, Light, Heat and Power Company.

Edward Matt, Lancaster Electric Light Company.

C. C. Custer, Miami Light, Heat and Power Company, Piqua, Ohio.

E. T. Selig, general manager, W. B. Wilkinson, Mt. Vernon Electric Light Company.

B. J. Denman, W. B. Thompson, Edison Illuminating Company, Detroit.

C. S. Longnecker, manager, Delta Electric Light Company.

Frank M. Tait, The Dayton Lighting Company.

John Gilmartin, Toledo Railway and Light Company.

Frank Houghton, M. E. Turner, Samuel Scovil, J. T. Kermode, W. H. Kelsey, Arthur Pomeroy, Cleveland Electric Illuminating Company.

Louis T. Kaiser, Thomas Emery's Sons, Cincinnati.

Frank Espy, manager Consolidated Gas and Light Company, Tiffin.

D. L. Gaskill, A. C. Robeson, Z. T. Dorman, S. M. Rust, W. T. Fitzgerald, M. D., Greenville Electric Light and Power Company.

Digitized by Google

S. E. Falk, Bryan, Ohio.

H. C. Dye (municipal plant), Galion, Ohio.

H. P. Grabill, Ashland Gas and Electric Company.

Frank Duncan, Salineville Electric Light, Heat and Power Company.

James O'Toole (municipal plant), Hamilton, Ohio.

D. W. Cameron, Cambridge Power, Light and Traction Company.

E. L. Booth, Bellaire Light and Power Company.

J. H. Maxon, Gallipolis Gas and Electric Company.

W. P. Engel, People's Gas and Electric Company, Defiance.

C. E. Inman, superintendent Warren Water and Light Company.

C. B. Rodgers, Tiffin Electric Illuminating Company.

F. DeWitt, Miamisburg, Ohio.

THE CONVENTION OF THE OHIO ELECTRIC LIGHT ASSOCIATION, PUT-IN-BAY, AUGUST 21, 22 AND 23.

A. N. Cope, Columbus Public Service Company.

W. A. Walls, C. C. Collins, Columbus Railway and Light Company.

S. F. Messer, Warren Water and Light Company.

W. F. Hubbell, Wauseon Electric Light Company.

E. A. Bechstein, Sandusky.

R. R. Johnson, Northern Ohio Traction and Light Company, Akron.

J. E. Rockwood, Toledo Gas, Electric and Heating Company.

J. S. Rotting, East Liverpool Traction and Light Company.

B. S. Young, Ada, Ohio.

A. B. Young, Kent Water and Light Company.

D. W. Low, Alliance Gas and Electric Company.

The contests for the ladies were carried out with the scrupulous regard for fair play which was so splendidly illustrated last year by the referee-in-chief, W. P. Engel. The generosity of the manufacturers this year made it possible to distribute elaborate and costly souvenirs to nearly every one of the ladies present. These prizes were donated by the General Electric Company, Westinghouse Electric and Manufacturing Company, Libby Glass Works, W. J. Barr Electric Manufacturing Company, W. G. Nagel Electric Company, Electric Appliance Company, Robbins & Myers, Fisher Electric Company, American Electrical Heater Company, Post-Glover Electric Company, Cleveland Electrical Supply Company, Morean Gas Fixture Manufacturing Company, Star Electric Company, F. Bissell Company, Erner Electric Company, Doubleday-Hill Electric Company and the Fort Wayne Electric Works. The prizes ranged in importance from a heating pad to a magnificent lamp and cathedral glass dome. They were awarded as follows:

Euchre contest—(1) Mrs. P. J. Williams, Columbus, Ohio; (2) Miss F. M. Tait, Dayton, Ohio; (3) Mrs. George A. Williams, Cincinnati; (4) Miss Mary Gaskill, Greenville.

Guessing contest—(1) Miss Helen Gaskill, Greenville; (2) Mrs. George A. Williams, Cincinnati; (3) Mrs. H. C. Houck, Cincinnati; (4) Mrs. J. T. Kermode, Cleveland; (5) Mrs. A. A. Serva, Fort Wayne, Ind.

Bowling contest—(1) Mrs. Z. T. Dorman, Greenville; (2) Mrs. William

Digitized by Google

Adams, Elyria; (3) Miss Annette Miller, Mount Gilead; (4) Miss Mary Gaskill, Greenville.

Pedro contest—(1) Mrs. W. H. Kelsey, Cleveland; (2) Mrs. E. L. Booth, Bellaire; (3) Mrs. George R. Craven, Cleveland.

Second euchre contest—(1) Mrs. A. A. Serva, Fort Wayne, Ind.; (2) Mrs. P. J. Williams, Columbus; (3) Mrs. Z. T. Dorman, Greenville; (4) Miss Mary A. Gaskill, Greenville; (5) Miss Annette Miller, Mount Gilead; (6) Mrs. F. M. Tait, Dayton; (7) Mrs. R. E. Gorton, Warren, Ohio; (8) Mrs. F. B. Houghton, Cleveland.

W. P. Engel, the president-elect of the association, is easily one of the most popular central station men in the central states. His quiet earnestness has won him the admiration of the electrical fraternity, and his integrity of purpose and loyal service to the association made him the logical candidate for the executive position. Mr. Engel is of German descent, and was born at Kenosha, Wis., in 1861. He learned the baker's and confectioner's trade with his father, but at eighteen years of age became a trackman for the Chicago & Northwestern Railway, afterward becoming fireman on a passenger train between Harvard Junction and Elroy on the same system. In 1883 Mr. Engel visited England, France and Germany, and saw the first German alternator set up in Berlin by the Siemens & Halske Company. He became acquainted with one of the younger Halske sons, and took a deep interest in electrical machinery. Upon his return to this country he worked as a lineman for the Arc Light and Power Company, Chicago. He then took charge of a lighting plant at Charlotte, Mich., afterward purchasing this plant, which he still operates. Mr. Engel purchased the Defiance plant in 1900. This plant had been operated by several companies, all of whom had suffered disaster and inflicted pecuniary burdens upon their stockholders. Mr. Engel has successfully brought the plant out of this condition, and is operating what is known as the People's Gas and Electric Company, which supplies all of the public utilities of the city of Defiance, excepting the waterworks, namely: electric light plant, gas plant, hot water heating plant on the Yaryan system, the street-railway system, and a summer resort known as Island park. Mr. Engel is a member of the Northwestern Association, and has been affiliated with the Ohio Electric Light Association since 1900, serving on the finance committee in 1904, and on the executive committee in 1905.

The representatives of the manufacturers and supply men were out in force, and contributed very largely to the success of the convention. The large reception room of the Hotel Victory was divided into sections, where a number of very interesting exhibits were shown.

The General Electric Company showed a number of new heating and cooking devices, new high-efficiency lamps, and the latest improvements in metallized filament lamps with Holophane shades. The company was represented by its host of good fellows, including W. J. Hanley, H. B. Goodloe, of Columbus; J. B. Pevear, H. C. Houck, A. H. Meirose, L. R. Dunkle, A. E. Alley and R. W. Palmer, of Cincinnati; A. S. Hertz, Cleveland; H. J. Mauger, C. F. Conn and N. R. Birge, of Schenectady; F. W. Willcox and G. C. Osborn, Harrison, N. J.

The Westinghouse Electric and Manufacturing Company had an elaborately decorated exhibit in one of the parlors, just off the main reception room. Their blue silk banners were a conspicuous adornment of their headquarters. The company exhibited a line of portable instruments, direct-current, single-phase and polyphase wattmeters, arc lamps for all circuits, and fan motors—ceiling and desk types. On behalf of the Sawyer-Man Electric Company the Westinghouse company distributed an incandescent lamp dictionary. In addition to the other literature of the company the book of Westinghouse views was greatly appreciated. The company was represented by George B. Dusinberre, R. W. Beebe, C. O. Baker and C. P. Billings, of Cleveland; J. W. Schrantz and J. A. Brett, Cincinnati; T. L. Schrantz and H. C. Marsh, Cleveland; W. F. Fowler, J. C. McQuiston and J. H. Wagenhorst, Pittsburg.

Exhibit of the Brilliant Electric Company, at the Convention of the Ohio Electric Light Association, Put-in-Bay, August 21, 22 and 23.

The Brilliant Electric Company had a handsome exhibit of the Brilliant tantalum and Brilliant "Gem" high-efficiency lamps. This exhibit, when lighted up in

Digitized by Google

the evening, was very generally admired. A feature of the exhibit which attracted a great deal of attention was the "Gem" tipless lamp in process of construction. The method of exhausting the Brilliant tipless lamp through the stem was the centre of a good deal of attraction. The company wes represented by E. J. Kulas, secretary and general manager; R. S. Jackson and E. V. Hennecke, who is in direct charge of the tantalum and "Gem" lamp departments. The company distributed a unique souvenir in the form of a small cigar enclosed in a 110-volt sixteen-candle-power tipless bulb, the base of which was cemented as in regular practice.

The Lafayette Electrical Manufacturing Company exhibited its new transformer, the exhibit being presided over by William Hornberger, the designer of this apparatus.

The Allis-Chalmers Company's exhibit consisted of induction motors, air-compressor and brake appliances, turbine blading, and a full line of literature. The company was represented by F. C. Colwell, Cincinnati; Clay Sprecher, Cleveland, and George A. Williams, Milwaukee.

The Phelps Company showed a number of advertising novelties, including the "Wink" sign frame, "Skedoodle J" turndown lamps, and the winking owl and dog. The company was represented by W. J. Phelps and F. T. Benson.

The Wagner Electric Manufacturing Company made a choice display of switchboard apparatus, portable indicating instruments, and single-phase elevator motors. The company was represented by C. E. Delafield, manager of sales; Walter Robbins, St. Louis; Dean Emerson, Cincinnati, and L. B. Hoit, of Cleveland.

The Electric Appliance Company showed a line of "Sangamo" motors, "Gem Zenith" and "Gem Packard" lamps. Represented by P. R. Boole and George R. Porter, Chicago.

The Nernst Lamp Company made an exhibit of its series street-lighting system, using the Nernst lamp in conjunction with arc lighting. Represented by Max Harris and S. P. Wilbur, Pittsburg; J. F. Hoover, Cincinnati; James L. Anderson, Columbus, and Charles H. Davis, Chicago.

The H. W. Johns-Manville Company exhibited a comprehensive line of oil switches, cutouts, service and subway boxes, fuse boxes and "Sachs Noark" fuses and fuse blocks. Represented by R. R. Braggins and H. McKinley, Cleveland.

The Simplex Electric Heating Company exhibited a line of household, laundry and tailors' irons, cooking utensils, including a chafing-dish outfit and quick-heating water cups, soldering and curling-iron heaters, dentist's sterilizer, and a glue pot and heating pads. This exhibit was in charge of I. W. Reynolds.

The Pittsburg Transformer Company showed a line of Pittsburg transformers and distributed some attractive literature. The exhibit was in charge of H. G. Steele, secretary, Pittsburg, Pa.

Among others who were present were J. C. Fish, president, and R. G. Van Horn, of the Shelby Electric Company. This company distributed a valuable souvenir in the form of a pocket receptacle containing court plaster neatly arranged in various shapes.

The Fort Wayne Electric Works—A. A. Serva and George B. Edgar.

Erner-Hopkins Company—W. A. Hopkins and H. B. Rogers.

Sangamo Electric Company—J. H. Hodde.

Curtis Advertising Company—C. H. Johnston and C. A. Parker.

National Carbon Company—N. C. Cotabish, A. B. Pyke and A. G. Summerell.

C. W. Lee Company—Frank B. Rae, Jr., secretary.

The Hoit Engineering Company—L. B. Hoit and C. B. Kelley.

W. J. Barr Electric Manufacturing Company—Thomas E. Barr, W. J. Barr and George R. Craven.

Bryan-Marsh Company—Fred W. Godfrey.

Doubleday-Hill Electric Company—Elliott Reynolds.

Fisher Electric Company—H. O. Fisher, manager.

Consumers' Rubber Company—J. N. Kirby.

Cleveland Electrical Supply Company—H. H. Cudmore and W. C. Marker.

F. Bissell Company—F. Bissell, F. M. Knierim and A. F. Knierim.

New York & Ohio Company—Robert E. Gorton.

Cleveland Window Glass Company—R. P. Anthony.

Erner Electric Company—F. R. DuGuay.

Osburn Flexible Conduit Company—W. P. Ambos and J. L. Carlton.

John A. Roebling's Sons Company—J. W. Brooks.

Post-Glover Electric Company—E. L. Van Winkle.

F. D. Lawrence Electric Company—C. S. Nolloth and P. J. Williams.

Benjamin Electric Company—S. R. Fralick.

Stanley-G. I. Electric Manufacturing Company—Oscar Carman.

Barney Electrical Supply Company—Thomas H. Harris.

W. G. Nagel Electric Company—A. J. Carney.

Cleveland Library Bureau—T. E. Crawford.

Buckeye Electric Company—F. Bliss.

J. Robert Crouse was kept busy talking about the progress of the work of the Co-operative Electrical Development Association. This work has been taken very closely to heart by the Ohio central station men and Mr. Crouse's representations were very much appreciated and earnestly endorsed.

A rejuvenation of the Sons of Jove was scheduled for Wednesday evening, but this was omitted, and in the early part of the evening an impromptu concert was given in one of the spacious parlors under the general direction of E. J. Kulas. Several splendid tenor solos were rendered by C. A. Parker, of the Curtis Advertising Company, and Mr. Kulas and J. L. Carlton also responded. The entertainment, however, was broken up by the announcement of dancing, which, although held under more or less distressing circumstances because of the hot weather, was appreciated and attended by many of those present.

Electric Power to Rid London of Smoke.

A plan has been proposed by Arnold Lupton, a member of the British Parliament, the object of which is to do away with the burning of fuel in London. The plan contemplates the use of electric power for heating, lighting and cooking in London, the power to be brought from the coal fields of the Midlands. In this way all furnaces and smoke producers will be driven from the city. It is estimated that the smoke nuisance causes actual damage every year amounting to about $10,000,000, and this does not include any allowance for the personal discomfort which it causes. The idea is not only to do away with this nuisance, but to supply the power on such a scale that it will be a cheap substitute for the present source of light, heat and power.

The plan proposed contemplates the transmission of electrical energy from the Midland coal fields, 120 miles away from London, at 60,000 volts. The average power to be supplied is about 1,000,000 kilowatts. Mr. Lupton estimates that, if done on this scale, power could be delivered in the city at one-half cent per kilowatt-hour and could be delivered in small quantities at a rate of two cents and in larger quantities for less. It is also estimated that it will cost about $17,000,000 to make a beginning. Mr. Lupton thinks that this would make London one of the sunniest cities on the globe, as well as the most beautiful city in the world.

Digitized by Google

A Visit to the Power-Houses of the Brooklyn Edison Electric Illuminating Company.

The Edison Electric Illuminating Company, of Brooklyn, N. Y., extended an invitation to all the electrical contractors of that city to visit its two great power-houses at the foot of Gold street, and Sixty-sixth street and New York bay, on Thursday of last week. The response included virtually the entire list of contractors of that borough. The trip was made in automobiles, and a dinner was served at Luna Park, Coney Island, in the evening. Starting from the Edison club rooms, a new and promising institution of the illuminating company in the Johnson Building, Brooklyn, the first visit was made to the Gold street station, which was found to be undergoing rapid and very complete expansion. The party then went to the Bay Ridge station and from there to Coney Island.

The attendance included Vice-President and General Manager W. W. Freeman and several of his associates, among whom were J. Becker and M. S. Seelman, Jr. Mr. Freeman presided at the banquet, and at its conclusion delivered a very interesting little talk respecting the agreeable cooperating relations existing between the illuminating company and the contractors, and alluded at some length to the growth of the lighting facilities in Brooklyn.

The Edison Electric Illuminating Company of Brooklyn began business on September 2, 1889, at 360 Pearl street, and supplied the first incandescent lamp system in Brooklyn. The company's generating equipment at that time consisted of two 250-horse-power engines, each belted to two 100-kilowatt dynamos on the floor above. This apparatus, with the low efficiency lamp then in use, would furnish current for about 7,000 lamps.

The two principal generating stations of the Brooklyn Edison Company to-day are located at the foot of Gold street, and at Sixty-sixth street and New York bay. They supply electrical energy to a connected load, which on August 1, 1906, equalled an equivalent of 1,052,380 sixteen-candle-power lamps, in addition to which uncompleted installations had been contracted for exceeding 75,000 equivalents.

Extensive alterations, additions and extensions are being made at the Gold street station of the company, and when these are completed and generating apparatus already ordered or planned for installed, this will be one of the most modern and important electric power-houses in the country, with a capacity exceeding 85,000 kilowatts, which would be sufficient to meet the maximum demands of a connected load amounting to 4,250,000 sixteen-candle-power incandescent lamps.

The improvements already made or anticipated at the Gold street station, briefly stated, are as follows:

The roof of the operating room has been raised eighteen feet. The station has been entirely remodeled, the walls practically rebuilt, and two wide mezzanine galleries added. A seventy-five-ton traveling crane and runway has been installed. The installation of an Allis-Chalmers horizontal

ELECTRICAL CONTRACTORS' VISIT TO THE POWER-HOUSES OF THE BROOKLYN EDISON ELECTRIC ILLUMINATING COMPANY—PHOTOGRAPH TAKEN IN FRONT OF BAY RIDGE STATION OF THE EDISON ELECTRIC ILLUMINATING COMPANY, OF BROOKLYN.

Digitized by Google

steam turbine, capable of generating 8,000 kilowatts. This is now in operation. Within a month a Westinghouse turbine of the same type and capable of generating 11,000 kilowatts will be in commission at this plant, and a third turbine of the larger size will be installed in 1907. More turbines will be added from time to time, as the demands of the system warrant, until the ultimate capacity of the new station equipment, 85,000 kilowatts, is reached.

An entirely new condensing water system has been constructed, consisting of concrete intake and overflow tunnels, and connections to these, made ready for the installation of the condensing apparatus of the turbines. Two of these units are now connected.

On the water front an entirely new dock and bulkhead has been constructed, and on this deck a complete system for the rapid and efficient handling of coal and ashes is being installed. The coal-handling system consists of two towers equipped with engines for hoisting and crushing the coal, hoppers for distributing the coal to cars, and a cable runway for handling the cars and conveying the coal to the bunkers, from which it passes through chutes as needed to the boiler-room floor. This system, when complete, will be able to deliver coal to the bunkers at the rate of 250 tons per hour.

The ash-handling system consists first of runways in the boiler-house basement, on which are operated cars receiving the ashes from the hoppers under each boiler. The ash cars deliver their loads to a vertical conveyor, which takes the ashes up and delivers them into the ash pocket on the dock. From here they are dumped directly into scows and towed out to sea.

During the coming year the old building back of the present station and extending through to John street will be torn down, and foundation laid for a new boiler-house, which will contain, eventually, 52,000 boiler-horse-power. It is expected to install sixteen of the ultimate eighty boilers at first, and to add to these as the need of steam for turbines develops.

The cost of the Gold street equipment already installed or ordered, and of the work completed, under way and contracted for, will exceed $2,500,000. This, as well as the further and very heavy recent expenditures at the Bay Ridge power-house, and for substations and extensions to the system, is an investment of capital by the stockholders of the company, following a broad-gauge policy which looks to future developments in Brooklyn to return a reasonable revenue on the money invested. These vast sums are being expended to provide the company's customers with a service as nearly perfect as possible, and to make adequate provisions for the increased business which will unquestionably result from the growing popularity of electricity in its light and power manifestations and the rapid and continuous development of the borough of Brooklyn as a residential, mercantile, manufacturing and commercial centre.

At the Bay Ridge power-house $750,000 has been spent during the past three years in improvements and additions. These include the installation of an additional 5,000-horse-power vertical cross-compound engine, direct connected to a three-phase alternating-current generator, capable of generating 3,750 kilowatts of current, one of three of this type and size now in use, in addition to smaller units at this station. Also a new boiler-house and boilers, a new steel coal hoist, pocket, endless-chain bucket-conveyor and cable railway, and new intake tunnels for condensing purposes. The total capacity of the Bay Ridge power-house exceeds 14,000 kilowatts.

The current as generated is alternating, three-phase, twenty-five cycles, 6,600 volts. The output is delivered to the fourteen substations of the company scattered throughout the borough. In alternating-current districts it is there stepped down to 2,400 volts and sent out along primary feeders to individual transformers, and there again reduced to standard consumption pressure, 115 volts for lighting and 230 volts for power. In direct-current districts primary current at 6,600 volts is stepped down at the substations to either 87 or 174 volts alternating, and converted in rotaries to 115 or 230 volts direct, and as such distributed to the mains.

At six of the substations, Pearl street, Rockwell place, Myrtle avenue, Sumpter street, Ainslie street and Atlantic avenue, are located storage batteries. This equipment is in the nature of a reserve and to provide a positive assurance against interruption of service on direct-current circuits. These batteries are not, however, the only provision against extraordinary emergencies, for the company's generating plants are so connected that in case of difficulty with any one unit its load is automatically transferred to the others.

As a matter of statistics, the Edison company's distributing equipment includes 556 miles of underground cable and 1,327 miles of overhead wires.

A photograph of the party, taken in front of the Bay Ridge station, is reproduced on the opposite page.

The contractors present were: F. A. Armstrong, Addison W. Brown, Frank G. Blanchard, A. S. Beach, Howard W. Bishop, C. H. Clarke, Henry Fallek, A. E. Greene, M. J. Hanson, William Hirkenstein, William Huth, John L. Kruger, Mr. Kebbe, Mr. Lillianstein, Peter J. Minch, P. O'Rorke, I. I. Prevost, M. R. Rodrigues, F. J. Rhoades, Eugene B. Stratton, Charles A. Soper, E. J. H. Thiemer, A. Weiderman and F. H. Ward; and representatives of the following companies: Acme Electrical Construction Company, Bateman & Miller, Peter Quinan & Company, Harding & Roth, Kent Grete Electric Company, Levine Electric Equipment Company, LeManquis Electrical Manufacturing Company, E. Murphy & Son, R. Manquis & Sons, George Weiderman Electric Company and R. J. Ward & Son.

The Convention of the Association of Edison Illuminating Companies.

The convention of the association of Edison illuminating companies will be held at the Hotel Frontenac, Thousand Islands, N. Y., on Tuesday, Wednesday and Thursday, September 4, 5 and 6.

In addition to the executive session and various forms of entertainment the following programme has been announced:

"Costs of and Results from Advertising and Soliciting," H. K. Mohr, Philadelphia, Pa.

"Details and Costs of an Inexpensive Underground System for Alternating Distribution in the Semi-Suburban Residence Districts of a Large City"—a symposium of short papers by the underground experts of the large companies—W. T. Morrison, New York; Wm. C. L. Eglin, Philadelphia; D. W. Ropes, Chicago; Sidney Hosmer, Boston.

"Adjuncts to the Power Load," C. J. Russell, Philadelphia.

"Investigation of Various Losses in the Electrical System of the Edison Electric Illuminating Company of Boston," L. L. Elden, Boston.

"Recent Developments in Incandescent Lamp Manufacturing," F. W. Willcox, Harrison, N. J.

"Various Types of Lamps and Practical Hints on Illumination," Steven B. Burrows, Brooklyn.

"The Isolated Plant Question," M. F. McAlpin, New York.

"Alternating-Current Motors for Various Purposes, with Especial Application to Elevators," E. W. Lloyd, Chicago.

"Evening Talk with Stereopticon Illustrations," W. S. Andrews, Schenectady.

"Legislative Influence on Income Through the Meter," Caryl D. Haskins, Schenectady.

"A Brief Report on Municipal Ownership," Arthur Williams, New York.

Digitized by Google

The Convention of the American Street and Interurban Railway Association.

The annual convention of the American Street and Interurban Railway Association will be held at Cleveland, Ohio, October 15, 16, 17, 18 and 19. The executive committee will probably be located at the Southern Hotel and the Hartman will likely be the headquarters for the ladies of the convention.

The Central Passenger Association has granted an application for reduced fare, as have the Trunk Line Association and the Southeastern Passenger Association.

The Manufacturers' Association will have a very comprehensive exhibit, 135 different companies having already been assigned exhibit space.

Those in charge of the entertainment features of the convention will have some announcements to make in the near future. It is expected that there will be a theatre party on Wednesday evening, and that the annual banquet will be held on Thursday evening. In addition, there will be interurban trolley parties, automobile rides, golfing and a number of other forms of amusement, most of which will be especially arranged for the ladies of the convention.

The convention will be held at the Ohio State Fair grounds, where suitable halls are available, conveniently situated with respect to the exhibit of the Manufacturers' Association.

The programmes for the sessions of the American Street and Interurban Railway Association and the Engineering Association are given below, and in addition to the meetings of these associations the Railway Accountants' Association and the Claim Agents' Association will hold forth during the week.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.

WEDNESDAY, OCTOBER 17, 10 A. M. to 12.30 P. M.—Convention called to order; address of welcome; president's address; report of executive committee; report of secretary and treasurer; addresses by presidents of affiliated and allied associations; announcements; new business.

WEDNESDAY, OCTOBER 17, 2 P. M. to 4.30 P. M.—Reports of committees: (a) membership; (b) compensation for carrying mail; (c) subjects; (d) car wiring; (e) standardization of equipment; (f) insurance; (g) promotion of traffic.

THURSDAY, OCTOBER 18, 10 A. M. to 12.30 P. M. (Interurban Meeting).—Report of committee on heavy electric railroads. Paper—"Elevated Railways and their Bearing on Heavy Electric Traction," by H. M. Brinckerhoff, consulting engineer, New York city. Paper—"Electric Railways in Sparsely Settled Communities," by E. P. Roberts, of the Roberts & Abbott Company, Cleveland, Ohio. Paper—"Interurban Limited Trains," by Harrie P. Clegg, president Dayton & Troy Electric Railway Company, Dayton, Ohio. Paper—"Interurban Freight and Express," by E. C. Spring, general manager Dayton, Covington & Piqua Traction Company, West Milton, Ohio. Paper—"Tickets and Rates," by F. W. Coen, secretary and treasurer Lake Shore Electric Railway Company, Cleveland, Ohio. Paper—"Some Distinctions Between City, Suburban, Interurban and Railroad Traffic," by Theo. Stebbins, expert, National Civic Federation, Cohasset, Mass. Appointment of nominating committee.

THURSDAY, OCTOBER 18, 2 P. M. to 4.30 P. M. (Employés' Meeting).—Report of committee on rules. Paper—"Y. M. C. A. Branches," by E. M. Willis, railroad secretary international committee of Y. M. C. A., New York city. Paper—"Selection of Trainmen," by C. E. Learned, superintendent of inspection Boston Elevated Railway Company, Boston, Mass. Paper—"Discipline of Trainmen," by F. W. Brooks, assistant general manager Detroit United Railway, Detroit, Mich. Paper—"Uniforms and Badges," by John R. McGivney, purchasing agent New Orleans Railway and Light Company, New Orleans, La.

FRIDAY, OCTOBER 19, 10 A. M. to 12.30 P. M. (Executive Session).—Report of committee on municipal ownership; report of committee on public relations. Paper—"Handling Public Complaints," by John A. Beeler, vice-president and general manager Denver City Tramway Company, Denver, Col. Paper—"Leaks Between Passenger and Treasurer," by A. H. Stanley, general superintendent Public Service Corporation of New Jersey, Newark, N. J.

FRIDAY, OCTOBER 19, 2 P. M. to 4.30 P. M.—Report of nominating committee; election of officers; resolutions; unfinished business; adjournment.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION.

MONDAY, OCTOBER 15, 10 A. M. to 12.30 P. M.—Registration; convention called to order; address of welcome; address—Hon. W. Caryl Ely, president American Street and Interurban Railway Association; address—Prof. Bernard V. Swenson, secretary and treasurer American Street and Interurban Railway Association; reading of the minutes of the last meeting; address of the president; annual report of the executive committee; annual report of the secretary and treasurer; appointment of convention committees.

MONDAY, OCTOBER 15, 2 P. M. to 5 P. M.—Report of special committees; report of committee on control apparatus; report of committee on maintenance and inspection of electrical equipments; paper—"Ballast," by Charles H. Clark, engineer maintenance of ways Cleveland Electric Railway Company, Cleveland, Ohio; report of committee on way matters; paper—"Ties, Poles and Posts," by C. A. Alderman, chief engineer, Cincinnati Traction Company, Cincinnati, Ohio.

TUESDAY, OCTOBER 16, 10 A. M. to 12.30 P. M.—Report of the committee on standardization. Paper—"Gas Engines," by Paul Winsor, chief engineer motive power and rolling stock, Boston Elevated Railway Company, Boston, Mass. Paper—"Underground Cables," by H. G. Stott, superintendent motive power Interborough Rapid Transit Company, New York, N. Y.

TUESDAY, OCTOBER 16, 2 P. M. to 5 P. M.—Paper—"Economy of Car Equipment, Weights and Schedules," by E. H. Anderson, Schenectady, N. Y.; discussion of the question box.

TUESDAY, OCTOBER 16, 8 P. M.—Informal reunion and dinner.

WEDNESDAY, OCTOBER 17, 10 A. M. to 12.30 P. M.—Joint meeting with "American" Association.

WEDNESDAY, OCTOBER 17, 2 P. M. to 5 P. M.—General business; election of officers.

New York, New Haven & Hartford Railroad Trolleys Sold.

It has been announced that the New York, New Haven & Hartford Railroad has disposed of its entire group of trolley lines to a voluntary association. The new association which now owns the trolley systems is to be known as the New England Security and Investment Company. It is understood that the sale or transfer involves all of the railroad company's holdings. This means about 600 miles of completed trolley lines in Connecticut, Massachusetts, Rhode Island and New York.

The lines in Connecticut form the largest group, fully seventy-five per cent of the entire street-railway system in that state having belonged to the New York, New Haven & Hartford Railroad. This includes the street railroads of Hartford, Willimantic, New London, New Haven, Bridgeport, Stamford and Norwich. In Massachusetts the holdings include the systems in Springfield and Worcester, the Berkshire Street Railway, and the Worcester & Southbridge Street Railway, as well as the Worcester & Blackstone Valley Street Railway.

Digitized by Google

A New Ozone Water-Sterilizing Equipment.

By Frank C. Perkins.

THE accompanying illustrations show the apparatus and methods of operation of a new system for the sterilization of water by means of ozone, electrically produced, this equipment having been constructed at Berlin, Germany, by the Siemens-Schuckert Company.

This apparatus is so arranged that a military outfit can be packed upon wagons for transportation in order that the troops in the field or at military stations may be provided with sterilized water for drinking purposes.

For military purposes it is of especial importance that the troops be supplied in the field with pure water, and this electrical apparatus may be connected with any ordinary direct-current circuit, thus supplying the necessary ozone for purifying the water.

A glass sterilizing column is utilized, about sixteen inches high, the ozone apparatus being mounted in a wooden case. A water inlet and exit is provided at the top and bottom of the column which is filled with small porcelain, clay or glass balls and is equipped with a differential gauge and a measuring tube having a throttling valve, this arrangement determining exactly the amount of ozone passing through the column by noting the data on a standardized table.

A ten-piece Siemens glass-tube ozone device is provided within the case, together with a transformer and a small direct-current motor, operating a small blower utilized for forcing the air through the ozone apparatus. A rotating circuit-breaker is employed which provides the necessary interrupted direct current for the primary coils of the transformer, and a wash bottle is utilized for drying the air by means of calcium chloride or sulphuric acid. A vertical switchboard is provided with the necessary switches and regulating resistances for the motor circuit, as well as the transformer primary interrupted direct-current circuit.

The Siemens ozone tubes consist of concentric glass cylinders, one placed within the other, and fused together at the top. The outer one is placed in cooling water, while the inner one is filled with water, this being utilized as a conductor of the high-tension current to the discharge poles of the ozone apparatus.

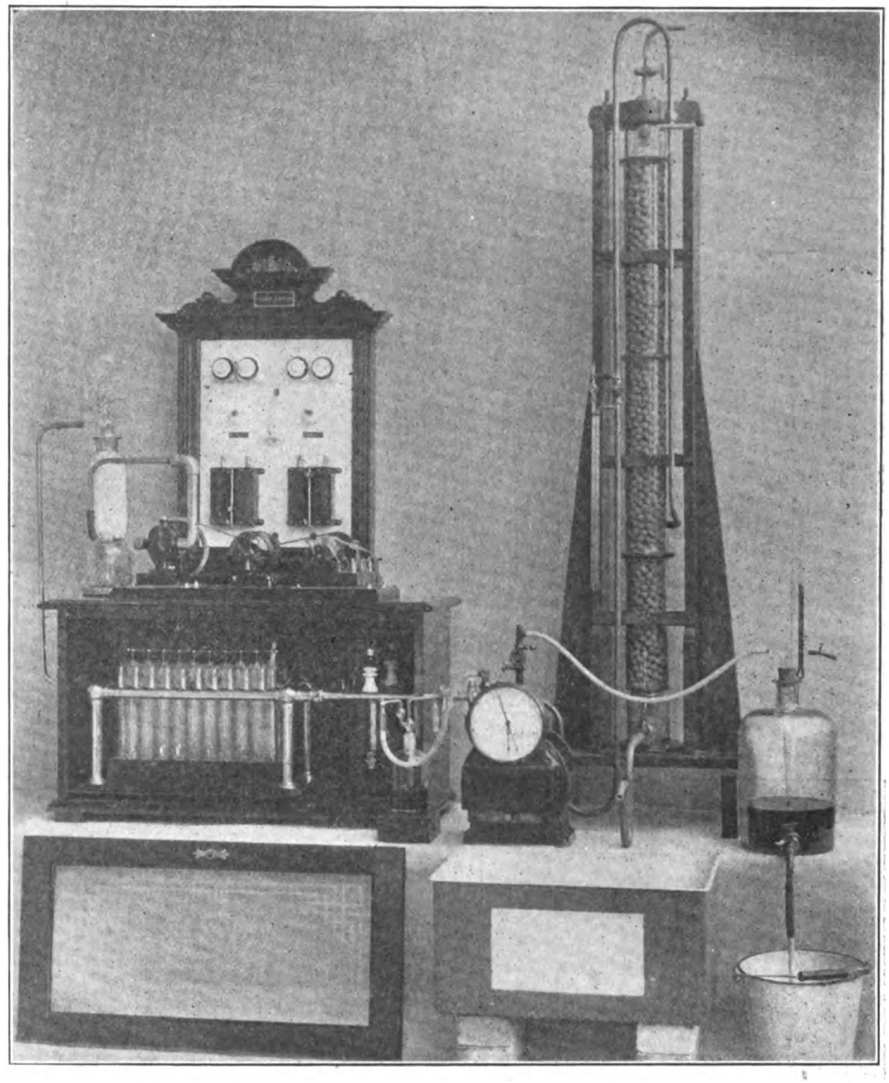
Where alternating current is available only, motor-generators are provided, a small direct-current dynamo supplying the necessary continuous current to the transformer, this dynamo being operated by an alternating-current motor of about one-half horse-power in the main supply circuit.

The motor-generator set is first placed in operation, and when the interrupter is rotating in a proper manner the circuit is closed to the transformer. The proceeding is reversed in stopping the process, the transformer circuit being first opened, and then the motor circuit being opened at the switchboard.

About one-half horse-power is required for operating the laboratory installation, which furnishes 130 to 260 gallons per hour. To determine its concentration, about six grammes of the ozone are tested by introduction into a slightly acid solution of potassium iodide. It is held that if pure oxygen be passed through the apparatus instead of air, the output is several times as great.

In St. Petersburg and in Munich, ozone installations have been employed, producing as high as 25,000 gallons per hour. In the former plant the sterilized water is used for drinking purposes in its natural state, while at Munich it is employed in a large brewery, while mineral water is being sterilized by ozone at a plant in Astrakhan.

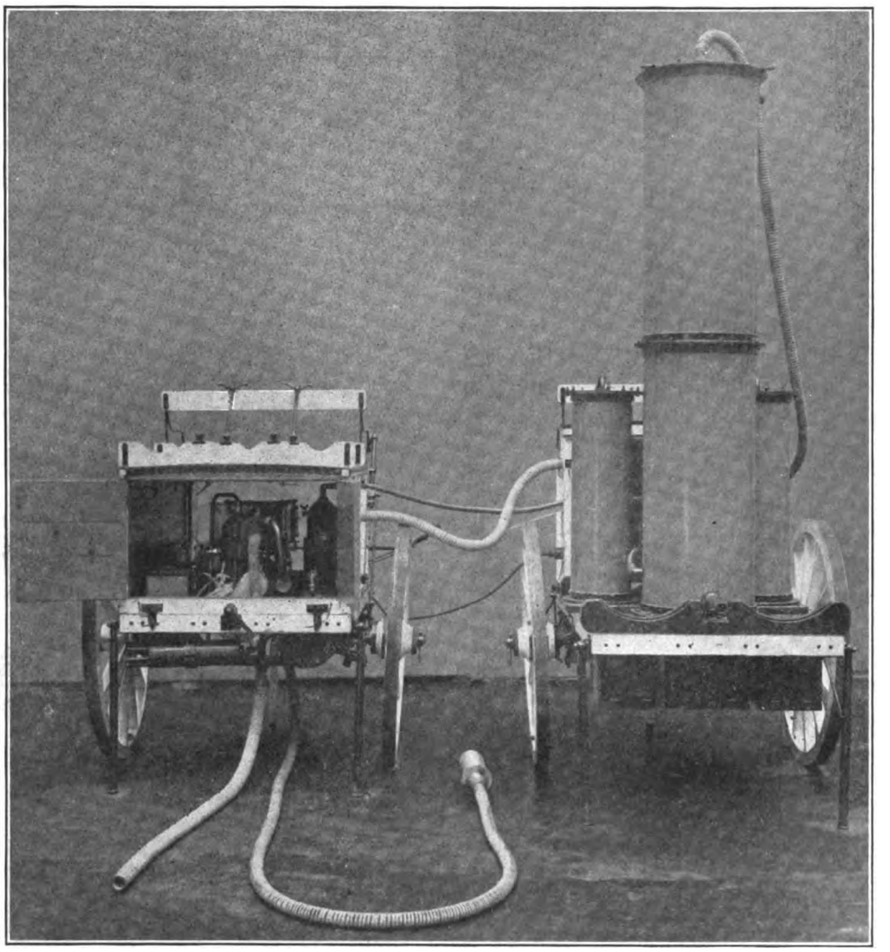
During the recent war in Manchuria the Russian army was provided with portable sterilization outfits, and these equipments are also in use for military service by other European governments for supplying water to fortifications and in military camps. A special wagon is provided with motors, generator and sterilizing ap-



SIEMENS-SCHUCKERT ELECTRIC OZONE WATER-STERILIZING APPARATUS.

Digitized by Google

paratus, the power being supplied by gasolene or alcohol engines, directly connected to a generator. A small rotary water pump

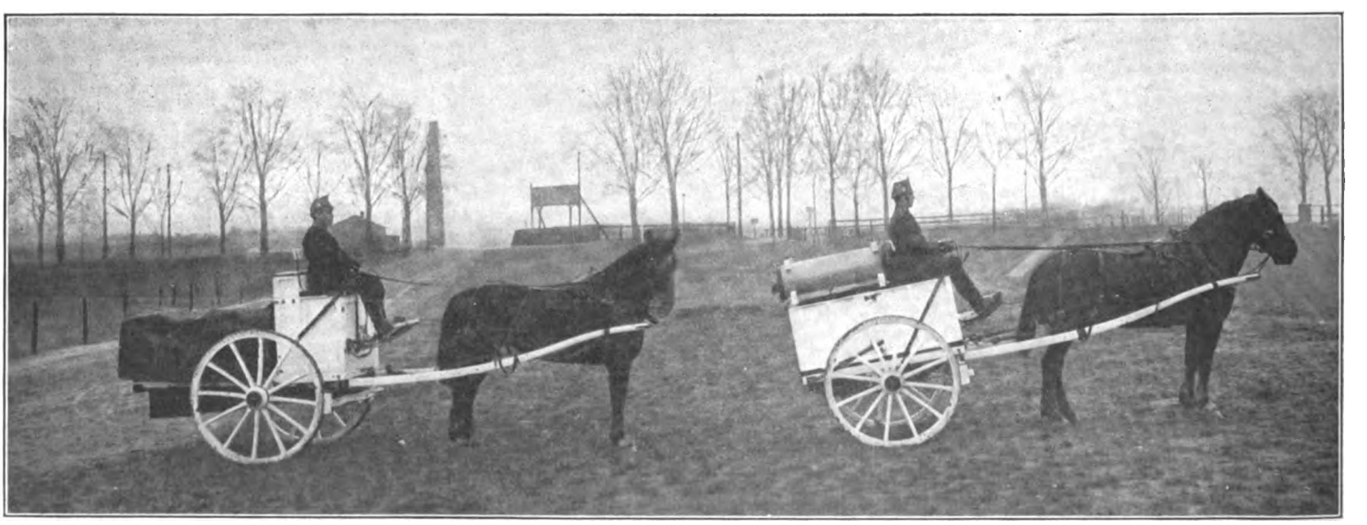


PORTABLE GERMAN MILITARY ELECTRIC OZONE WATER-STERILIZING OUTFIT.

is provided to draw the feed-water from the source of supply, and force it into the sterilizing column, and a small blower is used to supply the air for the ozone apparatus, the air being previously dried by passing it through calcium chloride. There are two spring-supported Siemens ozone cases mounted on another sterilizing vehicle. This equipment includes eight ozone tube elements and a transformer under the ozone apparatus for the production of the high-tension current from the low-tension primary alternating current supplied by the cable from the machine wagon. There are three parallel rapid filters provided also, consisting of metal cylinders in which are placed closed filter bags through which the feed-water is forced before it is pumped into the column, and is thus largely freed from suspended impurities. A cylindrical metal sterilizing column about eight feet in height is used filled with pieces of cement-covered pumice stone about the size of small pebbles. This column is arranged in two parts, each having a perforated space, and placed one upon the other, which permits the parts to be taken to pieces in sections easily, as they are joined by bolts.

This portable equipment weighs about a ton and produces about 800 gallons of pure water per hour. The engine which drives the small alternating-current dynamo is of about two horse-power. Such a large amount of ozone is produced that even though the water be in a very bad condition it is thoroughly sterilized. This is worked so as a matter of precaution, a very much greater amount of ozone being produced than is really necessary in order to ensure pure sterilized water for drinking purposes.

One of these outfits was utilized in one of the great military camps at Harbin during the recent Russian-Japanese war and is said to have given excellent satisfaction. Each of the military wagons is hauled by a single horse and weighs about a ton. Under ordinary conditions this plant supplies from 75 to 100 cubic feet per hour. The simplicity of operation and ease with which a plant of this design can be transported makes it of special importance for use in army service, as pure water is one of the first requirements in military camps.



GERMAN OZONE WATER-STERILIZING APPARATUS ON WAGONS READY FOR TRANSPORTATION TO ARMY CAMPS.

Digitized by Google

International Association of Municipal Electricians.

Report of the Eleventh Annual Meeting held at New Haven, Ct., August 15, 16 and 17.

THE eleventh annual convention of the International Association of Municipal Electricians was held at New Haven, Ct., August 15, 16 and 17.

The meeting was called to order by President Jerry Murphy, of Cleveland, Ohio, at 10.30 A. M. on August 15, and after an invocation by the Rev. Mr. Knight and addresses of welcome by the mayor, the Hon. J. P. Studley, and the governor of Connecticut, the Hon. Henry Roberts, with responses by A. S. Hatch and J. B. Yeakle, the usual business was taken up.

The president's address had for its theme the duties of a city electrician. Following his address Mr. Murphy read a paper on the "Advisability of Placing the City Electrician Under Civil-Service Rules." He expressed himself as being in favor of the plan, as in his opinion it would cause a better class men to seek the position.

In the discussion which ensued it was shown that some members did not favor the present systems of examination and of enforcement of the civil-service rules. They should be so amended as to eliminate politics.

A resolution was introduced and carried appointing a committee to investigate the matter and report at the next convention. A. S. Hatch, W. M. Petty and C. R. George comprise this committee.

The appointment of the nominating committee and the reading of certain communications closed the morning session.

In the afternoon the members took up matters relating to electric light and power, A. S. Hatch, of Detroit, making a report, which was discussed by Messrs. Petty, Bradshaw, Smith, George, O'Hearn and others.

Mr. Hatch also read a paper on "The Trackless Trolley," following which questions in the Question Box relating to electric lighting were taken up.

They were as follows:

"How are 'outs' reported and what record is kept of them? What notices are given the company?"

"Do you prefer mast arms or centre suspension in order to put the lamp in the centre of the street? With the former the lamp is not quite in the centre and with the latter there are two poles instead of one in the street."

"What restrictions are made in the disposal of broken globes and carbon stubs? How badly broken may the globe be before it must be changed?"

"What constitutes dark and moonlight nights? If the night is cloudy though moonlight, can you compel the lights to be turned on?"

"What methods are adopted to know the company is furnishing full current to the circuits?"

Regarding the reporting of "outs," the system adopted in the smaller towns was to have the police report the lamps out on their beats. This was then reported to the electric light company, which usually made it a practice of having men on duty to a late hour of the night to take care of such outs.

Mast-arms were considered the better means of suspending arcs wherever the streets were not heavily wooded. In such places the centre suspension was the better, although it had the disadvantage of requiring two poles.

The practice of throwing broken globes in the nearest lot as is done by some trimmers should be stopped. Many cities made it an offence punishable by fine for such practices.

The Philadelphia schedule was considered the best for places desiring a moonlight schedule. Most towns prefer the 4,000-hour schedule.

Regarding the methods adopted for knowing whether the company was furnishing full current to the circuits, it was the consensus of opinion that a periodical reading with a meter was the only practical method.

The evening was devoted to the consideration of the matters connected with the inspection department of the association. T. C. O'Hearn reported on a code, and a paper was read by C. R. George, of Houston, Tex., on "Conditions Surrounding the Inspection of Wires in the Southwest." This was discussed by Mr. Smith, of Norfolk, Va., who referred to several rules adopted by his city, among them those imposing a fine on carpenters and other craftsmen who interfered in any manner with the wires in buildings.

J. B. Yeakle said that in his opinion it was criminal neglect on the part of a municipality to permit poor installations of electrical apparatus.

Questions in the Question Box relative to the topic were then discussed. They were:

"What restrictions are placed on running services, particularly telephone and electric light services from distributing poles in the centre of the block with both classes of wires radiating in all directions, interlacing through each other?"

"What restrictions are placed on leakage of current from railway tracks to water pipes and what records are kept of such leaks?"

"What are the restrictions made concerning wires strung on buildings?"

"Who trims the trees, and what are the rules governing it?"

"Do any cities have an ordinance permitting or compelling pole lines being put on lot lines instead of streets and alleys where there are no alleys, or where they run in the wrong direction?"

These were answered by Messrs. Hatch, Brophy, Thompson, Smith, Bradshaw and others.

In his report for the aerial construction department Chairman W. Y. Ellett, of Elmira, N. Y., referred to the many improvements now being used in overhead construction, such as stronger and heavier material and means for keeping high and low-tension lines separate.

After a discussion by Messrs. Petty, Thompson, Gascoigne and others, bringing out many methods of ensuring good service in overhead work, the evening meeting adjoined.

Underground construction was the topic for the session of August 16, Louis Gascoigne, of Detroit, presenting his report on the subject and W. H. Thompson, of Richmond, Va., reading a paper entitled "Comparison of Underground and Overhead Wiring and the Relative Values of Single Rubber-Covered Wire and Lead-Encased Cable."

A question was also asked: "Is it not feasible to have a combined sewer and subway system, owned by the municipality, the subways to be rented to the public-service corporations?"

Discussing the above matters, Captain William Brophy gave some interesting history regarding the first attempt of the city of Chicago to put its wires under ground.

It was the consensus of opinion that all fire-alarm and police telegraph lines should be under ground, and the members favored both rubber and paper-encased wires for such cables.

It was decided that it was not feasible to have a combined sewer and subway system.

In the evening session of August 16 the subjects considered were fire-alarm

Digitized by Google

and police telegraphs. Reports were made by the chairman, J. B. Yeakle, of Baltimore, for the former, and T. F. Almon, of St. Louis, for the latter. Mr. Yeakle also read a paper entitled "Details of Certain Auxiliaries to Fire-Alarm Apparatus," and a paper by Adam Bosch, of Newark, N. J., was read, the title of the latter being "History of the Fire and Police Telegraph."

Questions relating to fire and police telegraph matters were:

"What is the most practical method of placing signal lights for police patrol boxes?"

"What would be a reasonable expense for the installation of such lights?"

Mr. Yeakle gave additional details of his systems of lighting fire-alarm boxes. The scheme had proved so successful that it was being extended throughout Baltimore. He uses eight-candle-power lamps enclosed in waterproof red globes and supplies the current to maintain the light from the nearest fire-house. He believes the cost does not exceed two cents per lamp per night.

Others expressed themselves as being in favor of some sort of distinguishing illumination of signal boxes at night. Mr. Petty said Rutherford, N. J., had red lamps installed on the same pole as the fire-alarm boxes, the lamps receiving current from the incandescent street circuits.

The morning session of August 17 was devoted to the business meeting. The following officers were elected for the ensuing year:

President—T. C. O'Hearn, Cambridge, Mass.

First vice-president—James Grant, New Haven, Ct.

Second vice-president—C. R. George, Houston, Tex.

Third vice-president—J. Berry, Indianapolis, Ind.

Fourth vice-president, W. H. Bradt, Troy, N. Y.

Secretary—Frank P. Foster, Corning, N. Y.

Treasurer—C. H. Diehl, Harrisburg, Pa.

Executive committee—A. D. Smith, Norfolk, Va.; J. B. Yeakle, Baltimore, Md.; William Crane, Erie, Pa.; Jerry Murphy, Cleveland, Ohio; W. H. Petty, Rutherford, N. J.; A. S. Hatch, Detroit, Mich.; W. H. Thompson, Richmond, Va.; C. F. McDonald, Ottawa, Canada.

Finance committee—L. W. Kittridge, New Haven, Ct.; C. E. Bradshaw, Charlotte, N. C.; W. D. Clayborne, Savannah, Ga.

Norfolk, Va., was selected as the next place of meeting.

During the convention exhibitions were made by the following companies:

Corning Glass Works, Corning, N. Y., an indestructible inner globe. After being used for some time in an arc lamp, and while still hot, this globe was plunged in cold water without cracking it. Also while in use the exhibitor would hold ice against it without causing it to crack.

The Gamewell Fire-Alarm Telegraph Company exhibited auxiliary fire-alarm forms of apparatus for the transmission and reception of alarms.

The Battery Supplies Company, Newark, N. J., exhibited its Gladstone-Lalande battery.

The Connecticut Auxiliary Fire-Alarm Company exhibited auxiliary fire-alarm apparatus of an improved type.

The Leeds & Northrup Company, Philadelphia, Pa., showed testing apparatus.

The Holtzer-Cabot Electric Company, Brookline, Mass., displayed many forms of telephone and other apparatus.

Stanley & Patterson, Incorporated, New York city, exhibited "Faraday" bells.

Telephones in Japan.

When a Japanese dies in Tokio one of the assets of his estate is his telephone, and the privilege of taking over the dead subscriber's instrument is worth, according to the Boston *Financial News,* just $400 to his heirs.

The government of Japan is interested in telephones for the reason that such instruments of communication are a monopoly in the little empire—a government monopoly. It is a fact of world-wide recognition that governments as a rule do not pay particular attention to industries which they may happen to possess a monopoly of—and this maxim is apparently true of Japan, though it is possible that Japanese telephone systems may be modernized.

The great complaint in Japan is not so much against the quality of the instruments and equipment of the systems as against the total inability of the government to supply service to all would-be subscribers. To get a telephone in Tokio a man either has to buy out a subscriber or wait his turn to secure an instrument, and there are no fewer than 8,000 people on the waiting list ahead of him.

The government is unable to supply the demand, for the simple reason that it has not the instruments, and has not the working force to install the telephones if it had them.

In Japan telephones are rented to subscribers at a flat rate; it makes no difference for what purpose they are used. A telephone for a private house costs just as much as one for a business office. In the city of Tokio, which has a population of a million and a half people, there are 22,000 telephone subscribers and thousands more who would willingly give $100 to secure accommodation.

The cost of a telephone in Tokio is $40 per annum, and that is gold, not silver, and the amount is payable strictly in advance. While the receipts of the government from its telephone monopoly are large, the cost of operations is comparatively light. For instance, it pays its linemen, the best of them, at the rate of fifty cents per day, and the nine-hour day has not yet been introduced in Japan. Switchboard operators are hired by the month, and they are paid $5 per month.

Notwithstanding the fact the net earnings from the telephone system of Tokio are very large and there is therefore every incentive to supply as many customers as possible, the government has so far found it impossible to keep even with the demand. In Tokio alone it is estimated that some four years will elapse before the government will be able to supply an instrument to the last man who puts his name on the waiting list. Of course many would-be subscribers die before their turn comes, and the man has the doubtful consolation of knowing that chances may throw an epidemic of disease among those on the waiting list, and, though he be spared, his chances of getting an instrument during his lifetime are immeasurably increased by the deaths of the others.

The Committee on Standard Rules of the American Street and Interurban Railway Association.

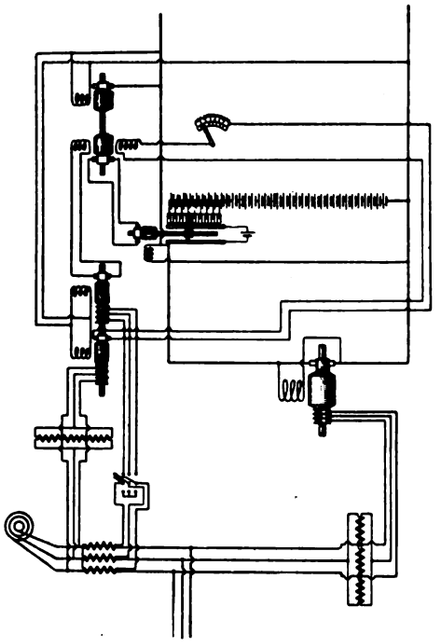
The committee on standard rules of the American Street and Interurban Railway Association has sent a data sheet to the general managers of the street and interurban railway properties of America. The committee desires to receive information as to whether the various companies have adopted the rules which were contained in the report submitted at the St. Louis Convention in 1904. The results of this investigation will form part of the committee's report which will be presented at the convention to be held at Columbus, Ohio, October 15 to 19.

The Independent Telephone Association of North Carolina and the Maine Independent Telephone Association have been organized within the last month. Both will affiliate with the International Independent Telephone Association.

Digitized by Google

Electrical Patents.

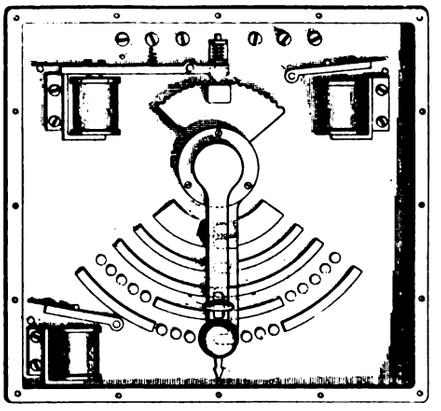
Albert S. Hubbard, Greenwich, Ct., has patented an electrical system of distribution (828,315, August 14). The invention relates to electrical systems of distribution, and more especially to systems in which there is an alternating-current generator connected through a rectifying device to a direct-current circuit in which is a battery connected across the circuit, and means are provided to automatically regulate the battery current. The object of the invention is to provide an efficient arrangement of apparatus to regulate the battery in accordance with the load on the alternating-current generator, and to this end is provided a special rectifying device which receives an alternating current that varies in accordance with the variations of load on the alternating-current generator, and causes the direct current from this rectifying device to energize or partly energize the field of a generator to govern the direction and intensity of the current from such generator. The current from this latter generator actuates a motor which operates in either direction to add to or remove



Electrical Distribution System.

cells from the battery circuit. The combination of an alternating-current generator and a circuit therefrom, a direct-current circuit, a rectifying device between the two circuits, a storage battery across the direct-current circuit, a motor controlling the number of cells in the battery circuit, a dynamo connected with the motor to supply current thereto, a field-coil for the dynamo, a rectifying device receiving an alternating current that varies in accordance with variations of load of the alternating-current generator, and a circuit including the direct-current end of the dynamo.

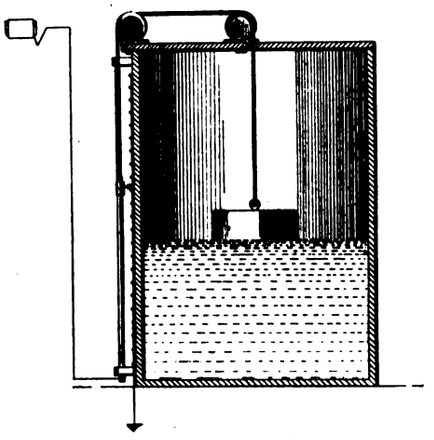
Samuel D. Black, Sherwood, Md., has obtained a patent on a motor controller (828,637, August 14), which he has assigned to the Manufacturers' Engineering Company, Baltimore, Md. The principal object of the invention is to provide a controller for use with motors, especially in their application to the individual driving of machine tools and the like, though it may be used in any case where variable-speed motors are used and where it is desired that they shall be easily and quickly controlled. In one form of the invention, the functions of the starting box and speed controller are combined with safety devices, such as overload and underload cut-outs, and with an arrangement permitting the quick reversal of the direction of rota-



Motor Controller.

tion of the motor without injurious sparking at the motor brushes. These are all controlled in the form of the invention shown in the patent by one handle without the use of any auxiliary handles or switches, thus enabling the operator to control the motor and the machine driven by it with one hand, and the whole is so enclosed in a dirt-proof case that it may be placed in any desirable position on the machine without danger of falling dirt or chips. An additional safety device is provided which prevents the operation of the machine on the starting resistances and which also prevents accidental starting in the event of the controller handle being struck by some portion of the operator's body or any passing object.

Michael C. Regan, United States Army, has patented an electrically operated indicator (828,570, August 14). This invention relates to improvements in apparatus for registering the movements of bodies, fluid or otherwise, at a point or points distant from the moving body being registered; and to this end the invention consists of means operated by the moving body and forming a contact for making and breaking an electric circuit controlling an electromechanical registering apparatus. In an electrical indicator, the combination with a shoe and means for operating same by the motion of the moving body being registered, of a plurality of contacts disposed in the path of travel



Electrically Operated Indicator.

of the shoe, a resilient connecting member attached to this shoe, the shoe comprising a pair of contact plates insulated from each other and from the connecting member, an indicator, electromagnets cooperating with the indicator to move it in reverse directions, and electric circuit wires interposed between the corelated contact plates of the shoe and electromagnets, substantially as described.

A Low-Resistance Glass.

At a meeting of Section A of the British Association, held recently in York, England, Charles E. S. Phillips described a glass which conducts electricity fairly well. This is obtained by fusing together sodium silicate and borax in the proportions of thirty-two of the former and eight of the latter. By adding one and one-quarter parts of Powell's flint glass to the mixture, greater stability is obtained and a better surface secured without any serious loss of conductivity. Such a glass is suitable for the cases or windows of electrostatic instruments. It may be cast into plates, but is not very workable on account of its low fusion point. It may, however, be drawn into rods or fibres, and takes a fine polish. It is somewhat harder than ordinary glass. The density is 2.49. It is transparent to X-rays, shows no fluorescence under cathode radiation, and is opaque to ultra-violet light. Its electrical conductivity is about 500 times that of the most conducting glass so far made. Its specific resistance is given as 10^9 ohms at twenty degrees centigrade. The glass may be powdered and fused onto clean copper, to which it adheres well without cracking. The resistivity of this glass changes markedly with its temperature.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

An Investigation of Auxiliary Apparatus for Determining the Mean Spherical and Mean Hemispherical Candle-Power.

In this article Dr. Berthold Monasch describes in detail a careful investigation into the merits of the spherical photometer suggested by Ulbricht, a brief description of which was given in the ELECTRICAL REVIEW for December 16, 1905. His results are given in both tabular and graphical form. He concludes as follows: In an Ulbricht sphere having a diameter of two metres, the indirect illumination at an observing window placed at any point is independent of the position of the source of light and of the distribution of light from this. A determination of the constant of the instrument is necessary for every type of lamp, if the source of light be more than ten centimetres below the top of the sphere or if the lamp be fitted with external reflectors. The covered hemisphere employed by the author gives also an intensity of illumination at the observing window which is independent of the position of the source of light and of the distribution, behaving just as an Ulbricht sphere. As the photometric integrator, any enclosed vessel of any form whatever may be used, provided that the light to be measured is entirely enclosed. —*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), July 19 and 26.*

Application of Unsymmetrical Magnetization of Iron in Alternating Currents.

A method of obtaining a static frequency transformer is described here by C. Léonard and L. Weber. The apparatus depends upon the magnetic saturation of iron, this property being employed to give a flux wave-form in which, during each half period, the flux falls to zero twice. The wave-form consists of two positive lobes, succeeded by two negative. This is obtained by means of two transformers having independent magnetic circuits. A circuit drawing its supply from a constant-potential source supplies current to two coils, one on each core, which produce magnetic saturation of the iron. There are, in addition, two primary coils, one on each core, which are connected in series across an alternating-current supply. The secondary winding consists also of two coils, one on each core, the two being in series. The action of this arrangement is as follows: Consider first one core alone thus magnetized by the direct-current winding mentioned above. As the alternating current increases during one-half cycle, the magnetomotive force set up will overcome that due to the direct current, if they be opposed, and thus reduce the magnetization to zero and carry it to an equal value in the opposite sense, if the relation between coils and currents be correct. As soon as the alternating current has reached its maximum value and begins to decrease, the direct-current winding begins to carry the magnetization back to its original value, which is reached when the alternating current again falls to zero. This corresponds to one-half cycle of alternating current, but a complete magnetic cycle for the core. During the following half cycle of alternating current the magnetomotive forces will be additive, but, due to the saturation of the iron, but little change will take place. During this half cycle of the alternating-current supply the secondary transformer core comes into play, having the same effect as the first; and since the two secondary windings are connected in series, the result is the superposition of two alternating-current electromotive forces, both unsymmetrical, but giving a symmetrical electromotive force having twice the frequency of the original supply. These simple relations hold only so long as the secondary be not loaded, for loading it introduces considerable complication. Another application of unsymmetrical magnetization which is suggested is to vary the inductance of a coil when it is undesirable to vary the number of turns in series. This may be done by adding a second winding and passing a direct current through this. By varying the direct current, a variation in magnetic flux will be brought about, thus causing a change in the inductance.—*Translated and abstracted from L'Éclairage Électrique (Paris), July 21.*

The Comparative Merits of Air and Electric Drills.

A comparison is made here between air and electric drills, by G. E. Palmer, considerably to the disadvantage of the latter. Invention has probably never won fewer and poorer rewards in proportion to the talent expended than those received by the designers of electric drills; and as the progress of the art during the last twenty years is analyzed, it seems to the author the difficulties presented to the designers of this form of apparatus are insuperable. The air drill seems to occupy a very secure position with regard to its retention as a standard form of apparatus, and it is quite remarkable that as a labor-saving device one of the most inefficient pieces of apparatus ever designed should have proved the most economical in its particular field. Drilling holes in rock is an operation in which an exhibition of bull strength and awkwardness is desirable, and this feature the air drill possesses to a remarkable degree. The jarring hammer blow transmitted to a cutting edge is the way of all ways for putting in rock holes of moderate depth, and for this class of work tools driven directly by air or steam are practically ideal, as all of the parts of the reciprocating piston that are liable to damage are easily protected from mechanical injury, and are so enclosed in a chamber of elastic and compressible gas that no damage results, even when sticking occurs. Although the electric drill with a short, rapid stroke cuts a cleaner and straighter hole, it does stick, with damaging results. The particular advantages claimed for the electric drill over the air drill are low first cost of plant and ease of installation, and great economy of power. Every one of these claims is true, but when the high cost of maintenance and time lost incident to breakdowns are considered, the above claims sink into insignificance, particularly when the continuous operation of the entire mine depends more upon the reliability of the rock-drilling apparatus than on any other factor. The main difficulty with the electric drill seems to be weak insulation, as no form that has yet been devised will stand up under the continued jar of the drill body for any appreciable length of time. With the motor removed from the drill body, insulation difficulties are overcome, but trouble is encountered with the connecting mechanism. The author has compiled a table showing the results of recent comparative tests between two electric drills equal to any put on the market, and two air drills operating at eighty pounds' pressure. The air drills were in actual use 317 hours, during which time they drilled 1,279 feet, or an average of four feet per hour, and were not stopped at any time for repairs. The electric drills were in operation 100 hours, drilling in that time 253 feet, an average of 2.55 feet per hour, and were laid up for repairs for seventeen hours. The work was done on black diabase during fifty-three consecutive ten-hour shifts.—*Abstracted from the Engineering and Mining Journal (New York), August 18.*

Digitized by Google

The Moutiers-Lyons (France) High-Tension, Direct-Current Transmission.

The most recent installation of the Thury direct-current system of transmission is that recently put into service from Moutiers, in Savoy, to the city of Lyons, France, a total distance of 110 miles. The maximum direct-current voltage is 60,000. The district lying to the east of Lyons contains many water-power stations, and the new power supply consists of an interesting combination of three-phase alternating current and high-tension continuous current. The generating station at Moutiers transmits energy eighty-five miles to the switch house at Sablonnières, which also forms the centre of a converging three-phase system of transmission lines bringing energy from Bellegarde (10,000 horse-power), Avignonet (8,000 horse-power), Lechylienne (8,000 horse-power), and La Bourne (5,000 horse-power). The whole system is under the control of the Société Grenobloise de Force et Lumière. All of these plants supply energy at 26,000 volts, fifty cycles, three-phase, with delta-connected transformers at the receiving end. From Sablonnières the total energy is transmitted twenty-five miles to Vaulx-en-Velin by two sets of three-phase lines and two direct-current lines, the total power required for Lyons being then transmitted two and one-half miles under ground to a receiving station, where it is partly transformed into direct current at 600 volts for the traction system by three-unit motor-generator sets, each consisting of two Thury motors direct-coupled through a flexible insulated coupling to a traction generator. At the Moutiers station there are four Thury groups, each driven by a separate water turbine. Each group consists of four armatures and four magnet frames in two pairs, each pair mounted on a common cast-iron base and separated from the other pair by an insulated friction coupling. The whole group is then coupled to the turbine through another similar coupling. All the generators are insulated from the floor. Each group is supplied with one ammeter, one voltmeter, a switch and a pair of horn lightning arresters. These are all mounted on a small controlling pillar standing beside the group. The object of the arrangement of generators employed is to overcome the objection that it would be impossible to increase the output of such a station without raising the pressure, if all the machines were operated in series. With the present arrangement it becomes possible to throw the two pairs of generators constituting a unit in parallel, thus doubling the current output of the station. Each group at the Moutiers station has a maximum pressure of approximately 15,000 volts, corresponding to 3,300 volts per commutator, and the line current is seventy-five amperes, making the total output of the station approximately 4,500 kilowatts. Provision is made for grounding the central point of the system and either line in case of a breakdown. At the earthing stations four ammeters are provided, which enable observations to be taken of the current passing either into or out of the station by the earth or by the wire. The earth connections at these stations consist simply of iron plates scattered over a small area and buried in wet earth. It is claimed that there is never more than a maximum drop of 200 volts between ground and line when carrying the full current of seventy-five amperes. The substation at Vaulx-en-Velin is more complicated than the others, because it forms the final receiving point for all power transmitted toward Lyons, and also acts as a reserve station, so that in case of a breakdown at Moutiers or on the transmission line three-phase station, the alternating-current machines at Vaulx-en-Velin may be driven as synchronous motors, operating the Thury motors as generators and supplying Lyons. In case additional alternating current is needed these units operate in the reverse sense. The voltage of the generators is regulated by a motor-driven solenoid-controlled regulator. The machinery at all of the stations is insulated by means of a floor consisting of an upper layer of pure asphalt, below which is a layer of asphalt and small stones and finally a concrete foundation. This floor, it is said, will withstand 80,000 volts alternating. The regulator at the Vaulx-en-Velin station performs a double function, as it acts not only as a voltage controller, but as a speed governor. It is said that there has been but little trouble on this system from lightning.—*Abstracted from the Electrical Review (London), August 10.*

Electrically Operated Slipway at Dublin.

A slipway for hauling vessels out of the water was in use in Dublin as far back as 1883, at which time it was constructed at a cost of $75,000. From that time until 1860 the hauling machinery was operated by hand. At the latter date steam haulage was introduced, without very materially quickening the work of taking a vessel from the water. With the revival of shipbuilding in the port of Dublin a few years ago, it became apparent that the antiquated slip machinery and carriage would have to be replaced by modern appliances. The change was provided for by the Dublin port and dock board in 1902, and a new carriage and winch operated by electricity have been installed. The machinery was designed to draw a vessel weighing 900 tons out of the water in thirty minutes. A flexible steel wire hawser is coiled on grooved drums, which are large enough to carry the whole length of the hawser without a second coil. Spur wheels are bolted to the drums and work by pinions which can be put in or out of gear by means of clutches, and thus enable a small drum which is installed for hauling the empty carriage back to the water to be operated independently of the large one. The small drum is driven through spur gearing by means of a friction clutch, and operates at the same speed of winding as the main winding drums. The motor drives the worm shaft through an enclosed single-reduction gearing. The worm is keyed to the pinion shaft. The motor selected is rated at 100 horse-power and runs at 750 revolutions per minute, drawing current at 500 volts. The gear ratio is 750 to 180. The motor is of the enclosed type, though usually operated with the sides of the cover open. It is provided with a number of resistances connected in the armature circuit, which are of sufficient capacity to reduce the speed to one-tenth the maximum when the motor is giving out one-tenth of its full-load torque, this for adjusting the carriage under the vessel. The machine is shunt-wound, and regulation at starting is effected entirely by the armature resistance. For light loads, when a higher speed may be employed, a regulating resistance is inserted in the field circuit, thus increasing the speed somewhat. The gradient of the slip is one in sixteen; the weight of the carriage approximately 100 tons. The usual size of vessels handled is not over 500 tons.—*Abstracted from Engineering (London), August 10.*

Society to Abate Smoke.

About forty city smoke inspectors held a convention in Detroit a few days ago for the purpose of forming a National Association of Smoke Inspectors. This it seems to us is an excellent idea, for the various members of this association by exchanging ideas and experience can enable any city that cares for such things to have the benefit of the best knowledge there is in the abatement of what is getting to be almost as serious a drawback to life in some of our American cities as it has been for generations in certain English cities. Little smoke need be made with bituminous coal.—*American Machinist.*

Digitized by Google

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

ORGANIZATION AND CONDUCT OF A NEW-BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.[1]

BY J. M. ROBB.

Success lies in never tiring of doing, in repeating and never ceasing to repeat; in toiling, in waiting, in bearing and observing, in watching and experimenting, in falling back on oneself by reflection, turning the thought over and over, round and about the mind and vision, acting again and again upon it—this is the law of growth. The secret is to do, to do it now; not to look away at all.

Bishop Spalding's definition of success fits the organization and conduct of a new-business department as though he had it especially in mind when he penned these lines. The ability to increase the sales of current must be as assiduously cultivated as you study the means of reducing costs and bettering your service, and there is no central station so small that it can afford to get along without a new-business department.

There is a general tendency to believe that others accomplish their work with less effort than ourselves, and this perhaps is responsible for the lack of confidence some central-station men have in their own ability to conduct a successful new-business department.

The busiest manager or superintendent, if he will persistently devote a few minutes daily to increasing his sales of current will accomplish results as amazing as they are gratifying when he reviews them. Do not let anything prevent your beginning your new-business campaign at once. Start now. Don't wait for printed forms or to think out definitely how you will go about it. When you have made your beginning you will be astonished at the opportunities for new business that will develop in the most unexpected places.

Working a new-business department is like popping corn. Your first efforts produce only a cracking sound, but no popped corn. If you stop now your work is lost; but keep on; first one kernel pops and then another and another. Encouraged by these, more and more kernels pop until your popper fills as if by magic.

If, most fortunately for you, your business seems to be in the condition of the full popper, remember the unpopped kernels that are always found when the popper is emptied.

There are plenty of unpopped kernels of undeveloped electrical business in your territory which a little attention would convert into profitable income.

Naturally your first thought will be "How much money shall I spend to secure more business?" As the limit up to which money can be profitably spent for this purpose is in all probability beyond your means, your chief concern will be to use to the best advantage the largest appropriation you can get. Go slowly at the beginning. As a general rule any expenditure for pushing your business will be beneficial, there are great possibilities for waste. Hence the necessity for waiting, observing, watching and experimenting.

How shall you spend your new-business appropriation? For solicitors? for newspaper advertising? or for "direct-by-mail" advertising?

The most efficient results will be obtained by a combination of all these methods; newspaper advertising to awaken your public to the possibilities of electric service, make your customers realize your appreciation that your business is governed to the largest possible extent by the same principles applying to any retail selling business, and to prepare the way for your solicitors.

Solicitors to call upon your possible customers, answer their questions, argue away their objections and clinch their orders, as well as to investigate the troubles of your present customers; explain your methods of handling their business, and convince them that they are actually receiving full value for the money they are paying you.

And, finally, direct-by-mail advertising, to excite the interest of these possible users of your service your solicitor can not readily reach; to back up his argument with those he does see, and to keep alive his prospective customers' interest between his calls.

Each of the above divisions of business-getting, properly handled, will produce excellent results, but the most effective work can only be done with a combination of all three.

Endeavor to handle your new-business appropriation so that your efforts will be continuous. If you must choose one of the three methods above outlined, by all means employ a solicitor and make strenuous efforts to keep him permanently at the work.

SOLICITORS.

In picking your solicitors, pay the most attention to their ability to handle people. For this work you must have salesmen, and no man who can not handle people can ever be a salesman.

The gift of "gab" is not an essential, but the ability to talk convincingly is. Many a loquacious salesman spoils his work by talking too much. Beware of the brilliant, sharp man who works by fits and starts.

Dependability is of the utmost importance. The slow plodder who never forgets a point once mastered will soon distance the speedy man who quickly catches on but just as quickly tires if his first efforts are not successful.

Persistency counts for more than dash. Few prospects are interested at the first call, and just as water constantly dropping wears away stone, so patient solicitation secures profitable business.

If you have, among your employés, a man who evidences selling ability, use him for a solicitor.

Your solicitor must, of course, thoroughly understand your business, but this does not mean that he must start with a working knowledge. If your man is a real salesman, he may be ignorant of the electric business at the start. A few days' coaching will fit him to begin your work, and every day after that will add to his knowledge. Some gas companies have made solicitors of their regular employés in connection with their routine work by paying them commissions on new business secured, with the understanding that the new-business work should be pushed only outside of regular working hours.

Properly handled, this practice will produce results, and it possesses the additional advantages of arousing the men's interest in pushing your business.

There is always danger, however, that

[1] Winner of the third prize offered by the Cooperative Electric Development Association.

Digitized by Google

the prospect of a commission will lead to neglect of some regular duty, and the practice is further likely to foment jealousy among the men.

An excellent way to pick solicitors is to advertise for salesmen and carefully study the applicants. You can soon pick out the effective men. The man who can't be earnest in advancing his own interests certainly won't make much headway in pushing yours.

In searching for soliciting material, do not neglect to consider how a woman can push your interests, if you can find one of the right sort.

Having picked your solicitors, take time enough to thoroughly explain your business policy to them. Discuss with them your rates, your contracts, your customs, and your rules and regulations. Make clear to them the distinction between profitable and unprofitable business. Teach them to think in dollars and cents and give them enough data to enable them to estimate the cost of connecting any business they secure.

Take them over your plant and endeavor to make them appreciate the amount of work involved in rendering good service to your customers.

If possible, make a few calls with each solicitor, letting him do all the talking, and then coach him between calls. If you already have one or more solicitors, they can assist you in training the new men, but it will be to your best interest to let the beginners receive their first notions of your methods of handling your customers from yourself.

Divide your territory into as many districts as you have solicitors, arranging as nearly as possible an equal division of business and residence territory in each district, so as to give each man an equal amount of possible business.

The size of your new-business appropriation will determine the number of solicitors you can use. Some companies have profitably worked one solicitor to each 4,000 of population. Each central station must determine the number of solicitors to employ from his own conditions.

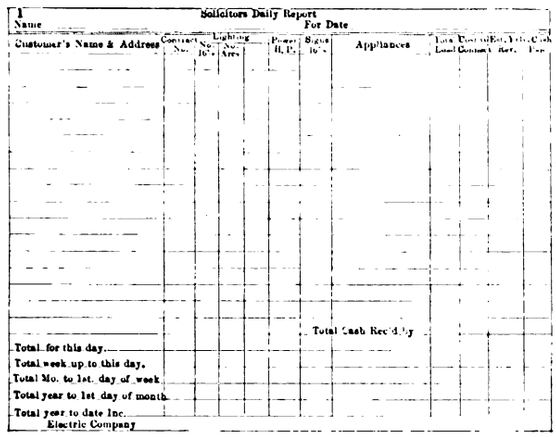
Your solicitors are now ready to go after business, but your work in handling them has just begun. It depends on you to arouse their enthusiasm to the highest pitch and keep it there.

Have the solicitors report to you each morning as early as convenient and canvass their previous day's work. Have a little booster meeting to start the day. Have each man tell of the orders he secured yesterday, the prospects he developed, and anything which helped him secure an order.

Encourage the men to discuss the business freely and to advance their criticisms and suggestions. Be liberal in your commendations of good work, and sparing of criticism, but criticize sharply when circumstances require it.

As often as possible, explain the operation of some appliance you are pushing. Demonstrate its good points and teach the men the arguments to down any objection that could be advanced by a prospective customer.

Use every means at your disposal to increase the men's knowledge of your business, constantly impressing upon them that any increase in their efficiency is to your mutual advantage. Note carefully any articles in trade papers, etc., or any articles on salesmanship that will help your men and specifically call their attention to them, asking the men to read them carefully and then tell you what they think of the matters discussed.



FORM FOR SOLICITOR'S DAILY REPORT.

Have your men 'phone to you at noon, both to let them know that you are following their work and to advise them of any prospects which may have developed in their respective territory since morning.

Keep a blackboard record of each man's work brought up to date, to advertise to all the employés the work the solicitors are securing. Have each solicitor turn in a daily report each morning, similar to form No. 1, given herewith.

If any payments are collected, the amounts must be properly entered, footed and receipted by your cashier, or whoever is authorized to receive the cash.

The daily, weekly, monthly and yearly totals make possible an immediate comparison of each man's work, both with reference to current results and to results obtained in any previous period.

This form should be printed on sheets in letter-head size and put up in pads. The completed sheets should then be filed in a vertical file, where they give a complete record of each man's work.

You must train your solicitors to be old-business retainers as well as new-business getters. They must realize that their own, the customer's and the company's interests are all bound together.

Turn over to them for investigation the complaints of customers in their territory. Have them look up the customer's apparatus, re-read his meter, explain to him the methods used in handling his business and make a vigorous effort to convince the customer that he has the same check on his purchases of current that he has on his purchases of any other commodity.

Energy expended to convince customers that they are receiving full value for the money they pay you, is one of the most profitable means of securing more business. If your customers are made to realize that they are receiving their money's worth in service rendered, they will use your service much more liberally and be much more open to your suggestions for their use of more conveniences requiring additional current.

It is a mistake to pay solicitors solely commissions on the sales of appliances. This practice will surely result in sales of appliances to customers who can not advantageously use them, and will certainly cause much dissatisfaction and loss to you.

A flat salary is preferable, and some managers adopt the flat-salary method because of the labor required to record the results of each solicitor's work.

The ideal method is a combination of a flat salary and a commission based upon the volume and value to the company of the sales of current effected by the solicitor, with a fine for business lost in the territory allotted to him.

One prominent gas company pays its solicitors a salary of $50 per month and a commission based on results secured, which is determined as follows:

A pool is made each month, representing a certain sum for each solicitor employed. The various kinds of business to be secured are classified and given an arbitrary value of a certain number of points. The greatest number of points is assigned to business requiring no additional investment to serve, and to busi-

Digitized by Google

ness corresponding to sign and power business.

From this the business is graded down to the lowest number of points for business which is simply renewal business, due to consumers removing from one location to another, and business requiring a heavy investment for a relatively small income.

To assist in the classification, the solicitor must report on a card the estimated cost of connecting the customer as determined from a schedule furnished him in which are given the costs, as determined by the previous years' averages, of the various items entering into the total investment necessary to serve the new business. He must also report an estimate of the first year's revenue from the new customer.

The ratio between cost of connecting and volume of sales is considered by the new-business department manager in assigning the number of points to the business secured.

At regular intervals the solicitor's records are checked from the customer's ledgers, so that the tendency to over-estimate the value of secured business may be offset.

A deduction of an arbitrary number of points is made for business lost in each solicitor's territory.

At the end of each month, each solicitor's points are totaled, and the percentage his total bears to the total of all the solicitors' points determines his share of the pool.

In this particular case the sum pooled for each solicitor is $25, making the average salary $75 per month per man. Some of the solicitors on this basis earn as much as $125 per month.

A better way is to determine what price you can pay for each kilowatt of new business secured, grading this price from a high rate for profitable business to a very low rate for business requiring a heavy investment, and no rate for unprofitable business.

Then agree to pay the solicitors a commission at these rates for a year for all business secured, having it understood that any business lost in their territory shall be deducted from the commission at the same rates.

Such an arrangement is mutually profitable for both solicitor and company.

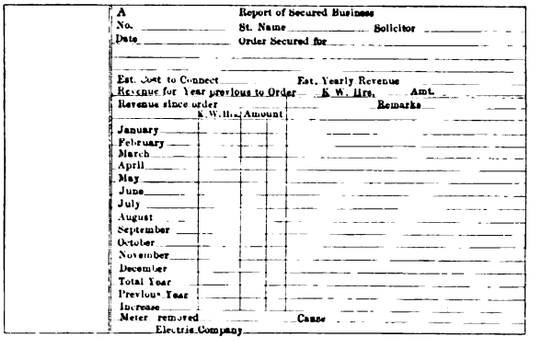
The business secured can be readily determined if the backs of the possible-business index sheets be printed as shown on sheet "A."

The solicitor should be required to turn in with each order the corresponding possible-business index sheet on which he has noted what his order covers.

If the order represents a customer already connected, the amount of the customer's business for the year previous to securing the order should be entered on the possible-business index sheet and also the monthly average for the year. The sheet should then be filed in a secured-business binder under the name of the solicitor securing the business.

Each month for the year following the date of the order, the amount of the customer's business should be posted to the sheets and the increased business credited to the solicitor at the agreed rate. Such an arrangement may be kept up with a minimum of work and may be modified to suit any set of conditions.

It would induce the solicitors to devote their efforts along channels most profitable to the company, and the deduction for business lost would insure their being old-business retainers as well as new-business getters.


A Report of Secured Business
No. St. Name Solicitor
Date Order Secured for
Est. Cost to Connect Est. Yearly Revenue
Revenue for Year previous to Order K. W. Hrs. Amt.
Revenue since order Remarks
K. W. Hrs. Amount
January
February
March
April
May
June
July
August
September
October
November
December
Total Year
Previous Year
Increase
Meter removed Cause
Electric Company

FORM FOR BACK OF INDEX SHEETS.

Under such an arrangement the solicitor would have every inducement to make every effort to remedy complaints, and he would find it very unprofitable to waste his time selling appliances to customers who could not use them to their best advantage.

If the foregoing seems too complicated a method of handling solicitors, you would do well to reflect that the success of your new-business department demands good men to carry on the work. You can secure the best work from good men only when you pay them in proportion to the results they secure for you.

Any plan which will increase the efficiency of your men in securing more business for you is mutually profitable to every one concerned.

POSSIBLE-BUSINESS INDEX.

One of the most necessary essentials of a systematic campaign for new business is a possible-business index.

Pope says:

Index learning turns no student pale,
But it grasps the eel of science by the tail.

That expresses the aim of a possible-business index. It is to the conduct of a new-business department what plans and specifications are to a piece of construction work. No two men will work up their new-business data precisely alike. Where one will want a complete plan, setting forth every detail, another will be content with a free-hand pencil sketch with a few notes.

It is well to bear in mind that when a man goes hunting he must have a pretty definite idea of what he seeks. If you have in your new-business campaign a complete index of the possibilities in your territory, you will waste less of your new-business appropriation.

While cards are generally used for such an index, loose sheets five inches by eight inches in size and bound in binders will be found to be far more useful, and, in addition, will give all of the advantages of a card index.

Some of the advantages over cards are as follows:

The sheets are larger, giving more space for useful data.

The sheets bound in the binders will always be found in their proper sequence, and, if necessary, can be removed from a binder as easily as a card from a file.

By using thin paper much more information can be filed in a given space.

By using a thin binder it may be carried in the pocket, and in this manner the sheets are much easier to handle in the field than cards.

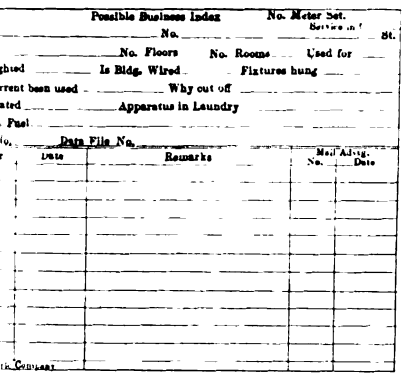
Forms 2 and 3 and "A" give a set of forms for a possible-business index. Form "A" is to be printed on the reverse sides of 2 and 3. These forms are self-explanatory. The 'phone number is put in because often very affective soliciting can be done by 'phone. The data file number is to be used when correspondence or estimates, etc., accumulate in soliciting a prospect.

An envelope, large enough to contain all of the letters, estimates, etc., in flat sheets, is used, given a number and filed in your data files. The envelope number posted to the index sheet gives quick reference to all of the data on file for the prospect.

Your possible-business index should contain a sheet for each house or prospect in your territory. As your territory is extended put in a sheet for each house or prospect in the new territory.

Digitized by Google

r orders so that every meter
transfer order and every
r will go to the person in
possible-business index, so
always up to date and show
of all electrical appliances
ing with current.
that your index is your
cting your fight for more
the more careful attention
less effort you will waste.
colors of paper to indicate
asses of new business.



OR POSSIBLE BUSINESS INDEX.

white paper to indicate
e no current has ever been

to indicate a building
lied with current. Make
is class of business show
tement of the connected

a building where current
ed, but for some reason
ected.
to indicate power pros-

o indicate sign prospects.
out and handled, the pos-
dex will not only show
for business, but it will
nount of work done on
id when the business is
e index sheets can be used
of the business obtained
This is easily accom-
on the sheets the orders
the solicitors and then
parate binder behind the
citor who is entitled to

ally, the revenue from
be posted to the sheets
olicitor, and his income-
thus readily determined.
st methods of starting
to have them first go
y to make up reports for
ess index. In this man-
ore easily broken for a

new man and he quickly becomes familiar with his territory.

Periodically, at regular intervals, depending upon your local conditions, have your man check up the new-business index and carefully make the necessary corrections.

If you are mailing matter to your prospects, this practice will not only save money in postage, but the moral effect upon your prospects will increase the efficiency of your new-business department many per cent.

To assist in keeping your possible-business index up to date, give your solicitors credit for any business closed in your office, where the index shows the solicitor has called on the customer within thirty days of the date of the order.

NEWSPAPER ADVERTISING.

Your new-business department can be made to prosper without the aid of your newspapers, but, if you are wise and your appropriation permits, you will use them liberally and continuously.

Properly used, the newspaper will aid you in molding a favorable public opinion, and it will also secure new business for you. If it does nothing else, it will pay its cost in the increased efficiency it will produce in your solicitor's work. The newspaper adds a dignity to the house-to-house work of your men, which it would otherwise lack.

Use as much space as your appropriation will buy, but us it continuously. Don't splurge unless your appropriation will stand it. Consider, also, how the average person scans his newspaper, and you will realize that if you would have your advertisements noticed they must be arranged so that "he who runs may read."

This means that your newspaper talks must be very, very short, sharp, pithy, incisive. They must stand out so that upon the paper being opened the advertisement at once catches the eye. Plenty of white space must be used to accomplish this.

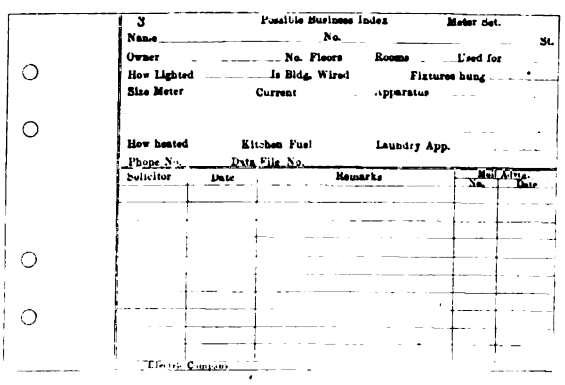
The following excellent suggestion is taken from the *Electrical World and Engineer* of March 25, 1905:

"In preparing copy for newspaper advertisements the central station man must bear in mind that his efforts will not be searched for, except by himself. Neither can he, as a rule, use sufficient space so that his advertisements will demand attention merely on account of their size. His problem, therefore, is to devise a means of insuring that his announcements will be read without resorting to anything bizarre or in bad taste.

"The plan here suggested has proved very successful, and any one who adopts it will find that his advertisements will be the most prominent thing on the pages which they adorn.

"It consists essentially of the purchase of a few fonts of a large, legible type to be used for your own announcements exclusively and differing from anything in regular use by the paper in which they appear. The type in which the advertisement here reproduced (but reduced to about sixteen points) is set is known as twenty-eight-point Caslon Old-Style and has the reputation of being the most legible face ever cut. It can be used to advantage in two ways—first, as in the example given, in a few lines well spaced and surrounded by plenty of white space; and second, in two or three lines well spaced, as before, and followed by matter in small type. While Caslon Old-Style is probably the best type for this purpose, there are other plain, bold and legible faces which can be used if the Caslon is preempted, though, as a matter of course, the results will not be so good if others are already using the same idea. When there is no competition in the lighting business, it is just as well in this style of announcement to omit all reference to name and address. It is 'different,' and that in itself is good advertising. The following are offered as suggestions for 'copy.' Some of them are original, others have been culled from various sources:

"In papers of ordinary get-up as to



FORM FOR POSSIBLE BUSINESS INDEX.

their advertisements, it is surprising how impossible it is to look at a page containing one such as I have described without seeing it first, almost to the exclusion of everything else. Two fonts of type costing about $8 will set any of the advertisements which can be set in the space commonly used."

In connection with the above, note the Macbeth lamp-chimney advertisements running in the magazines.

(To be concluded.)

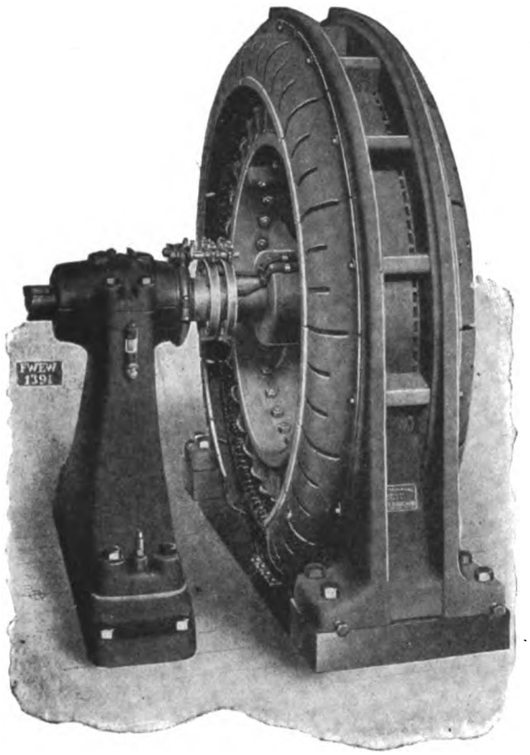
Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Polyphase Revolving-Field Engine-Type Generators.

The present practice in central-station and isolated plant engineering is away from the belt-driven type of generator, as the engine-driven type possesses some advantages. The large diameter of the rotating element enables the desirable high pheripheral speed to be obtained, while the weight of the moving part enables it often to take the place of the usual flywheel. Moreover, a direct-connected unit requires less floor space than a belted one and does away with the undesirable and expensive belt.



TYPE QRE FORT WAYNE TWO-PHASE, REVOLVING-FIELD, ENGINE-DRIVEN ALTERNATOR, WITH OUTBOARD BEARING.

To meet the demand for these machines the type of polyphase generator shown in the accompanying illustrations has been put out by the Fort Wayne Electric Works, Fort Wayne, Ind.

These alternators, when arranged for mounting the revolving field direct on the engine shaft, are designated as TRE type, when three-phase, and as QRE type when two-phase. When furnished with one or more bearings and a short shaft, and, if necessary, a base arranged for coupling to the source of power, they are designated, respectively, as type TRC and QRC.

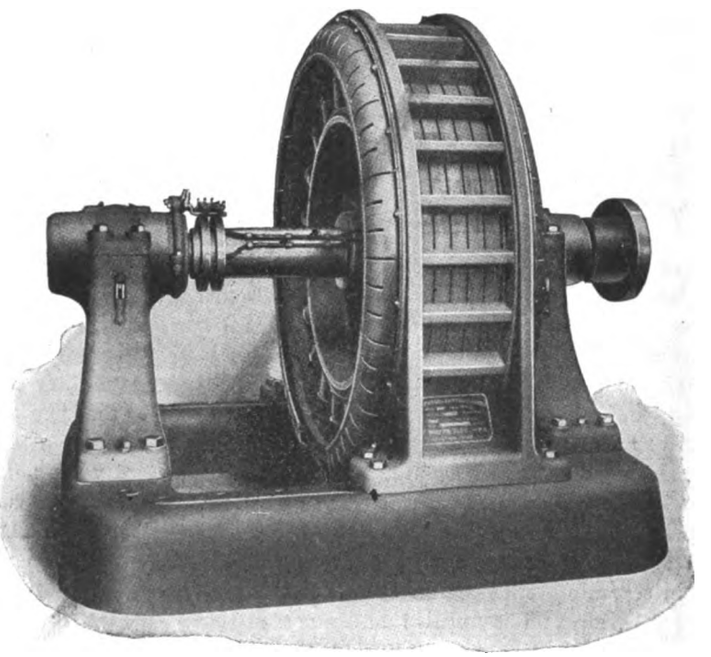
The revolving field of these alternators is made particularly rigid to withstand all mechanical strains. The cores consist of laminated iron stampings of high grade, clamped in place by means of through bolts which force them into a uniform rigid mass. These cores are mounted upon the rim of a cast-steel spider either by dove-tail construction or by means of through bolts, according to the centrifugal force which they must withstand during operation. Either construction permits the easy removal of any particular field core, if necessary. The field coils consist of edge-wound copper strips, each turn being insulated from its neighbor by means of paper templets placed between the layers, a construction which ensures efficient insulation and cooling, as the bare edges of the field conductors are directly exposed to the air. Current for the field coils is supplied from the exciter through two cast-iron slip rings mounted upon the shaft. Carbon brushes are used for making contact with the rings.

The main frame casting for these generators forms the support for the armature core, and the whole is designed so that it may be moved in a direction parallel to the shaft, in order to gain access to either the armature or field coils. Within this frame the armature core, built up of high-grade iron punchings clamped into a rigid mass, is supported by means of dove-tails into the frame. This construction reduces eddy currents and ensures a constant air-gap at all points; and also provides amply for ventilation.

The armature coils are form-wound, insulated and tested before being assembled in the core. This construction enables a damaged coil to be replaced easily. Great care is taken to provide insulation which will not deteriorate under all ordinary conditions of operation.

Two types of exciter are provided for these machines. That usually supplied is belt-driven from a small pulley placed on the slip ring end of the shaft, but, when desired, a direct-connected exciter will be supplied.

One feature of these alternators is the combined alternator-exciter field rheostat which is provided. This rheostat does double duty, as both the alternator and the exciter field currents are passed through it. Two contact arms are provided, one for each field circuit; but an adjustment of either one, since it affects a current flowing through a resistance which also carries the other current, will cause a corresponding adjustment in both circuits—that is to say, increasing the resistance in order to cut down the field current also lowers the voltage of the exciter.



TYPE TRC FORT WAYNE THREE-PHASE, 2,300-VOLT, ENGINE-DRIVEN ALTERNATOR.

Digitized by Google

A Voltage Regulator for Both Alternating and Direct-Current Systems.

A simple and reliable automatic voltage regulator for both direct and alternating currents is shown in the accompanying illustration. This regulator is the latest product of W. H. Chapman, and embodies the results of a long experience in solving problems of regulation in central station

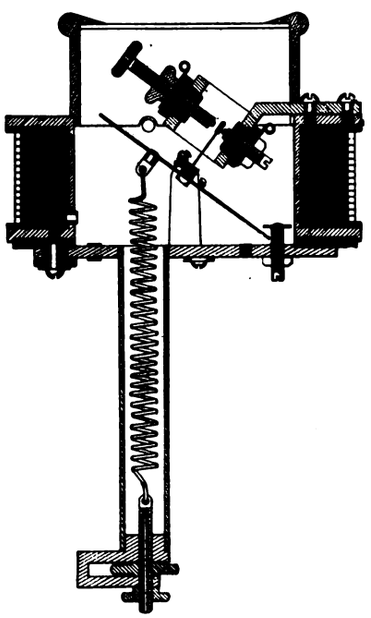


FIG. 1.—SECTION OF RELAY, "W. H. C." VOLTAGE REGULATOR.

and isolated plants. The regulator is manufactured by the Portland Company, of Portland, Me.

There are four methods in which this regulator may be applied. It may be used first either for alternating or direct-current generators, for regulating the voltage output and maintaining it constant at the bus-bars or at a distant end of the line. Secondly, the regulator may be applied for controlling the voltage delivered by a storage battery, maintaining it constant on a circuit for lamps and motors. Or the regulator may be used in the reverse manner for controlling the storage-battery charging current, keeping it constant. Finally, the regulator is suitable for controlling the voltage of individual lamp circuits or motors which are fed from a variable source of supply.

This regulator is composed of three essential parts—a relay for detecting small changes of voltage or of current and applying the corrective force; a rheostat, and a pair of working solenoids for operating the rheostat switch in response to the movements of the relay.

Fig. 1 shows a section of the relay. It consists of a coil wound upon a brass spool. Within the coil is a thin iron disc pivoted at opposite ends of a diameter. Due to the magnetic force set up by current passing through the coil, this disc tends to turn so that its plane will be along the axis of the coil, but is opposed in its motion by the spring shown. This spring is under tension, and is controlled by means of the thumb-screw and lock-nut shown at the bottom. This device enables a close adjustment of the voltage to be made, as to produce a change of one volt requires that the thumb-screw be given merely a turn.

Attached to this rotating disc is a spring having platinum contacts at the end. This, due to the motion of the disc one way or the other, makes contact at one or the other of two adjustable fixed contact points, which close the circuit through the controlling solenoids. These points are also tipped with platinum, and are protected from dust by means of a metal cover with a glass top. Two resistance lamps are placed in series with the relay coil for cutting down the current and for compensating for temperature changes. The temperature coefficient of resistance of the lamps is positive, while that of the coil is negative. In this

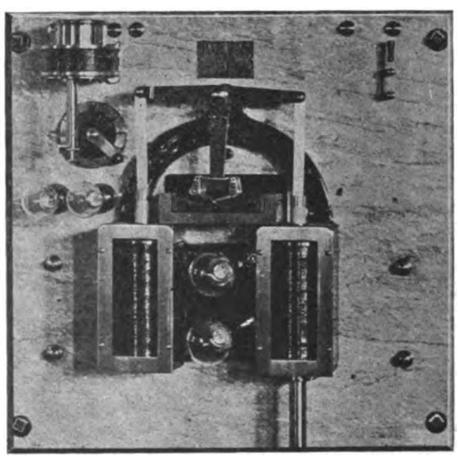


FIG. 2.—SWITCHBOARD TYPE OF "W. H. C." VOLTAGE REGULATOR.

way errors due to changes in temperature are avoided.

Fig. 2 shows the switchboard type of regulator. The relay is seen in the upper left-hand corner, while in the centre are the two solenoids. These solenoids are carrying current only when the circuit is completed by means of the coil, so that they are in operation only a small part of the time. They have two windings—a primary, which carries the operating current; and a secondary, wound in the same direction. The latter is short-circuited upon itself, and its function is to prevent arcing at the relay contacts, this being done by the reaction of the secondary current induced when the circuit is broken. There is, in addition, a pair of high-resistance lamps connected up so as to absorb any little discharge remaining after this action.

The rheostat by means of which the cir-

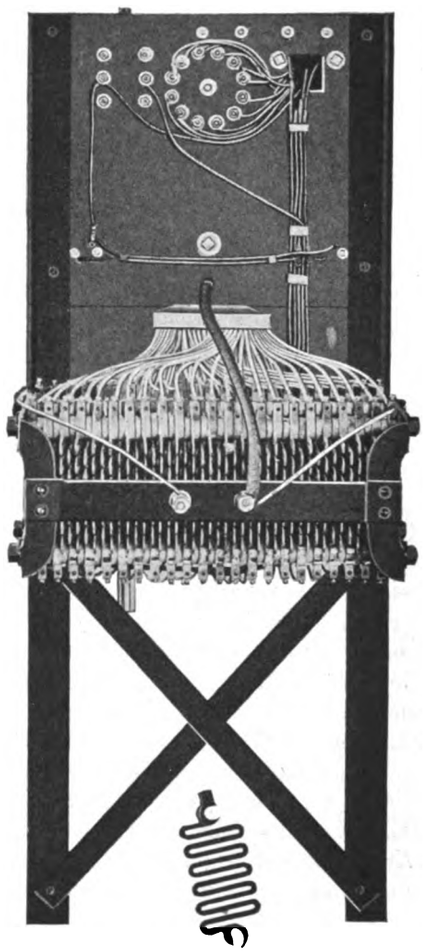


FIG. 3.—BACK OF 150-KILOWATT "W. H. C." VOLTAGE REGULATOR, SHOWING RESISTANCE GRIDS CONNECTING TO THE COPPER SEGMENTS, PROJECTING THROUGH THE SLATE PANELS.

cuit is controlled is made in two types. For small currents the resistance is built up of a set of enameled resistance units, while for larger sizes the resistance units are cast-iron grids. One of these grids may be seen in the bottom of Fig. 3. This figure also shows a rear view of a 150-kilowatt regulator, illustrating the manner in which the grids are held in position and connected to the dial plate on the panel-board.

To prevent oscillatory motion or drifting of the regulator, a dashpot is attached to one of the solenoid cores. This is a simple device, and by means of an ingenious arrangement the dashpot ports are opened or closed by a slight turn of the cylinder.

For use on large systems the regulator is supplied with a shunt block, from which

Digitized by Google

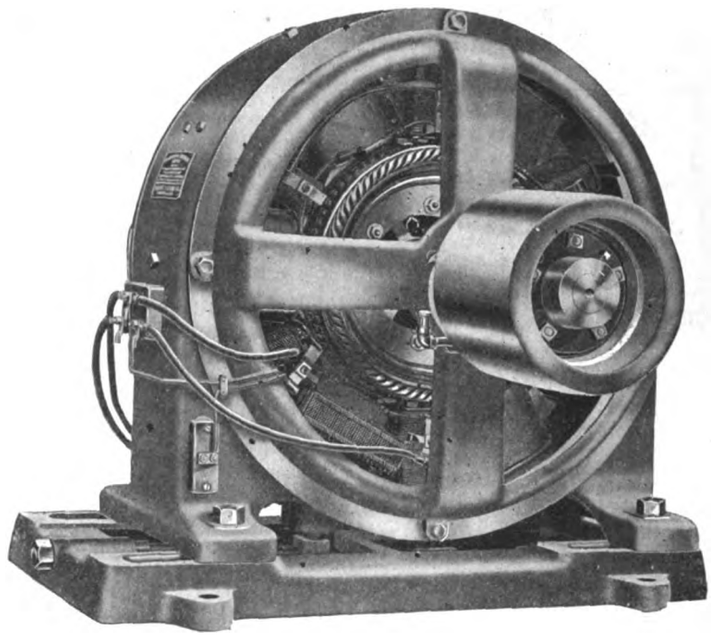
the small current required by the relay is obtained. For alternating systems, a series transformer takes the place of the shunt.

In Fig. 2 may be seen the method of making contact with the resistance units is clearly shown. The resistance units are connected to a set of copper segments arranged in the arc of a circle on the face of the regulator, and a lever arm carrying the contact shoes, pivoted at the centre of the circle, moves over them. The shoes are held firmly to the surface, yet cause but a small amount of friction. A current of one-half an ampere is sufficient to operate a 500-kilowatt regulator. For commercial purposes the regulator is designed to control within one per cent, this being all that is required, although, if necessary, a regulation of one-quarter per cent can be secured, though at some additional expense.

Commutating-Pole Variable-Speed Motors.

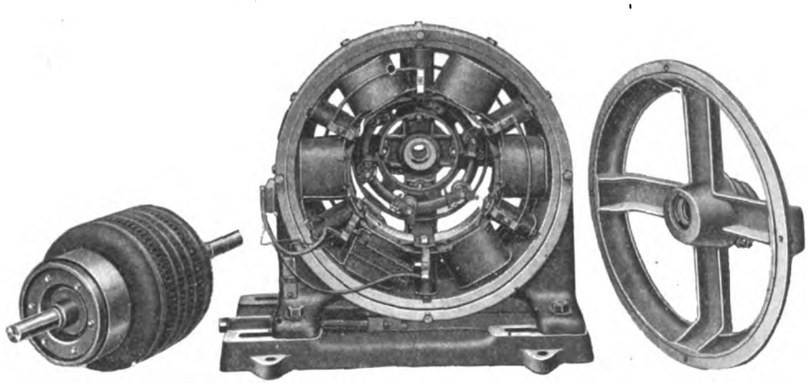
The exacting requirements of machine-tool motor drives, hoist work and other classes of severe service have created a demand for a variable-speed electric motor. In order to meet these conditions and also to increase the output from a given motor frame, the General Electric Company is placing on the market a line of variable-speed commutating-pole motors, known as the CLC type for large power, while the smaller sizes are designated as type CQC.

As can be seen from the illustrations, the commutating poles in these new machines are placed between the main field poles and are so wound that they are excited by a portion of the main current. The main field is usually provided with an ordinary shunt winding, but may be also compound wound when service conditions require. The commutating poles provide a magnetic field of sufficient intensity to neutralize the effect of the current in the armature coils which are short-circuited during commutation. Sparkless commutation at all loads within the speed range specified is thus obtained. As the action of these poles is reversible the motors can be run equally well in either direction.



COMMUTATING-POLE VARIABLE-SPEED MOTOR. SHOWING GENERAL DESIGN.

Not only does the addition of commutating poles improve the operating conditions of the motors, but the new machines can be operated at a higher output over a wider speed range, so that greater power is concentrated in a small-size frame.



COMMUTATING-POLE VARIABLE-SPEED MOTOR. ARMATURE REMOVED TO SHOW ARRANGEMENT OF POLES.

The mechanical details of construction of the new line of motors is similar to that of the well-known CL and CQ motors made by the same company. In the CLC motor the field frames are of cast iron, while in the smaller size CQC type they are built of steel. Both types of motors are so constructed that, by turning the bearing brackets through 90 degrees or 180 degrees relatively to the frame, the machines can be mounted on wall or ceiling. When motors are used in places where flying particles or dirt are liable to injure the machine, the bearing brackets are fitted with perforated hand-hole covers, which furnish complete protection to the motor and, at the same time, allow free circulation of air through the windings. Solid hand-hole covers can be supplied when it is necessary to enclose totally the motor; the capacity of the motors under such circumstances, however, will be somewhat reduced, owing to the increase in ventilation.

The CQC motor combining as it does the compactness and general efficiency of the CQ type of motor, together with the advantages accruing from the use of the commutating pole, is particularly suitable for individual variable-speed machine-tool drive. It is small in diameter, comparatively short along the shaft, and substantial in construction. All these qualities make it an ideal motor for driving lathes, as it can be mounted on the top, bottom or side of the driven machine. Similarly, the commutating-pole type CLC motor is suitable for the larger classes of machine-tool work as well as for ordinary commercial requirements. Type CQC motors range in size from five to twenty horse-power. For heavier work the CLC motor is built in capacities up to and including 130 horse-power.

Digitized by Google

A Rythmic Regulating Socket Plug for Fan Motors.

The accompanying illustration shows the outward appearance of a rythmic fan regulating socket plug which the Phelps

RYTHMIC REGULATOR PLUG FOR FAN MOTORS.

Company, Detroit, Mich., has recently placed on the market. This plug contains within the extended fibre tube a thermostat, which throws the fan motor on and off, keeping the air in a disturbed condition, and, at the same time, cutting down the consumption of current. The regulator is interpolated between the electric fixture and the fan plug.

The "Peerless" Switch.

A new five-ampere switch has been put upon the market by the Marshall Electric Manufacturing Company, of Boston, Mass. This is designated as the "Peerless" and has been got out to meet the

"PEERLESS" FIVE-AMPERE SWITCH, WITH COVER.

demand for such a switch. The accompanying illustrations show the inside and outside appearance of the switch. From them it is seen that there are but few parts; that the mechanism of the switch is quick-acting, strong and serviceable. Tests have been made which have proved that thousands of turns of the switch might be made, as required by the underwriters, without any injury to the mechanism.

One feature of the switch which is worthy of notice is the lining of the cover.

"PEERLESS" FIVE-AMPERE SWITCH, COVER REMOVED.

This is drawn in one solid piece without seams or crimping.

These switches are carried in stock at the New York office of the company, 227 Fulton street, and at the Chicago office, 169 Adams street, as well as at the office in Boston.

A New Company to Manufacture Incandescent Lamps.

Financial interests comparatively new to the electrical industry are behind a new company — the Novelty Incandescent Lamp Company—which is being organized in St. Marys, Elk county, Pa., for the manufacture of incandescent lamps. The new company is being operated on an entirely independent basis, it is announced, and no understanding or agreement as to methods or prices will be entered into with any existing association of manufacturers in this field. It is believed that the character of the men committed to the company and the policies as to sales methods and prices which it is the purpose of the management to inaugurate will be sufficient to gain the interest of lamp buyers.

The product to be marketed will embrace the new "Elk Standard" incandescent lamps, "Novelty" miniature lamps, and "Novelty" renewed lamps.

For the manufacture of the new types of standard incandescent and miniature lamps the company is now erecting a new building at Emporium, Pa., twenty-one miles from St. Marys. For handling the department devoted to renewed lamps a two-story brick addition to the plant now occupied at St. Marys is in course of construction.

The officers of the company are: R. K. Mickey, president and general manager, St. Marys, Pa.; Josiah Howard, vice-president, Emporium, Pa.; Joseph Kaye, secretary, Emporium, Pa.; A. F. Vogt, treasurer, Emporium, Pa. These gentlemen, together with Henry Auchu, of Emporium, Pa., constitute the principal members of the board of directors.

It is announced that in the near future the two plants of the Novelty Incandescent Lamp Company will have developed facilities for the production of 10,000 lamps daily.

An Interesting Suggestion for the Electrical Contractor.

Ralph A. Schoenberg, proprietor of the Sarco Company, New York city, has introduced a novel suggestion concerning the placing of electrical specialties by the workmen in charge of the installation. This suggestion is embodied in a letter recently sent to a number of contractors throughout the country, an extract of which is given below:

At the National Contractors' convention, recently held at Cleveland, I chanced to meet a contractor who has two stores in London and a branch office in Paris.

I happened to show him the new pendant switch manufactured by us, and he informed me that in London, when an article of this kind is brought out on the market, the contractor gives each of his wiremen a sample to carry in his pocket, and when he goes out on a job, either to a private house, store or office, where they have electroliers, cluster lights, banquet lamps, brackets or chandeliers out of reach, the wireman is instructed to show the owner how easily the light can be controlled by a switch in circuit.

The average customer would be more interested in a suggestion from the wireman, who is a disinterested party, than from the boss, who is out to make his profit, the result being the wireman in some instances has sold as high as twelve or fifteen pendant switches at a price ranging from $1.50 to $2 apiece, and the wireman gets the commission for the extra work received, which at the same time induces the wireman to keep his eyes open for other extra work.

I have mentioned the above method to several prominent members of the Contractors' Association here in New York and they have secured such very good results that I have decided to mention the matter to you, and should you try it and meet with success, I would appreciate a line from you in regard to same.

New System of Railway Signaling.

A new system of railway signaling is being experimented with by the Great Western Railway, of England. This is briefly described by United States Consul Frank W. Mahin in a recent report. A noteworthy feature of the new system is that the signal is given audibly, and not visually. The engine, as it travels along the track, comes into contact with an apparatus fixed to the track, which is controlled from the signal tower. This apparatus sets in motion the signaling mechanism on the engine. Signals are given by means of a whistle and a bell, both of which are fixed in the cab beside the engineer. The new system is thought to be of particular value for foggy weather, and is therefore suitable for parts of England.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NORTHWESTERN TELEPHONE STOCK INCREASED—The Northwestern Telephone Company, Minneapolis,, Minn., will issue $5,000,000 new stock, increasing its capital from $10,000,000 to $15,000,000, to provide for the extension of lines through Minnesota and the Dakotas.

TELEPHONE LINE ACROSS PENNSYLVANIA—A charter has been granted to the Philadelphia, Pittsburg & Erie Telephone Company, of Harrisburg, Pa., to operate a telephone line across Pennsylvania. This is understood to be a combination of the independent telephone companies.

SOUTHERN PACIFIC TO ELECTRIFY PART OF ITS SYSTEM—The Southern Pacific Company has undertaken the work of transforming its entire Alameda (Cal.) system of local trains to an electric system, and will extend the system into Oakland over new lines. Engineers of the company have about completed detailed plans for the change.

ST. LOUIS TO VOTE ON INSTALLING A MUNICIPAL ELECTRIC LIGHT PLANT—An ordinance will be sent to the municipal assembly of St. Louis, Mo., when it reconvenes September 7, providing for the submission to the voters of a proposition to install a municipal electric light plant. It is estimated that the cost of such a plant would be $1,000,000.

MEXICAN LIGHT AND POWER COMPANY—An interim report of the Mexican Light and Power Company has been issued for the first half of the present fiscal year. It shows gross earnings for that period of $1,754,833, in Mexican currency, with operating expenses of $722,330, which represents about forty-one per cent of the gross receipts. There has been a steady increase in the monthly earnings since the commencement of 1906.

NEW UNDERGROUND TELEPHONE SYSTEM—An underground telephone line is being constructed between Chicago, Ill., and Milwaukee, Wis. It is estimated that this will be ninety miles in length and will carry 18,000 miles of wire. The Pupin system of loading coils is being installed. The construction work will be carried by the Chicago Telephone Company to a point near the Wisconsin line and by the Wisconsin Telephone Company from there to Milwaukee.

PUEBLA (MEXICO) ELECTRIC COMPANIES MERGE—It has been announced that the Puebla Light and Power Company, recently formed by Canadian capitalists, has taken over the lighting and power companies in the city of Puebla, in addition to the tramway lines. The latter were secured from the Wernher-Beit company, who also formerly owned the Mexican tramway lines, while the light and power companies were purchased from other English capitalists. The Puebla company will have a capital of $5,000,000 bonds, and $3,500,000 stock.

CONSOLIDATED TELEPHONE COMPANY BUYS GREAT EASTERN COMPANY'S FRANCHISE—It is announced that the Consolidated Telephone Company, of Buffalo, N. Y., has bought from the Great Eastern Telephone Company the latter's franchise to maintain and construct telephones, telegraph lines and electric lights in New York city. The amount paid is said to be $50,000,000. A syndicate is to be formed to take over the franchise, and an operating company will later be formed to install an independent telephone service in New York.

DAYTON COMPANY INCREASES CAPITAL STOCK—The Dayton Citizens' Electric Company has increased its capital stock from $100,000 to $1,500,000 and elected the following board of directors: Valentine Winters, Adam Schantz, S. W. Davies, E. J. Barney, George Sohngen, S. J. Patterson, of Dayton; Edward Sohngen, Edward Murphy, of Hamilton, and George B. Cox, of Cincinnati. Mr. Winters was elected president and treasurer; Adam Schantz, vice-president, and Cyrus E. Mead, secretary and general manager. The company will expend $1,000,000 during the present year and already has the work well under way.

WORK STARTED ON NEW POWER PLANT—The Spartanburg Electric Power Company will spend $1,000,000 in developing water powers in Spartanburg and Cherokee counties, South Carolina. The company is composed of Pittsburg and Spartanburg capitalists. R. C. Crawford, J. C. Slack and F. R. Dravo, of Pittsburg, are among those interested. The work of building an electric power-house on Broad river, near Gaffney, is now under way. As soon as this is completed the company will erect a power-house at Nesbitt shoals for supplying electricity to cities and towns in the adjacent territory.

LARGE BOND ISSUE SOLD—It is announced that the Chicago State Bank and the Trowbridge & Niver company, of Chicago, Ill., have bought the $3,000,000 bond issue of the La Crosse Water Power Company. The water-power company will build a water-power plant at Mormon riffles, on Black river, near Hatfield, Minn., and proposes to supply Winona, La Crosse, Black River Falls and other cities within the territory with power and light. The company will also build an electric railway line between La Crosse and Black River Falls, a project which has been under consideration for a number of years, and for the accomplishment of which several companies have been organized in the past.

PITTSBURG COMPANY BUYS MASSENA POWER PLANTS—The Pittsburg (Pa.) Reduction Company has obtained absolute control of the extensive electric power facilities at Massena, N. Y. The company bought the controlling stock of the St. Lawrence County Electric and Water Company, capitalized at $100,000; the St. Lawrence Water Company, capitalized at $100,000, and the Massena Electric Light and Power Company, capitalized at $50,000. The Pittsburg company recently purchased the St. Lawrence River Power Company, which owns the canal between the St. Lawrence and Grasse rivers, now developing 35,000 horse-power, with an ultimate capacity of 150,000 horse-power.

ELECTRIC WATER POWER IN HAWAII—The first electric water-power plant in Hawaii has been completed on the island of Kanai. The plant is operated by the Kanai Electric Company, and its entire equipment represents an investment of $300,000. The electrical machinery was furnished by the Westinghouse Electric and Manufacturing Company. The main purpose of the plant is to operate a number of pumping stations on a large sugar-cane tract, distributing water over the land situated at high levels. This work had been done with steam pumps. By the utilization of the electric current the capacity of the plant will be raised to 40,000,000 gallons a day, at a saving of $17,000 a month.

PORTLAND (ORE.) RAILWAY CHANGES HANDS—Important changes have been effected in the management of the United Railways Company, placing the entire control and nearly all the stock of that organization in the hands of C. E. Loss, of San Francisco, Cal. In addition to the steps already taken, Mr. Loss announces that the reorganization of the company will soon be completed, subsequent to which the construction of its projected lines in and tributary to Portland will immediately be commenced. W. L. Benham will retire as president of the company and will be succeeded by Mr. Loss. It is planned to spend $3,000,000 in constructing lines in Portland and vicinity. Of this amount $1,250,000 will be required to build and equip the system within the Portland boundaries. The lines within the city are to be constructed first.

MICHIGAN LAKE SUPERIOR POWER COMPANY—The United States Circuit Court of the Western District of Michigan has granted permission to Receivers C. D. Warren and Clarence M. Brown, of the Michigan Lake Superior Power Company, to issue $500,000 receivers' certificates. The receivers will dispose of these certificates immediately. They will probably be placed with Philadelphia and New York banking houses, although the bondholders may be given

Digitized by Google

the opportunity to subscribe to a portion of the issue. The proceeds will be used to complete the necessary improvements to the power plant, so that it can be brought to its maximum capacity. The Lake Superior corporation has guaranteed that the $500,000 will cover the cost of all necessary improvements. The Union Carbide Company, which now has a considerable contract with the power company, has also agreed to take as much additional power as can be allowed it when the improvements are completed.

PERUVIAN ELECTRIC CONSOLIDATION—Details are at hand of the recent consolidation of electric companies in Lima, Peru. The capital of the new corporation will amount to 15,000,000 soles ($500,000), to which the united companies have contributed in the following proportion: the Santa Rosa Electric Works, 6,150,000 soles, or, say, 615 soles for each of its 10,000 shares; the Lima Electric Tramway, 5,500,000 soles, or twenty-five soles for each of its 222,000 shares; the Lima & Callao Electric Railway, 2,100,000 soles, or twenty-one soles for each of its 100,000 shares, and the Lima & Chorrillos Electric Tramway, 1,200,000 soles, or fifteen soles for each of its 80,000 shares. To this capital must be added the various issues of bonds of the united companies, which amount in the aggregate to about 6,000,000 soles, the whole making 21,000,000 soles, which may be considered as the representative value of the concerns composing the so-called trust. The corporation's board of directors will be made up of twenty-two members, including two chairmen.

CINCINNATI LIGHTING DEAL—A lease for ninety-nine years of the Cincinnati Gas and Electric Company has been signed, giving it into the hands of the Union Gas and Electric Company. A. S. White, C. A. Leib, J. J. Rollins, of New York, and R. W. White, of Cleveland, represent the new company. The leasing company deposits $3,000,000 as a guarantee of dividends to the old stockholders. The capitalization is $20,000,000, half preferred at six per cent and half common. It is expected that Norman Kenan, president of the old company, will be elected to a similar position in the new corporation. It is said that the new company, which will succeed to a practical monopoly of the lighting business in Cincinnati, will spend large sums in the improvement of its property. The contract is said to contain a stipulation that $2,000,000 is to be expended in the next five years. The Union Gas and Electric Company has increased its capital from $10,000,000 to $20,000,000. It is understood that $10,000,000 six per cent preferred stock will be sold immediately.

PERSONAL MENTION.

MR. ERNEST RITTER, manager of the York (Pa.) office of the Pennsylvania Telephone Company, has been made manager of the Easton office. He is succeeded by Mr. G. H. Fulmer.

DR. GEORGE G. BAKER, an old-time electrical man who some years ago was prominently connected with telephone and telegraph interests, is visiting relatives in New York city. Dr. Baker is now permanently located at Denver, Col.

MR. JAMES ROSS has retired from the presidency and directorate of the Mexican Light and Power Company. His successor is Sir George A. Drummond, president of the Bank of Montreal. Mr. Charles H. Cahan, the company's solicitor, has been added to the directorate.

MR. GEORGE B. TRIPP, formerly general manager of the Colorado Springs Electric Company, has become associated with the organization of Messrs. Curtis & Hine, engineers and central station managers, with headquarters at Colorado Springs, Col. A number of large projects are under way, and Mr. Tripp expects to be very busy in the future on various undertakings that his company may supervise. Mr. Tripp had been connected with the gas and electric proposition at Colorado Springs for five years, and under his direction these properties have been very successful. He is one of the best-known men in the Western field, and for several years has been the efficient secretary-treasurer of the Colorado Electric Light, Power and Railway Association.

MR. MAX LOEWENTHAL, the well-known electrical heating engineer, having been commissioned by Mr. John Wanamaker to reorganize the electrical supply department, is now installing an elaborate display covering a floor space of 1,600 square feet in the basement of the New York city building. A model kitchen and bedroom are being erected, in which every conceivable electro-domestic appliance, from a push-button to a refrigerating plant, will be shown in actual operation. Electric cooking will be demonstrated at another portion of the exhibit, which will be opened to the public during the first week in September.

ELECTRICAL SECURITIES.

Every full business day during the last week in the stock market showed a record in excess of a million shares. Prices show not only general gains for the week, but, in some cases, the advances have been of very generous proportions, showing new high levels for the year. So far as the industrial and commercial situation is concerned, it can be said that there is no let-up in the widespread prosperity. There are already unmistakable signs of the usual fall trade expansion. This is reflected in bank clearings, railroad earnings and in reports of conditions in the leading trades, notably iron and steel and the cotton industry.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 25.

New York:	*Closing.*
Allis-Chalmers common	20
Allis-Chalmers preferred	48
Brooklyn Rapid Transit	77¼
Consolidated Gas	140
General Electric	168
Interborough-Metropolitan common	39¾
Interborough-Metropolitan preferred	80
Kings County Electric	160
Mackay Companies (Postal Telegraph and Cables) common	73⅜
Mackay Companies (Postal Telegraph and Cables) preferred	72½
Manhattan Elevated	147¼
Metropolitan Street Railway	106
New York & New Jersey Telephone	125
Western Union	91⅛
Westinghouse Manufacturing Company	150¼

Boston:	*Closing.*
American Telephone and Telegraph	132½
Edison Electric Illuminating	245
Massachusetts Electric	71½
New England Telephone	130
Western Telephone and Telegraph preferred	84

There has been a remarkable increase in the list of stockholders in the American Telephone and Telegraph Company, from 10,790 on January 1, 1903, to 17,556 on January 1, 1906.

The Edison Company, of Boston, during July showed an increased business of 22,000 sixteen-candle-power equivalents, against an increase for July, 1905, of 15,000 sixteen-candle-power equivalents. The company has closed a contract to supply the electric lighting and electric power for the new National Shawmut Bank building. The contract calls for about 4,000 lights.

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	71
Electric Storage Battery preferred	71
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	29½
United Gas Improvement	87⅜

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	138
Metropolitan Elevated preferred	68
National Carbon common	85
National Carbon preferred	120
Union Traction common	4
Union Traction preferred	14

The Metropolitan West Side Elevated has issued its report for the year ended June 30. It is as follows: gross, $2,530,279; expenses, $1,208,287; net, $1,321,992; other income, $11,997; making a total income of $1,333,989; charges, $975,479, leaving a surplus of $358,510, equal to 4.11 per cent on the preferred stock. This surplus compares with $230,142 a year ago.

OBITUARY NOTICE.

MR. L. W. EATON, president of the Bryant Electric Company and the Perkins Electric Switch Manufacturing Company, of Bridgeport, Ct., died at his residence in that city on the morning of August 16.

Digitized by Google

TELEPHONE AND TELEGRAPH.

BROCKTON, MASS.—The mayor of Brockton has signed the franchise of the Home Automatic Telephone Company.

LAMONT, IOWA—The Buchanan County Telephone Company has sold the local telephone exchange to the Delaware County Telephone Company, the sale dating from August 1. The company will make many improvements to the system, and will shortly install a copper circuit.

VICTORIA, TEX.—The Southwestern Telephone and Telegraph Company will make extensive improvements to its system at Victoria and the section adjacent. Among the improvements will be the moving of the exchange nearer the wire centre, and the installing of a new switchboard and new telephones. The company's long-distance business has so increased that it is necessary that additional wires be strung between Victoria and Houston and points north and west.

COTTONWOOD FALLS, KAN.—E. P. Kellam has sold the telephone system of Cottonwood Falls and Strong City, with a number of rural lines, to the Missouri & Kansas company, of Kansas City. Prior to the sale Mr. Kellam had made arrangements for several new rural lines and will act as local agent for the new company until the proposed routes are completed. This is one of the best paying telephone systems in the state in proportion to its size. It is understood that the Council Grove system has also been sold to the Kansas City company.

RICHMOND, IND.—The trouble between the independent telephone companies in western Ohio and the Richmond Home Telephone Company, which threatened to cut off relations if the Ohio companies gave their patrons connection over the Bell long-distance lines, is to be amicably adjusted. The injunction suit brought by the Ohio companies, to prevent the Richmond company from cutting off service, has been called in the Wayne Circuit Court, and a continuance was granted till the September term of court, with the understanding that the differences will be patched up.

TOLEDO, OHIO—The Central Union Telephone Company has installed a despatching system for the Toledo Urban & Interurban Railway Company. There are now twenty-three sets of telephones in operation between Findlay and Toledo. The same company has also installed a despatching system for the Canton-Akron Railway Company between Canton and New Philadelphia. In addition to sixteen stationary sets in the offices of the traction company at various points there are twenty-five portable sets carried on the cars for the use of the motormen in receiving running orders.

SPOKANE, WASH.—Official announcement is made by Charles W. Reynolds, manager of the Spokane division of the Pacific States Telephone and Telegraph Company, that $500,000 will be expended on its system in the improvements now under way. New instruments are to be installed and the distributing frames will be replaced with apparatus of the newest design, the cost of the latter being $66,000. The company recently completed the installation of 1,500 telephone instruments, connecting the ranchers and farmers in the Spokane district with the central offices in that city.

WHEELING, W. VA.—At a meeting of directors of the National Telephone Company, held at Wheeling, a semi-annual dividend of three per cent was declared, and plans were announced for several important extensions and connections which will greatly improve the service of the company. It was decided to start work at once upon the new line to Mannington and Fairmont at an outlay of about $40,000. The right of way has been secured as far as Cameron. With the connections, which will be made at Fairmont, the extension will give National subscribers service to all important cities in northern part of West Virginia as far north as Steubenville. It was also decided, in connection with general plans for giving a first-class service to all parts of West Virginia, to proceed to close the gap of twelve miles between Wheeling and Marietta and Parkersburg. When this improvement is completed a large additional number of cities will be reached. The directors decided to close a contract with the United States Telephone Company for the construction of a line to Cambridge. This will furnish service to Columbus and Indianapolis and to all important points in Ohio, Kentucky and Michigan.

NEW INCORPORATIONS.

GUTHRIE, OKLA.—Weatherford Interurban and Light Company, Weatherford. $250,000.

JEFFERSON CITY, MO.—The Kelso Telephone Company, Illmo. Increase of capital stock from $5,000 to $10,000.

JACKSON, MICH.—Cambridge Telephone Company. $220. Directors: Millard E. Managan, Herbert R. Watkins and Chandler R. Knapp.

CAMDEN, N. J.—Electric Tramway Construction Company, Camden. $500,000. Incorporators: M. L. Berry, J. A. Riggins and W. B. Wolcott, of Camden.

NASHVILLE, TENN.—Hollow Rock Rixie Telephone Company, Carroll county. $1,000. Incorporators: J. W. Rowe, T. T. Park, M. G. Bowers, F. A. Broughton and T. A. French.

COLUMBUS, OHIO—The Navarre Electric Light Company. $10,000. Incorporators: George A. Myer, John W. Zinsmaster, David A. Fisher, Peter Zinsmaster and Charles Fetters.

AKRON, OHIO—The Canton-Akron Consolidated Railway Company, Akron. $10,000. Incorporators: Andrew Squire, C. E. Sander, W. M. Duncan, J. H. Dempsey and J. Wallrath Sutphen.

NEWARK, N. J.—Panama Street Railway Company, Newark. To construct railways, car lines, etc. $500,000. Incorporators: J. J. Spellman, of Orange; A. C. Walker and W. F. Delaney, of Newark.

ST. LOUIS, MO.—North St. Louis & Suburban Railway Company, St. Louis. For the purpose of constructing and operating a line of street railway in St. Louis and St. Louis county. $50,000. Stockholders: John Scott, John Scullin, Edward J. Scott, John B. Scott, Thomas Murphy, James Scullin and William Scullin.

KANSAS CITY, MO.—Electric Terminal Railway Company, Kansas City. Incorporated for the purpose of building a line of railway five miles in length, all within the limits of Kansas City. $300,000. Incorporators: John Mayer, of Parsons, Kan.; George H. Kahmann, W. E. Winner, Bayles Steele and H. G. Pert, all of Kansas City.

NEW PUBLICATIONS.

REPORT OF THE BOSTON (MASS.) WIRE DEPARTMENT—The annual report of the wire department of the city of Boston, Mass., for the year 1905, prepared by the commissioner of wires, Patrick J. Kennedy, has been issued. This describes in detail the work accomplished by the department.

THE STANDARD UNDERGROUND CABLE COMPANY'S HANDBOOK—The Standard Underground Cable Company, Pittsburg, Pa., has published a handbook of price lists, telegraph code and useful information relating to bare and insulated wires and cables for the conduction of electric currents, compiled by Joseph W. Marsh. While this handbook is primarily a price list of the insulated wires, electric cables and accessories manufactured by the company, there are included sufficient engineering data to remove it entirely from the classification of ordinary trade catalogues. There are a number of very interesting half-tone illustrations of wires and cables of different types, and a number of illustrations showing applications of various accessories. The sections entitled "Working Directions," "Testing" and "General and Electrical Information" will be found of particular value to engineers in general. The company is limiting the gratuitous distribution of the book to one to each of its customers and one copy to the executive officers of the larger corporations using such material as it manufactures. In order, however, that any one interested in the subject may be able to secure a copy, the company has decided to put the book on sale at a figure which is really nominal and which represents less than half the actual cost, *viz.*: grade A, bound in blue cloth, fifty cents; grade B, bound in plain leather, gilt edges, seventy-five cents; grade C, bound in limp leather with bill flaps and pockets, gilt edges, $1.

NEW MANUFACTURING COMPANY.

ALBANY, N. Y.—A certificate of incorporation of the New York Beck Lamp Company, of the village of Mineola, has been filed with the secretary of state. It is proposed to manufacture and sell electrical machines and appliances. The capital stock is placed at $50,000, consisting of shares of $100 each, and the directors for the first year are as follows: William Ottman, Henry E. Schwartz and Septime S. Sanguenette, of Brooklyn.

Digitized by Google

ELECTRIC LIGHTING.

GENEVA, IND.—H. O. Fisher, of Toledo, Ohio, is trying to secure a franchise to install an electric light plant at Geneva.

LAREDO, TEX.—The Cannel Coal Company has closed a contract to have a complete electric plant installed at its mines, twenty miles above Laredo, at a cost of $30,000. All work in the mines will be done by power furnished by electric motors.

HYATTSVILLE, MD.—Bids have been invited for installing an electric lighting system in Hyattsville, the voters having recently approved a bond issue of $12,000 for this purpose. Hyattsville has been practically without street-lighting facilities for about six months, and the citizens are anxious to remedy the conditions.

EAST LIVERPOOL, OHIO—Steps are being taken to secure information concerning municipal operation of lighting plants by the East Liverpool council. The contract for city lighting with the East Liverpool Traction and Light Company expires soon, and it is expected that the company will seek a renewal of the contract for at least three years. The council appropriates annually about $12,000 for street lighting.

RICHMOND, VA.—The common council at its last regular meeting failed to pass the ordinance providing for an electric light plant to be owned and operated by the city. The vote was lost through lack of a two-thirds majority, standing eighteen to twelve. The finance committee and the board of aldermen had already reported adversely on the proposition. The matter will probably come before the new council, which will convene early in September.

HEMPSTEAD, L. I.—The trustees of Hempstead have received from Robert M. Van Dorn an application for a franchise to erect and maintain a system of electric lighting, heating and power. The applicant agrees to furnish lighting to the village at a considerable reduction from the present rate paid, also to improve on the system of installation now in vogue. The trustees have requested the applicant to furnish evidences of his financial backing before they act on his application.

SCHAGHTICOKE, N. Y.—It is thought that shortly a dam will be built on the Hoosic river, near Schaghticoke, for impounding water for a power plant. Borings are being made under the direction of Charles Hollingsworth to determine the character of the rock of which there is in the vicinity sufficient to entirely construct the dam. It is expected that the power plant will form another of the series that have been built by the Hudson River Water Power Company, although it has not been authoritatively stated that this company is responsible for the survey now going on.

YAKIMA, WASH.—William Filey has sold his 160-acre farm on the Columbia river at lower Priest Rapids to the Hanford Power and Irrigation Company, of Seattle. The price is not made public, but it is understcod to be in the neighborhood of $20,000. The company is composed of a number of leading capitalists who propose to put in a large pumping plant for the purpose of pumping water from the Columbia river for irrigating the arid lands on the west side of the stream. They alsc expect to erect a large electric plant and will furnish power to the land owners in that section, who in turn will put in plants for pumping the water and irrigating their farms.

WILMINGTON, DEL.—Mayor Horace Wilson has vetoed the franchise recently granted by the street and sewer department to the Commercial Light, Heat and Power Company. The company promised to pay the city $50,000 within eighteen months for the franchise, one-fourth to be paid within ninety days, to give the city three per cent of the gross receipts for electricity furnished to others than the city; to furnish the city arc lights at $40 per year each, electricity for street lighting at two cents per kilowatt and for public buildings at five cents per kilowatt, and to the public at a rate not exceeding ten cents per kilowatt, to furnish gas to the city at seventy-five cents per thousand cubic feet for street lighting and ninety cents per thousand cubic feet to the public. The mayor said he did not think additional franchises of the kind were necessary or advisable, that in future only such as provided for underground conduits should be granted, and he was not convinced that the city would be benefited by the corporation in question. A movement is said to be on foot to secure a franchise for a gas and electric company composed of local interests.

ELECTRIC RAILWAYS.

MARYSVILLE, CAL.—The city council of Marysville has granted the Northern Electric Company a franchise to build through the streets of that city.

ASHLAND, KY.—The Ashland Interurban Street Railway Company has secured a franchise for its line through Greenup county. The company's engineers are at work, and the line will be constructed as rapidly as possible.

EAST LIVERPOOL, OHIO—After two years of fighting, J. L. Francis has secured the passage of a franchise ordinance which gives the Ohio River & Northern Railroad Company the right to build a second railroad through East Liverpool.

CHAMBERSBURG, PA.—An application will be made on August 28 for a charter for the Chambersburg & Western Electric Railway Company, the line to run from Shippensburg to Chambersburg, thence to Fort London, a distance of twenty-five miles.

SEATTLE, WASH.—The city council has passed an ordinance calling for a special election to vote on the issuance of $4,273,000 worth of bonds for a municipal street-railway system and the extension and enlargement of the Cedar river water system. The date of the election was set for September 12.

MASONTOWN, PA.—W. J. Sheldon, F. S. Gleason, Sr., O. K. Eaton, T. J. Lewis and T. B. Black, of McKeesport, with C. M. Watt, of Pittsburg, and G. R. Anderson, Lewis Kail, Dr. J. H. Cloud, Frank A. Madas and James Sterling, of Masontown, have secured a charter for a new street-car line into Masontown. The title of the concern is the Masontown Electric Railways Company.

UTICA, N. Y.—The Utica & Mohawk Valley Railway Company has filed an application for a franchise to construct, maintain and operate a double track on North Genesee street to Deerfield Corners, a single track from the Corners westerly along the Marcy road to the Seymour road, and a single track from the Corners northerly to the reservoir. Permission is also asked to erect the necessary poles, switches, etc., to maintain and operate the Deerfield road by electricity instead of by horse power.

FORT WORTH, TEX.—It is announced that the merger of the Arlington Heights Traction Company, Rosen Heights Street Railway Company and Citizens' Light and Power Company, all of Fort Worth, has been accomplished. W. W. Christy, H. H. Johnson and S. M. Kelsey, of Cleveland, and C. B. Close, of Toledo, represent Cleveland capital, and the company will be the largest in the state. Millions of dollars are to be expended in building and equipment, including a fifty-mile interurban line from Fort Worth to Mineral Wells, the noted Texas health resort.

WASHINGTON, PA.—The borough council has granted a perpetual franchise over certain streets in Washington, Pa., in favor of the Washington & Canonsburg Street Railway Company. The Pittsburg Railways Company will reach Washington by the new road, and will operate a car line direct from Pittsburg to Washington. It is hoped to have cars running before winter. Large interurban cars will be used, and Pittsburg will be reached through the Mount Washington tunnel. The company is already at work on the upper end of the line and is building from a point on the Charleroi line to Canonsburg.

LORAIN, OHIO—The Lake Shore Electric Railway Company is planning to spend hundreds of thousands of dollars on improvements to its lines in the near future. According to a despatch from Lorain, the company intends to set aside $750,000 for these improvements, which will be on a large scale. The Lorain despatch says: "With the filing of incorporations at Columbus for the Lorain Street Railroad Company, with a capitalization of $2,500,000, the Avon Beach & Southern and the Lorain Street Railway companies will sink into oblivion. With the incorporation of the new company the property of the two companies will be merged into one and will be known under the new name. In addition to merging the two roads, the value of which is placed at $1,750,000, a bond issue of $750,000 is also to be provided for, which will be used in the improvement of the line now operated on Broadway in Lorain. The bonds are issued in the name of the Lorain Street Railroad Company, but are guaranteed by the stockholders of the Lake Shore Electric. The company will double-track the Lorain Street Railway from Lorain to Elyria, and will remove the loop in the business district of Lorain."

Digitized by Google

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1416 describes and illustrates the style K Gates rock and ore-breaker.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., is sending out a neat postal card showing an illustration of its enlarged factory at Van Buren and Morgan streets.

THE OSWEGO BOILER AND ENGINE COMPANY, Oswego, N. Y., will be pleased to send bulletin No. 50-A, giving statistics concerning its horizontal return tubular boilers.

THE NEWTON MACHINE TOOL WORKS, Twenty-fourth and Vine streets, Philadelphia, Pa., will send catalogue No. 44, describing keyseat milling machines, to any one interested upon request.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., in bulletin No. 66, describes and illustrates form W motors for rolling mills. These are for 220 volts, one speed, either series or compound-wound.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., are mailing to the trade a very attractive circular-letter. The wording of this letter is particularly clever, and the company ought to secure great results from its distribution.

THE SARGENT STEAM METER COMPANY, Chicago, Ill., has ready for distribution an attractive little booklet describing and illustrating the Sargent steam meter. This booklet will be mailed to any one interested upon request.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, New York, N. Y., has ready for distribution a new booklet showing net prices and discounts covering contents of catalogue No. 21, and also showing changes and corrections which have occurred since publication.

THE ELECTRIC GOODS MANUFACTURING COMPANY, Boston, Mass., in bulletin No. 9 describes and illustrates a few examples of representative installations. This bulletin has been very carefully prepared, and will be found of great usefulness to any one interested in this apparatus.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is sending out to the trade its cost price list applying to its general catalogue No. 24. The prices quoted are the latest in force, and it is suggested that any one who has been overlooked in the distribution to write to the company for a copy.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has issued bulletin No. 1081, describing and illustrating type A transformers. Bulletin 1080 describes multiphase, revolving field, engine-type generators. A price sheet for catalogue No. 2004, to replace page 73, gives new prices for parts of "Wood" form 1 arc regulator.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., has produced a very neat bulletin entitled "How Shall We Know Good Switches?" This literature is really more than an advertising proposition, as it contains some engineering data which can be assimilated to advantage by every one interested in this material.

THE MARSHALL ELECTRIC MANUFACTURING COMPANY, Boston, Mass., is beginning the erection of a new factory at Waltham, Mass. This has become necessary in order to take care of the company's increasing business. The Marshall company reports a brisk demand for its new "Peerless" switch, which is carried in stock in large quantities at Boston, New York and Chicago.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., has issued bulletin No. 609, superseding bulletins No. 25 and No. 194, devoted to floor and wall outlet boxes. Circular 786 is devoted to new type K arc lamps. Circular 787 is devoted to direct-current motors and generators. Any of this literature may be secured by addressing the Pittsfield office or any of the branch offices.

CHARLES F. JOHNSON, Cleveland, Ohio, announces a number of bargains in railway motors, interurban cars and general railway and electrical equipment. Mr. Johnson makes a specialty of mail-order business for heavy supplies. The company has recently established new offices at 710 Citizens' Building. Offices are also located at 623 Ellicott square, Buffalo; 111 Broadway, New York city, and 1240 First National Bank Building, Chicago.

THE LOCKE INSULATOR MANUFACTURING COMPANY, Victor, N. Y., announces that it will shortly issue its new catalogue No. 9, which will be prepared on lines similar to the company's catalogue No. 8, "The Insulator Book." In addition to the regular English edition there will be published a polyglot edition printed in Spanish, German and French. This has been found necessary on account of the company's extensive foreign trade.

THE MURRAY IRON WORKS COMPANY, Burlington, Iowa, has published a handsome catalogue descriptive of Murray Corliss engines, high-pressure boilers and complete power plants. This catalogue is replete with interesting information concerning this character of equipment, and in addition to the text there are many half-tone illustrations of equipment and typical applications, and line-drawings and diagrams showing the parts of the apparatus in detail.

THE TRUMP MANUFACTURING COMPANY, Springfield, Ohio, is distributing some attractive literature describing the features of Trump turbines. These turbines are guaranteed under heads as low as three feet and as high as 300 feet. The company builds horizontal turbines on draught chests, either single or in pairs. The company is also constructing vertical turbines in steel and cast-iron casings. Full information and literature will be sent upon request.

THE WESTERN TUBE COMPANY, Kewanee, Ill., has ready for distribution a booklet regarding a new discovery in bronze mixture known as the "High-Duty" metal. As indicated in the pamphlet, this metal shows a loss in efficiency when subjected to high temperatures of only 5.6 per cent. The company announces this metal as a distinct advance in bronze compositions, and asserts that the discovery is worthy of careful consideration. Copies of the pamphlet will be forwarded upon request.

THE WESTINGHOUSE MACHINE COMPANY, East Pittsburg, Pa., has recently contracted with the Sheffield Company for a 1,250-kilowatt Westinghouse-Parsons steam turbine to be installed in its plant at Sheffield, Ala. The turbine will run under rather poorer operating conditions than usual—a steam pressure of 125 pounds and twenty-six-inch vacuum. It will be direct-connected to a Westinghouse three-phase turbo-generator of the enclosed type, delivering current at 2,300 volts to a light and power system.

"PHONO-ELECTRIC TROLLEY AND TELEPHONE WIRE" is the subject of several unique pieces of literature recently issued by the Bridgeport Brass Company, New York city. One of these folders sententiously reports: "Over seven years ago we received a letter of enquiry from one of the largest street-railway companies asking about 'Phono-Electric' wire. We gave them all the data at our command; showed them where the relative proportion of efficiency was considerably in favor of 'Phono-Electric' over hard-drawn copper wire. Now, they did not exactly doubt our word, but they made their own tests, and in a short time we received their first order. To-day they operate over 500 miles of track, and every foot of overhead wire is 'Phono-Electric.'"

THE STRAUSS BASCULE AND CONCRETE BRIDGE COMPANY and the WALLACE-COATES ENGINEERING COMPANY, Chicago, Ill., announce that they have entered into an agreement whereby the latter will act as general sales agent and constructor for the Strauss bascule and concrete bridges. The rapid growth of the Strauss Bascule and Concrete Bridge Company has necessitated the division of the business, and under the new arrangement the Strauss company will confine itself exclusively to the engineering work in connection with its general designs, and will also give its attention to general engineering. The Strauss company has under way a number of prominent installations of its bascule bridges. The Wallace-Coates Engineering Company was organized a short time ago and incorporated in Maine with a capital of $500,000 by H. U. Wallace, formerly chief engineer of the Illinois Central Railroad, and who, during the past year, has been third vice-president of J. G. White & Company; and by F. R. Coates, formerly chief engineer of the Chicago Great Western Railroad, and who, during the past two years, has been vice-president of the Thomas Phee Company. The company will open an office in Portland, Ore., in charge of O. O. Alexander, general western agent.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 10. NEW YORK, SATURDAY, SEPTEMBER 8, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW
CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager. . . MANHATTAN BUILDING
BOSTON
NEW ENGLAND OFFICE, M. W. BARBER, Mgr., DELTA BLDG., 10 Post Office Sq.
LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager. 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE
TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single copy, 10 cents. Back numbers, beyond one month, each	.25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS.

EDITORIAL:
The Second Law of Thermodynamics . . . 349
The Life of Electrical Machinery . . . 349
The Rotating Sector-Disc Photometer . . . 350
Progress in Electrification . . . 351
Progress Toward an Ideal . . . 351
The Second Law of Thermodynamics—Its Basis in Intuition and Common Sense, by Dr. William S. Franklin . . . 352
The Present Status of the Electrification of the New York Zone of the New York Central & Hudson River Railroad, by W. J. Wilgus . . . 354
The Field of a National Engineering Society, by Calvin W. Rice . . . 358
The Single-Phase System in Steam Line Electrification and Electric Railway Development, by Calvert Townley . . . 360
Problems in the Chemistry of Rubber . . . 361
Improving the Italian Telephone Systems . . . 362
The Railway Signal Association . . . 362
Improvements in the Tantalum Lamp . . . 362
LETTERS TO THE EDITOR . . . 363
A Unique Electric Motor Installation . . . 363
Recent Advances in Steam Turbines—Land and Marine . . . 363
Discovery of the Mariner's Compass . . . 364
The Electrical Discharge in Air and Its Commercial Application . . . 364
The Sons of Jove . . . 364
The Benefit of Enquiry to Lightning-Arrester Practice, by N. J. Neall . . . 365
Electric Power from Southern Waterfalls, by J. W. Fraser . . . 367
Small Railway Substations, by W. L. Waters . . . 372
Report of the British Association Committee on Practical Standards for Electrical Measurement . . . 375
Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw . . . 376
The Sao Paulo Tramway, Light and Power Company, by F. M. Feiker . . . 378
The Telephone Situation in Chicago, by a Staff Correspondent . . . 381
The Liberal Education . . . 383
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 384
METHODS OF GETTING NEW BUSINESS—"Organization and Conduct of a New-Business Department Suitable for Central Stations in Cities of 50,000 Population and Under," by J. M. Robb (Concluded) . . . 386
INDUSTRIAL SECTION:
Single-Phase Induction Motors . . . 388
New Generators for the Ottumwa Railway and Light Company . . . 389
Enlargement of Equipment of the Locke Insulator Manufacturing Company, Victor, N. Y . . . 389
Meeting of the Sales Managers and Representatives of the Buckeye Electric Company . . . 389
Meeting of the Shelby Electric Salesmen's Association . . . 390
The Gleason Universal Moulding Box . . . 390
The "Star" Toggle Bolt . . . 391
Eureka Electric Flat-Irons . . . 391
Weatherproof Incandescent Lamps . . . 391
Adjustable Incandescent Lamp Fixtures . . . 392
New Type Midget Plug and Receptacle . . . 392
The Buckeye Two-Cycle, Single-Acting Gas Engine for Generator Driving . . . 392
National Air-Compressors . . . 394
CURRENT ELECTRICAL NEWS . . . 396
Directory of Electrical and Allied Engineering and Scientific Societies . . . 401
Record of Patents Issued . . . 402

Copyright, 1906, by Electrical Review Publishing Co.

THE SECOND LAW OF THERMODYNAMICS.

One of the fundamental laws of physics, and yet one which is very frequently misunderstood, is that known as the second law of thermodynamics, the law which states the maximum possible efficiency of a process involving the transfer of heat. This law is encountered in nearly all of our dealings with energy, and the engineer should have not only a complete grasp of its meaning when expressed in mathematical symbols, but it should become second nature with him, so that he recognizes it in all his dealings with nature. Something of this sort of feeling does exist, although it is not generally recognized as a law of thermodynamics. This idea is enlarged upon in a most interesting paper appearing on another page of this issue by Dr. W. S. Franklin, professor of physics at Lehigh University, who contends that the law has a basis in intuition; that we recognize its application unconsciously; and he drives his arguments home with apt quotations from old, but honored, sayings. No one who reads this article can fail to get a better understanding of what the law implies and how wide is its application.

THE LIFE OF ELECTRICAL MACHINERY.

A good deal has been said recently about the rapidity with which electrical machinery becomes antiquated and the readiness with which machinery only a few years old is thrown out, to be replaced by more recent designs. It has been said that the generation of electrical machinery is, at the most, three or four years, and that at the end of this time it should be replaced by new.

Such statements probably lead many to believe that electrical apparatus is delicate, and that a few years' service render it unsuitable for further use; otherwise, why should it be thrown out after such a short time? This, of course, is an incorrect view, for machinery which becomes useless after but three years' service could not give that reliability in service which is necessary. Should one who is not informed make some enquiry into the matter, he would probably be told that the changes are made, not because the old machinery is worn out, but because the new machinery is so much better that it may be purchased and the old thrown away, and yet the difference in the returns to the station show that the change has been profitable. Such an incomplete explanation would naturally lead to the idea that the old machinery was very poor and inefficient. Here again the conclusions would be at variance with the facts.

To illustrate the fact that, although a generation in electrical machinery may be brief, this does not mean that the life of any particular machine is short, a report recently made by Sir William Preece respecting the equipment of the Bristol,

Digitized by Google

England, municipal power station may be mentioned. While this station was put in service in 1893, it contains a good deal of modern machinery, including a number of steam-turbine-driven alternators. Enlargements and changes becoming desirable, and the plant being a municipal one, it was necessary that all items of cost should be carefully examined. Sir William was asked to prepare a statement showing the probable life of all parts of the equipment if properly maintained, also the value at the end of this life. In his report he states as his opinion that the life of the dynamos and alternators is thirty years, and the residual value eight per cent. The life of the armored cables is thirty-five years, with a residual value of fifteen per cent. The life of motors is put at twenty-five years, and their value at the end of that time at nine per cent. Compare these figures with the similar ones for other parts of the equipment. The water-tube boilers, for example, are given a life of twenty-five years and a residual value of five per cent. The engines and other machinery are given twenty-five years and a residual value of six per cent. It is evident that, according to this report, the electrical machinery has a longer useful life than have other moving mechanisms, and this is to be expected if one considers the character of the work performed.

A few other figures from this report may be interesting. Storage batteries, for example, are given a life of fifteen years, with a residual value of ten per cent—figures which will, doubtless, be surprising to many. Arc lamps are expected to last twelve years, and lamp-posts forty years. Meters and accessory instruments of a similar kind are given twelve years.

Such figures certainly do not agree with the idea of delicate mechanisms; so the question may properly be asked, why should the old equipment be thrown out? The answer is, of course, as mentioned above, to increase the efficiency of the station. But electrical machines are probably the most efficient mechanisms, taken as a class, that man has yet constructed, and a change of a fraction of a per cent would hardly seem to warrant wholesale condemnation and vast expenditure.

The explanation is the correct one, but it does not go far enough. The fact is that while the new electrical machinery is more efficient than the old—and this is to be expected with our growing experience—it is in other parts of the equipment that the gain is made. The enormous new generators now becoming standard are not so very much better than the older machines, but they make possible the use of more efficient engines, the doing away with wasteful appliances, and the operation of the station in such a way as to obtain better results. It is not simply because the 5,000-kilowatt generator is some per cent more efficient than the 500-kilowatt machine that it is being adopted and the other thrown out, but it is because, with this size of unit, the station as a whole is much improved and economies are effected which would otherwise be unobtainable. In other words, while electrical machinery is highly efficient and may be run satisfactorily as long as other classes of machinery, advances in electrical design have made possible such improvements throughout the entire plant that it becomes profitable to change from the old to the new.

THE ROTATING SECTOR-DISC PHOTOMETER.

Accurate work with the photometer is not as easy as the uninitiated would suppose. It requires a considerable degree of skill, and is trying work. Any new method of making photometric comparisons which brings increased accuracy or relieves the operator of some of the strain is valuable. There are so many precautions to be observed, such as protecting the operator, as well as the photometer itself, from stray light, and distinguishing between a difference in intensity of illumination and a difference in tint, and the fact that the final comparison must depend upon the eye, that any new method must be scrutinized carefully and put to very severe tests before it should be adopted.

One of the methods which is used to some extent depends upon reducing the intensity of illumination of one of the surfaces observed by means of a rotating disc cut in such a way as to enable the amount of light which falls upon the surface to be varied at will. This device is not new, but its accuracy has been questioned. It possesses some advantage, since, when used, there is no need to move either of the two sources of light which are compared. Their position is then always known exactly. But the physiological effect upon the eye would seem at first thought to be a more or less complicated function of the amount of light falling upon the retina, so that actual proof must be given before we can accept the principle that a certain intensity of illumination acting continuously produces the same effect as one of double the intensity, but which is allowed to act upon the eye intermittently but half the time, even though the interruptions come so rapidly that the eye does not perceive them. If, on the other hand, it can be demonstrated experimentally that the actions produce the same stimulation, it would seem to establish a law of simple relations. This effect is the so-called Talbot law, which was enunciated in 1835. Talbot himself recognized that a physical law could not be applied to physiological phenomena, but his law was based upon experimental evidence. Since his time many have investigated the law, some finding that it holds with fair accuracy, and others not finding satisfactory agreement; and while the apparatus has continued in use, the question raised regarding its reliability has never been satisfactorily answered. To clear up the uncertainty thus surrounding a useful photometric instrument, Mr. E. P. Hyde has recently carried out a very careful and somewhat elaborate investigation, and he gives his results in the bulletin of the Bureau of Standards, Washington, D. C., for June.

In making these comparisons, since a high degree of accuracy is sought, certain assumptions usually made in photometric measurements were not allowable. For example, the law of inverse squares, which is universally adopted—at least, in all commercial measurements—could not be employed when using a source of light the luminous surface of which was not fairly well concentrated at a point. For this reason incandescent lamps of the usual types were not available, because of the length of the filament, although, in other ways, they are most satisfactory. With such lamps there is also a possibility of error due to the images formed by reflections from the bulb. Mr. Hyde therefore substituted for the incandescent lamp the Nernst lamp, and inves-

Digitized by Google

tigated the deviation from the inverse square law which would follow when a cylindrical luminous surface such as is presented by the glower was employed. The investigation showed that if the radiating cylinder had infinite length, the intensity of the action varied inversely with the distance, agreeing with a well-known law in electromagnetism. For ordinary distances, however, and for lengths of glower such as were used, the deviations from the inverse square law were entirely negligible. Certain precautions were found necessary when using the glower, particularly the method adopted for protecting it from draughts of air, which caused changes in temperature.

Mr. Hyde found that the deviation from Talbot's law varied with the angular opening of the disc in degrees. When the opening was 180 degrees there was perfect agreement with the law. With an opening greater than this there was an apparently slight deviation from it, amounting in the worst case to an error of 0.2 per cent. With smaller openings the error was in the other direction, amounting to about 0.4 per cent when the opening was but forty degrees.

A closer examination of the conditions of the experiment suggested to the investigator that some of the discrepancy might be due to a congested condition of the apparatus at those times, and to the deviation of the glower in the inverse square law; but the error under the excellent conditions of the experiment was surprisingly small. Experiments made with colored lights also gave approximate agreement with the law, but the error of observation was in these cases somewhat greater; and when lights of different color were employed on the two sides of the screen, the same satisfactory agreement was obtained. The author concludes that Talbot's law, in its application to a rotating sector disc, is verified for white light for all total angular openings between 288 degrees and ten degrees, to within a possible error of 0.3 per cent, which represents probably the limit of accuracy of the experiment. The deviations from the law for red, green and blue light are of the same order of magnitude as those for white light. Moreover, a difference in color on the two sides of the photometer screen produces no appreciable change in the observed deviation from the law. The last word is thus in favor of the rotating sector disc, and this convenient piece of apparatus may now be used with confidence.

PROGRESS IN ELECTRIFICATION.

Somehow or other, when one speaks of "electrification" to-day the idea conveyed is the substitution of electric motors for the steam locomotive on railways. Why this one adaptation should have appropriated to itself the term can not be explained, though it probably has something to do with the interest which the public has in all matters relating to railway improvement. Whatever may be the explanation of the limitations imposed upon this term, there can be no question regarding the great interest of all in the work itself, and for this reason all will read with pleasure the two articles on this subject appearing in this issue of the ELECTRICAL REVIEW. The one by Mr. W. J. Wilgus describes the progress which has been made by the New York Central & Hudson River Railroad in the enormous change which is being carried out on its New York section. This is, undoubtedly, one of the most magnificent pieces of engineering work that is being done in the world to-day.

The second article is by Mr. Calvert Townley, and it deals with the possibilities of the single-phase system, which has been adopted by the New York, New Haven & Hartford Railroad, the conversion of which to electric traction is also one of the big transformations now going on.

Mr. Townley is a firm believer in the single-phase system, but his arguments are not merely an advocacy of that system. They deal with the larger problems of electrification; the advantages to be secured by the adoption of the motive power, irrespective of the particular system employed. The arguments in favor of electrification most frequently heard are that it will reduce the expense of operation and will give a cleaner and more frequent service. These, however, are not the real reasons for adopting the new system; in fact, an increase in operating expense may follow electrification, and yet the transformation be most satisfactory from a commercial point of view. The real advantages lie in the fact that the capacity of the road, and therefore its earning power, may thereby be greatly increased. More cars may be run, more passengers and more freight handled without necessitating a reconstruction of the roadbed. This is an argument which will appeal to those who are called upon to furnish capital for carrying out the transformation.

PROGRESS TOWARD AN IDEAL.

From time to time every journal which keeps pace with the growth of the industry to which it is devoted finds that certain changes become desirable, if it is to present to its readers the information they seek in a form at once the most complete, the most instructive and the most attractive. To this end it becomes imperative to adopt those improvements in the arts of printing and of illustrating which are continually being made.

Again one of these periods has come to the ELECTRICAL REVIEW, and those changes and enlargements which make this journal better and more representative of the great electrical industry are made in this issue. Attention is called to them with the confidence that they will meet with approval and that this issue will receive the commendation of all readers as an example of a well-balanced journal. To emphasize these changes, a number of unusually valuable and interesting papers have been contributed by men eminent in the various branches of electrical engineering.

In carrying out these improvements the old ideals set forth in the first issue have not been lost sight of: "To keep our readers informed as to the most important and valuable inventions pertaining to these subjects, giving suitable illustrations of new objects and discursive reviews of the same, is the principal purpose of this journal." But it is believed that the ELECTRICAL REVIEW in its present form more nearly represents these ideals as they are held to-day.

Digitized by Google

The Second Law of Thermodynamics; Its Basis in Intuition and Common Sense.[1]

By William S. Franklin, Sc.D., Professor of Physics in Lehigh University.

IT is the object of this article to give a simple account of that fundamental principle in physics which is known as the second law of thermodynamics. This law ranks with the principle of the conservation of energy, and the two are, perhaps, the most important of the generalizations of modern physical science. Some adequate sense of the meaning of both must sooner or later become ingrained in the intuitive consciousness of all men; indeed, most men have already an intuitive sense of the second law of thermodynamics of no mean order, and it is the purpose of this article to give a sharp characterization to this widely diffused intuition.

Every one has a feeling of the irretrievable effects of disaster. The collapse of a bridge, the destruction of a house by fire, or the wreck of a ship, these things involve losses which indeed may be forgotten after reconstruction, but never balanced. The havoc that is wrought is essentially irreparable.

It is desirable to use the word degeneration in a very narrow technical sense later when we come to consider the second law of thermodynamics, and the way may be paved to a clear understanding of the later and accepted use of this word in physics by applying it now to designate that aspect of disaster which is irreparable. We may speak, for example, of the degeneration of any structure from a state of coordinated perfection to a cataclysm of chaos, and this degeneration is essentially irreparable, or it can be repaired only at a certain cost.

It is very important, however, to avoid the carrying over of this idea of structural degeneration to thermodynamics, where a much more limited conception of degeneration arises. The term thermodynamic degeneration applies to the effects of turbulence, in the changing of a gas from high to low pressure, in the equalization of temperature in a pail of water when a hot stone is dropped into it, and so on.

Before passing on to the consideration of that kind of degeneration which accompanies turbulence, thermodynamic degeneration, as it is called, it is important to consider the extent to which the laws of mechanics, including the laws of equilibrium and acceleration, and the law of action and reaction, are inapplicable to the infinitely complicated phenomena that accompany turbulence in physical systems.

The laws of motion! Every one has to some extent a feeling of the absurdity of the idea of reducing the more complicated phenomena of nature to any orderly system of mechanical law. For, to speak of motion is to call to every one's mind first of all the phenomena that are associated with the excessively complicated, incessantly changing, turbulent and tumbling motion of wind and water. These phenomena have always had the most insistent appeal to us; they have confronted us everywhere and always, and life is an unending contest with their fortuitous diversity, which rises only too often to destructive sweeps of destruction in fire and flood and in calamitous crash of collision and collapse where all things commingle in one dread fluid confusion. The laws of motion! Be assured that the science of mechanics is circumscribed in utter repudiation of such universal phrase.

Before attempting to define the limits of mechanics, which we must do if we are to define the limits of thermodynamics, for most of present-day physical science falls under the one or other of these two heads, let us consider a very general application of the simplest idea of motion, the idea of velocity. Every one has an understanding of what is meant by the velocity of the wind, and a sailor having what he calls a ten-knot wind knows that he can manage his boat with a certain spread of canvas and that he can accomplish a certain portion of his journey in a given time; but an experienced sailor, although he speaks glibly of a ten-knot wind, belies his speech by taking wise precaution against every conceivable emergency. He knows that a ten-knot wind is by no means a sure or simple thing, with its incessant blasts and whirls, and a sensitive anemometer, having much more regard for minutiæ than any sailor, usually registers in every wind a number of almost complete but excessively irregular stops and starts every minute and changes of direction that sweep around half the horizon.

Surely the science of mechanics, using the term in its broad sense, which includes hydraulics and pneumatics, can not extend in its strict application to such fitful phenomena as those presented by the wind. In fact, the science of mechanics, except in its vaguely general aspects, as exemplified by the above application of the idea of velocity to the wind, is limited to the more or less ideal phenomena which are associated with the motion of rigid bodies, either singly or in connected systems, with systematic motion of distortion of elastic bodies, and with ideally simple motion of flow of liquids and gases. When we consider actual motion, however, we always encounter turbulence more or less marked, and the science of mechanics, which is the science of describing the phenomena of motion, fails utterly if we insist upon taking account of the minute details of the phenomena of motion which are involved in this turbulence.

Let one, for example, watch the movement of the water at a certain point in a brook. There is indeed a fairly steady average velocity of the water at the point and a certain mean rhythmic variation, but superposed upon this average motion there is an erratic variation of velocity that is infinitely manifold, the details of which are beyond the scope of any descriptive science, a descriptive science being a science like mechanics, which is concerned with how things progress as a phenomenon develops itself, how the structural members of a bridge stretch and shorten as a car passes across the bridge, how pressure and temperature of steam vary during the successive stages of admission, expansion and exhaust of a steam engine; how electromotive force, current strength, electromagnetic force and all of the changing variables play in the operation of a dynamo. But who could recite the story of the most minute details of these phenomena? It can not be done, and if it could be done it would be of no avail, for these details can never be twice alike, and the very essence and value of a science lies in the discovery of types which in their important features recur so that a knowledge of these types can serve as a basis for anticipation and design.

The important thing in connection with the turbulent aspect of a physical phenomenon is its general result or consequence, just as the important thing about the burning of a house is the loss. How utterly useless and uninteresting it would be, for example, to study the minutest de-

[1] All rights reserved. Copyright, 1906, by William S. Franklin.

Digitized by Google

tails of a conflagration, assuming such a study to be possible, recording height and breadth and the irregular and evanescent distribution of temperature throughout each flicker of consuming flame, the story of each crackling sound, and every yield and sway of timber and wall.

The fact is that we are immersed in an illimitable sea of phenomena, every single detail of which is itself infinitely manifold, and no completely adequate descriptive science can ever be developed. One fundamental fault in modern meteorology, for example, lies in the complete domination of nearly all meteorologists by the methods and ideas of the so-called exact sciences, exact because they refer very largely to ideal phenomena and ignore minutiæ.

Physical science, then, consists of three main branches: (1) mechanics, including hydraulics, electricity and magnetism, light and sound; the science of those phenomena in which turbulence may be for practical purposes ignored; (2) statistical physics, the science of those phenomena in which turbulence introduces an appreciable and practically important erratic element; meteorology is the best example of statistical physics, although any phenomenon whatever has its statistical aspect; and (3) thermodynamics, and in order to explain the essential characteristics of thermodynamics it is needful to draw a parallel. In every-day life we see the fire insurance companies concerned with certain broad features of statistical physics in their examination and records of fires, and we see them also concerned with a profit-and-loss account which is wholly abstracted from the details of the phenomena of conflagration. Thermodynamics is the profit-and-loss branch of physics, as it were, and, like the profit-and-loss branch of fire insurance, thermodynamics, properly speaking, is completely and absolutely abstracted from any consideration of the details of any physical phenomenon. Thermodynamics is concerned with the measurement and accounting of that type of physical degeneration which accompanies turbulence, just as fire insurance is concerned with the estimation and accounting of what we might call, using a fine phrase, structural degeneration by fire.

A turbulent process[1] in a physical system always plays a certain havoc, or effects a certain degeneration of the system. Thus a certain degeneration is associated with the escape of a compressed gas through an orifice, a certain degeneration is associated with the flow of heat from a region of high temperature to a region of low temperature, a certain degeneration is associated with the conversion of work into heat by rubbing a coin on a board, and so on.

The numerical measure of thermodynamic degeneration is called entropy.[1]

THE SECOND LAW OF THERMODYNAMICS.

(*a*) *The thermodynamic degeneration which accompanies a turbulent process can not be directly repaired, nor can it be repaired by any means without compensation.*

This is an entirely general statement of the second law of thermodynamics. The direct repair of the degeneration due to a turbulent process means the undoing of the havoc wrought by the turbulence by allowing the turbulent process to perform itself backwards, an idea which is exactly as absurd as the idea of allowing a burned house to unburn itself, or as the idea of the man in our town who was so wondrous wise, and who after scratching out both his eyes, just scratched them in again!

Following are several specialized statements of the second law of thermodynamics:

(*b*) *Heat can not pass directly from a cold body to a hot body, nor can heat be transferred from a cold body to a hot body by any means without compensation.*

(*c*) *Heat can not be converted directly into work nor can heat be converted into work by any means without compensation.*

The direct conversion of heat into work would be the simple reverse of any of the ordinary turbulent processes which involve the degeneration of work into heat. For example, work is degenerated into heat in the bearing of a rotating shaft, and we all know that to reverse the motion of the shaft will not cause the bearing to grow cold and the heat so lost to appear as work and drive the shaft! That would be a rotary engine indeed! There is an important general theorem in thermodynamics to the effect that if two turbulent processes, A and B, involve the same amount of degeneration, and if either of the processes, say A, has been allowed to perform its sweep, then, by a lever arrangement, as it were, the process B can be let down gingerly and the havoc wrought by the sweep of A can be undone, leaving the system B, however, in the condition into which it would be degenerated if the process B had been allowed to sweep instead of being let down gingerly. This is very much as if, having two exactly similar houses, A and B, one of which, A, has burned, we could rig up a mechanism which would reduce B imperceptibly to ashes and thus cause A to be restored, and *vice versa*. This general theorem is as thoroughly established as any generalization in physics, and if it is true, and if we ever find a way to convert heat into work unconditionally and without cost or compensation, then it will be proven indirectly that a shaft *can* be driven by heating one of the journals in which it rotates, for direct conversion of heat into work by one process must be, according to this general theorem, equivalent and replaceable by the reverse of any ordinary process which converts work into heat.

(*d*) *A gas can not pass directly from a region of low pressure to a region of high pressure, nor can a gas be transferred from a region of low pressure to a region of high pressure by any means without compensation.*

Fancy a gas squirting itself backwards, through a nozzle into a high-pressure reservoir! The repeated statement of self-evident facts concerning direct repair in these statements of the second law of thermodynamics may seem ridiculous to the intelligent reader, but it must be remembered that few people realize that the second law of thermodynamics is a statement of a fact which every one knows coupled with a generalizing clause which once thoroughly understood is almost if not quite self-evident. Here is one more statement of the second law, the oldest English version of it:

> Humpty Dumpty sat on a wall,
> Humpty Dumpty had a great fall.
> All the king's horses and all the king's men
> Can not put Humpty Dumpty together again.

This is perhaps the most dignified of all the statements of the second law, for which we will allow it to pass for the moment, inasmuch as it omits all nonsense about direct repair and refers at once to external means.

It is of the utmost importance, however, to remember in Humpty Dumpty's case that we are concerned with structural degeneration; or, if Humpty Dumpty was ever really alive, with a much more elusive and irreparable kind of degeneration which defies all external means, compensated or not compensated; but let us return to the fourth statement (*d*) of the second law and consider by means of an example what is meant by compensation in its thermodynamic sense.

A gas can be transferred from a region

[1] It is undesirable here to go into a full discussion of the three types of physical action which produce thermodynamic degeneration. See an article in *Science*, November 20, 1903, and see chapter on thermodynamics in Nichols and Franklin's "Elements of Physics," vol. i.

[1] It is not desirable here to outline the argument which establishes the idea of entropy and fixes its use as a numerical measure of thermodynamic degeneration. See *Science*, and Nichols and Franklin, *loc. cit.*

Digitized by Google

of low pressure to a region of high pressure by means of a pump, and the work that is done in driving the pump, even supposing the pump to be frictionless, is all converted into heat. This conversion of work into heat, which is a degeneration, is the necessary cost of or compensation for the transfer of a gas from a low-pressure region to a high-pressure region, which transfer is what might be properly called a regenerative process.

Considering the second statement (*b*) of the second law, we know that in an artificial-ice factory heat is continually abstracted from the freezing room and transferred to the warm outside air, but in order to accomplish this, even by an ideally perfect and frictionless mechanism, a certain amount of work must be allowed to degenerate into heat so that the amount of heat that is delivered to the warm air outside exceeds the heat that is abstracted from the cold room by the amount of heat that has resulted from the conversion into heat of the work spent in driving the refrigerating machine.

Considering the third statement (*c*) of the second law, we know that in an ordinary steam engine heat is converted into work, but in order to accomplish this transformation a large quantity of heat must be supplied to the engine at high temperature, and some of this heat (about nine-tenths of it in the very best engines) must be let down, as it were, to the low temperature of the exhaust to compensate for the conversion of the remainder into work.

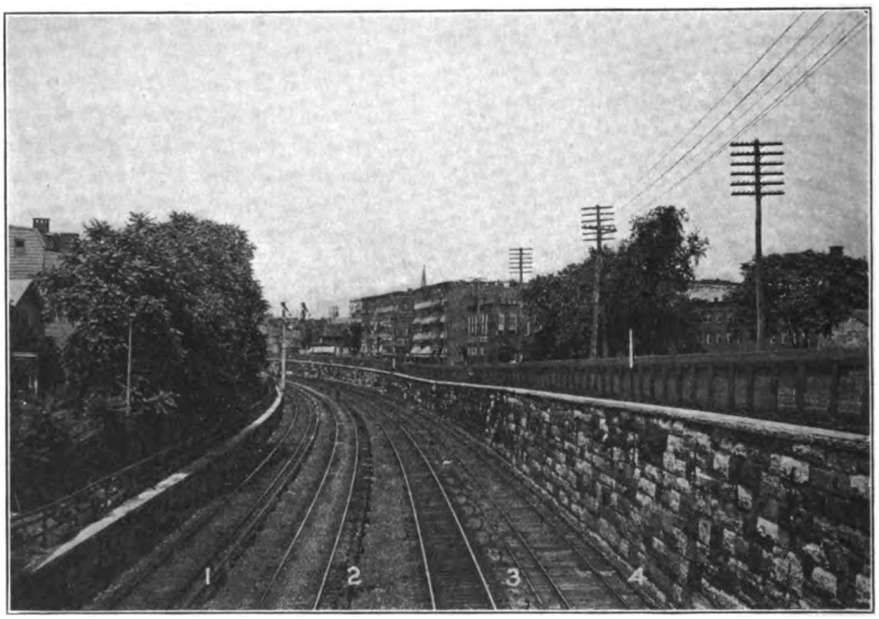
The Present Status of the Electrification of the New York Zone of the New York Central & Hudson River Railroad.

By W. J. Wilgus, Vice-President of the New York Central & Hudson River Railroad.

THE change of motive power from steam to electricity on the New York Central & Hudson River Railroad involves a number of problems of almost as much interest and importance as the substitution of electricity for steam as a motive power. The departure from steam practice of seventy years' growth brings with it the necessity for many other changes from existing methods of handling traffic. The use of electricity naturally carries with it a much more frequent train service, which necessitates the elimination of all track, street and highway grade crossings, radical changes in passenger station facilties, increase in the number of main tracks for handling a larger number of high and low-speed units, the substitution of automatic for controlled manual signals, and many other improvements that are necessary for handling an increased electrically propelled traffic with safety, convenience and reliability.

The agreement between the city of New York and the railroad company calls for the substitution of electricity for steam through the Park avenue tunnel only, but the railroad company, from a broad standpoint, concluded that the benefits of electric traction should be extended to embrace not only the remainder of its passenger lines in New York city lying northerly of the Park avenue tunnel, but also extending out into Westchester county for a distance of from twenty-five to thirty miles from the Grand Central terminal. In reaching this conclusion it was also decided that the ordinary principles of humanity must be observed in carrying on, simultaneously with the change of motive power, the elimination of grade crossing through the cities and towns. In almost every instance the local communities cooperated with this policy, but regardless of the strenuous efforts of all concerned the proposed improvements north of the limits of Greater New York are at a standstill because of the lack of approval of the plans for the elimination of grade crossings by the board of railroad commissioners as provided by law.

Consequently the railroad company is forced to temporarily terminate the northerly limits of its electric zone at High Bridge on the Hudson division and Wakefield on the Harlem division, seven miles and thirteen miles, respectively, from the Grand Central terminal. The extension of the electrical service northerly from those points to the ultimate termini at Croton or Peekskill on the Hudson division and North White Plains on the Harlem division is dependent upon the action of the state officials in approving the elimination of grade crossings.



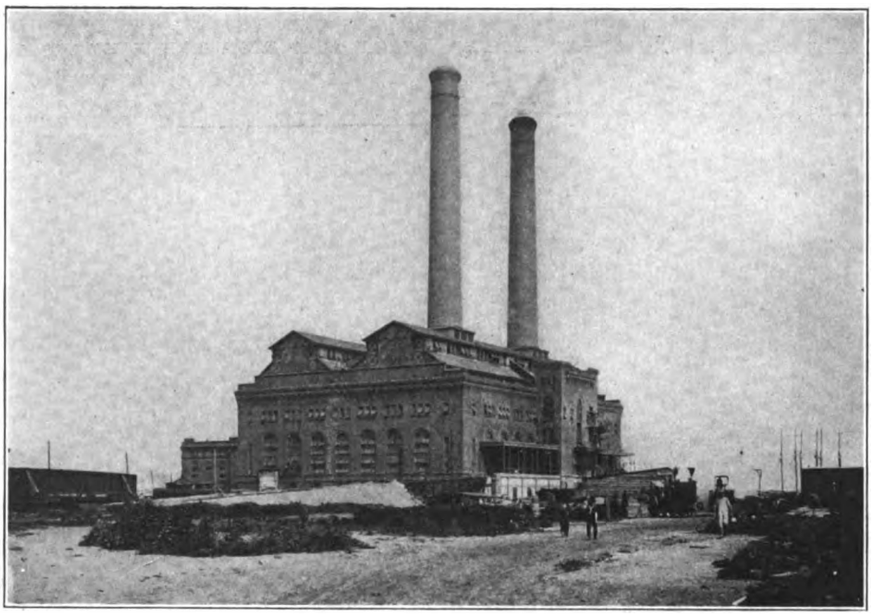
GRAND CENTRAL TERMINAL IMPROVEMENT.—THIRD RAIL AND PIPE LINE. 1 AND 4—THIRD RAIL ERECTED COMPLETE. 2 THIRD RAIL ERECTED WITHOUT COVERING. 3—THIRD-RAIL BRACKETS ERECTED.

The work incident to the change of motive power in the initial electric zone south of High Bridge and Wakefield is progressing rapidly, and, so far as motive power is concerned, everything will be in readiness for the change in the latter part of September or the early part of October. The inability, however, to complete the new automatic block signals and all-electric interlocking at that time, coupled with the

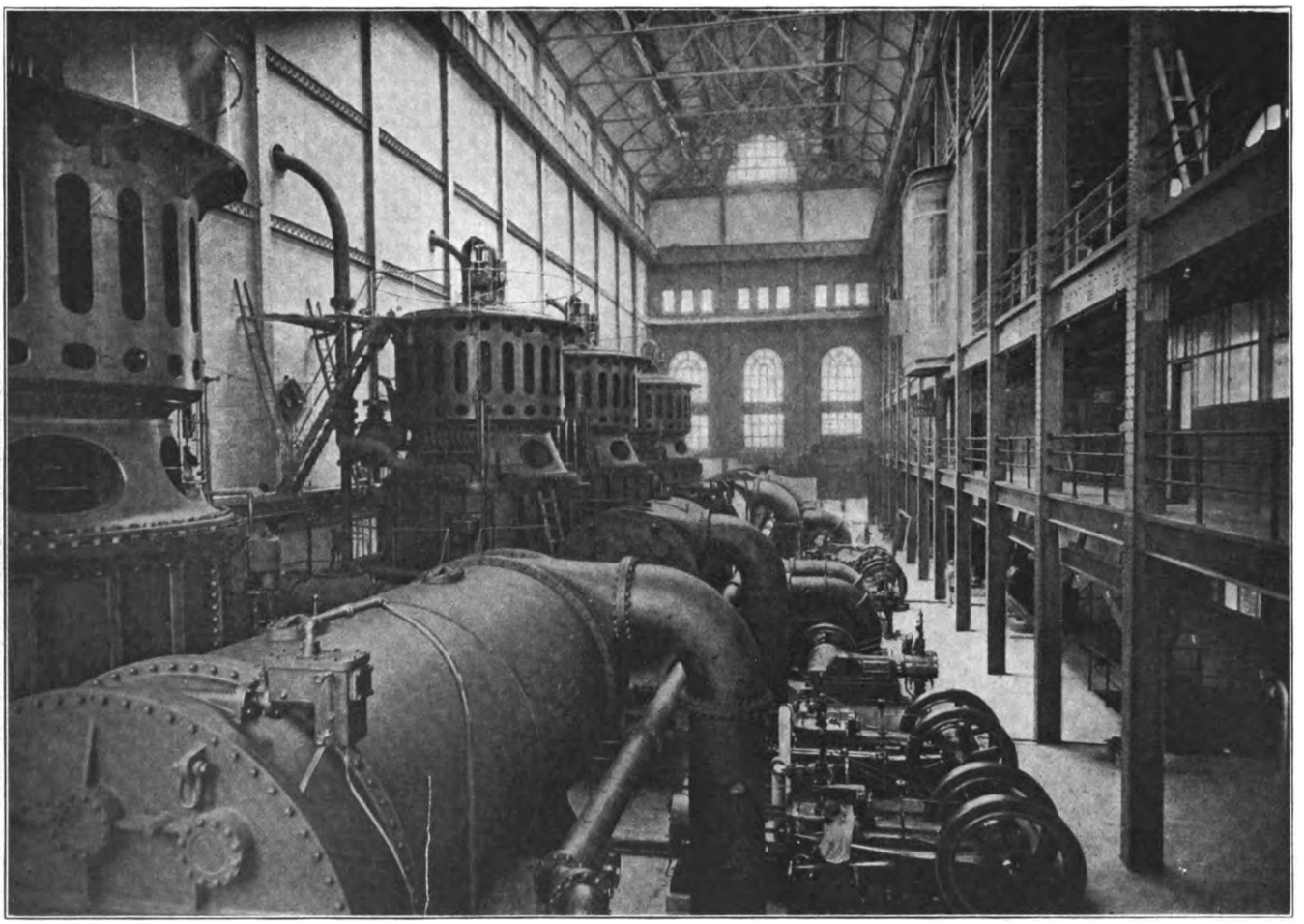
Digitized by Google

abnormal rush of passenger business in September and October, makes desirable the fixing of the final date for the change of motive power from steam to electricity in the latter part of October or the early part of November.

In order that the change of motive power may be made prior to the final completion of the enlarged Grand Central terminal, the portion of the new terminal adjacent to Lexington avenue, between Forty-fourth and Fiftieth streets, and also on the east side of Park avenue between Fiftieth and Fifty-seventh streets, is rapidly approaching completion and will be temporarily equipped to act as an electric suburban terminal. The westerly side of the existing steam terminal will be electrified so that the through trains hauled by electric locomotives may be accommodated therein. This procedure will permit the abandonment of the easterly side of the existing steam terminal, the site of which will then be excavated and the permanent work constructed, so that the Lexington avenue terminal may be extended westerly sufficiently to accommodate all business, both suburban and through trains. The westerly existing terminal will then be abandoned, the site excavated and the new permanent terminal completed. The first step, as above described, will be in readiness for the change of motive power in the fall; the second step will follow about a year later, and the final completion of the terminal is expected to take place in 1910. It is, of course, self-evident that this gradual process of construction is necessary in order to avoid interference with the exceedingly large regular passenger traffic



PORT MORRIS POWER STATION, LOOKING NORTHEAST.



PORT MORRIS POWER-HOUSE—TURBINE ROOM, LOOKING WEST.

Digitized by Google

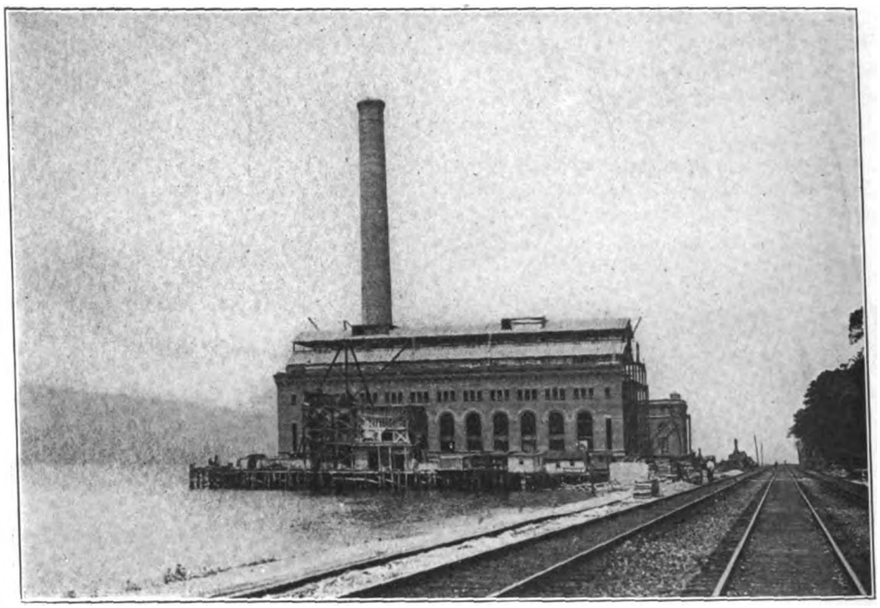
of the railroad companies using the Grand Central terminal at the same time that the new double-storied station, yard and street viaducts are being constructed.

In addition to the Grand Central terminal, work is about to be started on the new Bronx station improvement at Mott Haven, which will involve the building of an overhead station spanning eight main tracks and the elimination of all grade track crossing at the junction of the four-track Hudson division and the four-track Harlem division with the four-track trunk line between Mott Haven and the Grand Central station.

New commodious overhead stations are also about completed at High Bridge, Morris Heights and University Heights on the Hudson division, and minor station changes are also under way at other points within the initial electric zone to harmonize with the change of motive power and reversal in direction of traffic.

In order to properly provide for the change of motive power from steam to electricity, and *vice versa*, elaborate temporary engine terminals are about completed at High Bridge and Wakefield. At these places engine-house facilities have been provided for the steam locomotives and inspection sheds and pits for the electric locomotives. At Croton and North White Plains extensive permanent shops are under construction for the inspection and repairs of electric motor-cars and electric locomotives.

Heretofore, the four-track line of the Harlem division terminated on the north at Woodlawn. Between that point and Wakefield two additional tracks have now

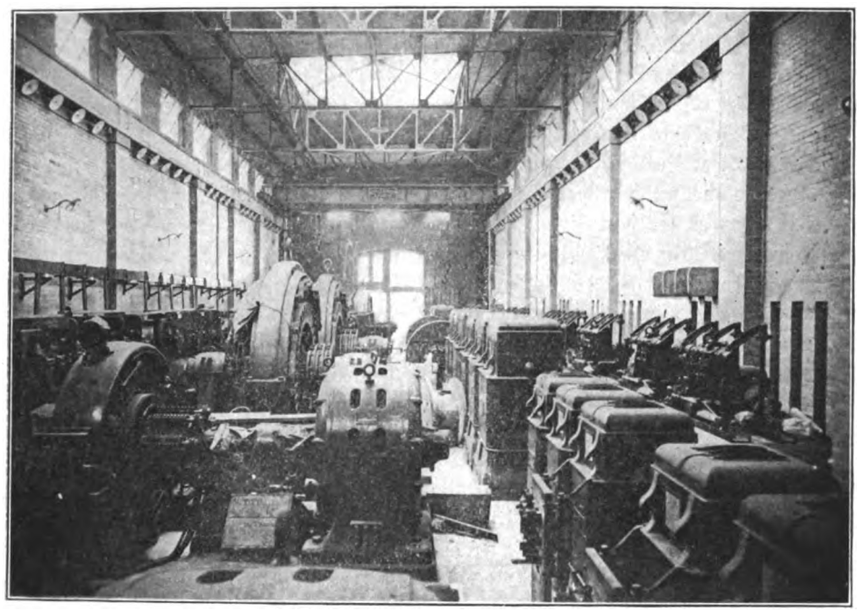


YONKERS POWER STATION, LOOKING NORTHWEST.

GRAND CENTRAL YARD IMPROVEMENT.—GENERAL VIEW, SHOWING EXTENT OF EXCAVATION, LOOKING SOUTH FROM FORTY-NINTH STREET.

Digitized by Google

been laid, making four in all. On the Hudson division two additional tracks have been constructed, making four in all from the junction with the Harlem division at Mott Haven to Kings Bridge, some distance north of High Bridge; between High Bridge and Croton from two to four additional tracks are now under construction, involving, among other items, the building of the Marble Hill cut-off in the upper portion of Greater New York and the four-tracking of the existing two-track tunnel through Sing Sing prison. The construction of the proposed four-track tunnel for straightening the alignment south of Spuyten Duyvil has been postponed, pending the conclusion of negotiations with the city for the right to pass beneath city streets.



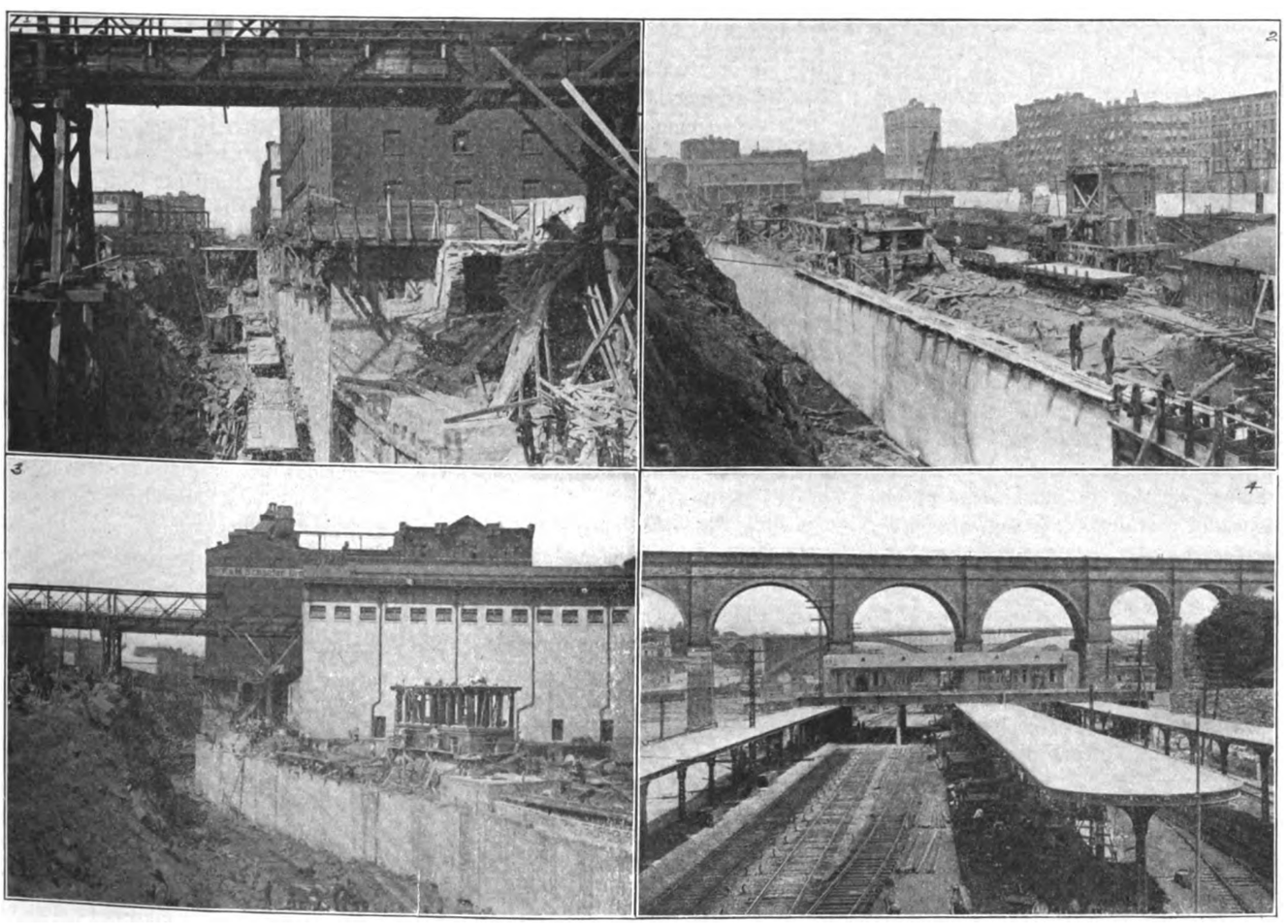
MAIN FLOOR, INTERIOR OF MOTT HAVEN SUBSTATION.

On the Port Morris branch between the Harlem river and the East river, at the terminus of which the Port Morris power station is located, the double-track line has been straightened and depressed so as to eliminate many street grade crossings, involving, among other items of heavy construction, a tunnel under St. Mary's Park.

Second only in importance to the change of motive power is the necessary radical change in signals and interlocking within the initial electric zone, as in conjunction therewith the direction of traffic is to be changed from left-handed to right-handed running.

The construction of the new all-electric interlocking plants and electric automatic signals with alternating-current track relays, the new signal bridges, towers, battery houses, substations, duct-lines, etc., is well under way.

For operating the ultimate electric zone



GRAND CENTRAL TERMINAL IMPROVEMENT.—1—SOME IDEA OF THE DIFFICULTIES. 2—THE HUGE RETAINING WALL. 3—ANOTHER VIEW OF THE WALL, THE TEMPORARY VIADUCT AND ONE OF THE SIGNAL TOWERS. 4—THE HIGH BRIDGE STATION.

Digitized by Google

two large power stations are provided, one of which, located at Port Morris, is completed and in regular operation, and the other, at Yonkers, is approaching completion. The power station at Port Morris has ample capacity to operate the initial electric zone.

The four substations for operating the initial electric zone are practically completed.

The construction of the transmission lines has offered a number of interesting problems, as all kinds of conditions have arisen that have necessitated different methods of treatment. For instance, through the Park avenue tunnel, pipe-ducts have been adopted hung either from the roof or the sides of the tunnel; on the Park avenue viaduct, pipe-ducts are used located on the tops or sides of the girders; under the Harlem river, submarine cables are used; from the Harlem river to Mott Haven Junction, vitrified ducts beneath the streets have been adopted; through the Harlem depression as far as substation No. 7, at Bronx Park, cables are placed in pipe-ducts hung from the sides of the retaining walls; from Mott Haven to the New York & Ptunam crossing near High Bridge, cables have been placed in vitrified ducts beneath the surface; northerly of the cable tower at the New York & Putnam crossing on the Hudson division and northerly of substation No. 7 on the Harlem division, cables have been placed on steel poles with substantial steel trusses where it is necessary to have the transmission line cross the railroad tracks.

All of the transmission line work, including circuit-breaker houses, is practically completed.

The third-rail working conductors are nearly finished, with the exception of the special work at important places like the Grand Central terminal, where it is expected that the finishing touches will be completed during the month of September. At a number of complicated places overhead construction has been found necessary so as to afford electric locomotives continuous contact, and this work is well in hand. Feeders and jumpers in connection with working conductors are progressing rapidly and will be finished early in September.

Electrical equipment consisting of locomotives, motor-cars and trailers has been partially delivered, and the remainder is coming along in time for use in regular operation in the fall.

Thirty-five electric locomotives will be needed for the hauling of through trains and 186 steel suburban cars will be used in the initial service, of which 125 are motor passenger cars, six motor combined express and baggage cars, and fifty-five trailer cars which can later be altered into motor-cars by the addition of electrical equipment.

The Field of a National Engineering Society.

By Calvin W. Rice.

EVERY reader of this article, whether or not a member, has ideas of the possible and legitimate activities of a national engineering society.

We will all agree at the outset, first, that the society must be of use to every individual member.

This in particular should mean that the member living far away must have quite as much thought and attention as the one near headquarters, and second, with the increase of membership the service must be proportionately varied, and the responsibility for rendering same is even greater.

Before starting to name some of the avenues of usefulness it is well to take an observation.

Engineering is passing into a new era. The necessity for specializing is greater at the present time than ever before, but the obvious advantages of cooperation among the several specialists was never more apparent, and the spirit of such cooperation was never more advanced than it is at present.

The national engineering societies are organizations of men for the mutual benefit of themselves and the general promotion of the "arts and sciences connected with engineering," but they will fail of substantial success if they lack the spirit of cooperation. Combinations do not bring about economy or general benefit, except that there is cooperation, and the latter, it is always inferred, will result when the former is recommended.

One very common mistake is the fear of the loss of identity in such combinations. This is an admission of the element of weakness on the part of the individual or association so deciding. It shows that that individual or society is thinking more of itself. He who forgets himself absolutely and works solely for the ideal will more surely attain success, and with it the reward—ungrudgingly allowed by his fellows, because unselfishly sought.

Several features suggest themselves, and they will be important, as they serve the greatest number.

A—The library service.

B—The making of acquaintances.

C—Research.

The library must be there for permanency, and is of prime importance, although most societies start and are kept alive by the social or human element.

Where possible, the circulating feature of the library should be permissable, and where not, then the organization should develop a department of research, so that a member may apply for "searches" on any subject. This would make, then, to every member a substantial acquisition to his resources.

The library is an ideal avenue of usefulness. This carries with it another, of which there is some doubt, but only according to the ability with which it is managed, the "Question Box" or bureau of information.

Theoretically, if not practically, all the members of a national engineering society are engineers, therefore their questions are legitimate and are not the attempt on the part of clients to secure for nothing engineering information and advice.

There has been a very substantial success in the Question Box for a particular meeting. Why not make it continuous?

If tried to a moderate extent it ought to be a living and practical benefit. Every engineer almost daily is meeting some problem which is more or less novel. If there could be a central bureau where assistance or suggestions could be immediately secured, this would be an invaluable resource to the membership.

B—One of the great benefits which one obtains from membership in a national society is the development of his acquaintanceship. This feature should then be the work of importance of the meetings. This should be the central object of its meetings about which everything revolves.

Make the programme attractive and of greatest profit so that full attendance is secured, then systematically provide the machinery for the members to meet each other.

The out-of-town member is the more deserving of attention and must have it. Particularly should the younger members

Digitized by Google

be brought in contact with the great men of the profession.

Let each meeting be so broadening and uplifting that, so to speak, one may see the spirit of the society grow. Further, this is inseparable from the ideals of professional honor, the standards of which are unconsciously formed at such times.

C—With the increase of strength of the society should come the desire for advanced work—research. In Germany this is undertaken by the government. In this country we have the large corporations and manufacturing establishments doing this in the most routine manner, considering that such is an essential to their progress.

For obvious reasons the individual can not do it.

The national engineering society is, therefore, the logical instrument to undertake research work in the lines of the activities of its members.

The society should be in a position to suggest topics for investigation to colleges whose graduating students are preparing theses. There should be especially close sympathy between the colleges and the national engineering society, and papers read before societies, and presumably the latest on a subject and the statement of actual experience, should be given to students as a text-book and the students required to abstract and discuss.

In a certain sense societies should lead and not follow. This is peculiarly true of standards. This is not only true in the atmosphere of professional honor, the standards for which the society should stand, but also the material standards of the arts.

To the extent that America is to excel must we adopt standards in manufacture, standards of measure, specification, strength of materials, etc. To maintain interest a magazine should be published, not to encroach on the regular publications as such, but just to cover the items of peculiar interest to members of the society.

While the foregoing cover the wants of the majority, yet there are numerous other activities which combine to reach every member, which, we have all agreed, must be served.

Such another work is the maintenance of an employment bureau.

It ought to be true that a member is never long out of employment. The very fact that he has not been permitted to join till his record has been proved separates such a man from the average applicant and in general should make him acceptable. On the other hand, it is most natural that the headquarters of a society should receive requests for men, and these should be conscientiously passed on to the members as their due.

All of these opportunities of national engineering societies are founded on cooperation between the members, each contributing to the success of the whole.

An evidence of the progress of the spirit of cooperation in engineering is the Union Engineering Building. Here will many societies make their headquarters, each preserving identity and constituency, but will combine libraries, and it is to be hoped in some intimate way with the technical sections of the New York Public Library developing a true centre of engineering in America. But let the influence be to an ever-receding horizon, and with its growth the society takes its natural office as leader of the profession.

The Single-Phase System in Steam Line Electrification and Electric Railway Development.

By Calvert Townley.

THE remarkable success of the American nation in the family of nations is undoubtedly due, in a great measure, to the vigor and persistence with which the average American man attacks the problems before him, whatever they may be. He has been trained to do whatever he has to do as hard and as quickly as he can. One effect of this training has been to make us a nation of partisans and to give us a persistence in adhering to our individual ideas and a delight in seeing those ideas carried forward to a successful conclusion against opposition of varying kinds and intensities. Knowing this, it behooves all engineers to discriminate as clearly as they can between the fixity of purpose, the energy and persistence necessary for a successful conclusion to any enterprises entrusted to them, and the danger of regarding as a part of their duty partisanship as to engineering methods. It is natural that a manufacturer of machinery who has succeeded in producing a new device, marking a step in the advance of his art, should urge upon the public all the advantages of his invention for purposes of commercial gain, while his less fortunate competitors should combat with equal vigor the introduction of something which will take their business away. The value of an engineer to his client lies, to a considerable extent, in his ability to discriminate between such opposing claims in determining the value of any advances that may be made in his art, so that his client may make the best use of any new weapon in the battle of progress and escape being misled by false prophets.

I have heard electrical engineers complain that their profession is not given the standing to which it is entitled by the importance of the interests involved. There is ground for this complaint, and it is, no doubt, due in part to the newness of the industry, and to the lack, until recent years, of many high-grade neutral engineers. It can not be successfully denied, however, that this condition is also in no small degree due to their own readiness to belittle each other's work. A public, or even a private, attack on a brother engineer may injure him. It is more likely to injure the author of it. It certainly does not tend to raise the standard of the electrical engineering profession in the minds of the business public, on whose favor all engineers depend. An engineer usually strengthens himself by saying a good word for a brother engineer when opportunity offers. He can always discourage by ignoring them, or by disparagement, attacks made by others. The temptation to make public reply to some half-baked criticism of one who has rushed into print about your work, and who has thereby laid himself wide open for a telling retort, is undeniably strong, but it should generally be resisted.

The production of a commercial single-phase alternating-current motor for railway service by B. F. Lamme has placed a new weapon in the hands of the railway operator and his engineering advisors, about the use of which much has been said and written, both favorable and otherwise. The importance of this invention is very generally recognized, but its bearing on many of our modern problems is frequently misunderstood. A brief analysis

Digitized by Google

of the situation may not be out of place and may perhaps assist in preventing our regarding this motor as a panacea for all our previous ills, or, on the other hand, as a quack nostrum which will soon be discredited by a later development.

The application of electricity to the propulsion of cars involves three entirely separate and distinct essentials, *i.e.:*

1. The generation of electric power from the prime mover;

2. The transmission of such power from the point of generation to the moving vehicles; and

3. Its reconversion at those points again into mechanical power applied to the wheels.

The single-phase alternating-current motor has done essentially one thing, and one thing only, *i. e.,* it has made possible the use of simpler methods of transmitting power from the power-house to the moving vehicles. It has radically changed neither the method of generating power in the first place, nor the method of utilizing it in the third place. Power-houses for the production of single-phase alternating current differ in no marked degree from our standard polyphase power-houses. The alternating car or locomotive equipment, while changed much in detail, is likewise similar in all its elementary features to the car or locomotive equipment previously used with continuous current. Therefore, whether or not the single-phase alternating-current system is desirable for any particular installation depends in a very large degree—I had almost said depends altogether—on how valuable may be the simplified methods available for distributing electrical energy which its use permits.

The essential difference between the alternating and the continuous currents is that the relation between the pressure and quantity can be readily changed in the alternating current, whereas with the continuous current such change involves the introduction of cumbersome, complicated and expensive devices. The ability to transmit energy in the form of a high-pressure current permits smaller and less expensive conductors and simplifies the moving contact mechanisms for connecting the stationary conductors with the moving car. If the distances of transmission are short and the energy to be collected by any unit relatively small, the above-named advantages largely, or entirely, disappear; and, conversely, if the distances of transmission are great and the amounts of energy to be used per unit large, the advantages of the alternating current become more valuable.

Steam railroad service as compared with trolley service furnishes greater average distances and requires larger units of power. Therefore, the distributing simplicity of the alternating current has a greater relative value than in city trolley systems.

The disadvantages of the single-phase system are largely those which are incident to its newness. The car equipments as at present built are heavier, and they are more expensive. The details of the auxiliary parts are still somewhat more complicated, and they have not as yet been perfected in design. The introduction of higher trolley voltages means better insulation and the adoption of additional precautions to protect the traveling public against shock. All of these objections may fairly be put in the same class as the objections which have been many times encountered in the past twenty years' development of the electrical industry, and which objections we may confindently expect will be duly removed by the ingenuity and persistence of the American designer. The present arguments between advocates of the single-phase railway system and of the continuous-current railway system remind one forcibly of the debate of eighteen to twenty years ago as to the relative merits of alternating and continuous current for lighting. They should not be allowed to cloud or confuse the underlying and elementary facts which govern. An attempt to universally introduce the single-phase railway system would be doomed to failure at once by reason of its imperfect interchangeability with the continuous-current system already in use on all the large trolley systems. The folly of discarding a satisfactory and successful continuous-current apparatus, and thus sacrificing present investments for the purpose of catering to a new fad, is even less pardonable in an engineer's advice to his client than would be a neglect to take advantage of the single-phase system by reason of the conservative, but natural, mistrust of its new and somewhat untried features. By all means let us, in the first place, have as full information as possible, and, in the second place, countenance nothing but the most thorough consideration of the needs of every individual problem.

Much has been said and written about the electrification of steam railways, and prognostications freely made by enthusiastic electrical partisans who relegate the steam locomotive promptly to the scrap heap. The average man, however, has no very clear idea of what really does govern electrification, nor where it can reasonably claim material advantages. Comparing the two methods of propelling cars it will be noted that the motive power, in the first place, is, in either event, generated by burning coal—for the steam locomotive under its portable boiler, and for the electric locomotive under a stationary boiler in the power-house. In the second place, the steam produced is used to drive an engine, likewise portable in the case of the steam locomotive, and stationary in the case of the electric locomotive. Here, however, the steam locomotive scores a distinct advantage, because its steam is applied directly to produce propulsion, whereas in the electric system the energy must still go through several transformations, requiring complicated and expensive equipment, and entailing severe energy losses. Therefore, in the case of a one-train railroad, the electric system is clearly outclassed. Suppose now that we multiply the traffic by 100, and consider a railroad on which 100 trains on an average are in service, what are the conditions? We now burn coal under 100 portable boilers for steam locomotives, or under suitable batteries of stationary boilers in the power-house for electric operation, while steam is applied in 100 sets of locomotive cylinders in one case, or to a few large engines in the power-house in the other case.

It is perhaps worth while to here comment on the fact that the use of electricity has nothing whatever to do with the generation of power; in fact, it is not a source of power at all, but simply a means of transmitting power which is generated by the prime mover to the point where such power can be used, an attenuated flexible steam pipe, if you will, between the power-house and the moving train.

Now, having in effect an infinite boiler capacity on every engine, and likewise having in effect the ability to enormously increase the cylinder dimensions of the locomotive without increasing its weight, it becomes possible to do with the electrified system what was previously, with steam traction, entirely out of the question, and a new and very interesting situation is created. The limit of the weight of trains which can be hauled, and of the speed which they can maintain, is usually the power of the locomotive which draws them. The limit of the power of the largest locomotive that may be used is the strength of the track, bridges, etc., to withstand heavy weights, and this means that beyond a certain milestone in the progressive increase of a railroad's business there must be reconstruction, always at enormous expense and at a loss of valuable time, and usually at a severe handicap to

Digitized by Google

operation. These difficulties electrification largely avoids, and, therefore, on a congested railroad system where increased train weights and speed, or both, are of value, electrification unquestionably affords facilities which are beyond the reach of steam.

In the matter of the number of trains which can be operated over a given track and the measure of their safety of operation, there is a different condition introduced by the use of electric traction. Present practice provides safety by signaling an approaching train whether or not there is another train in the block ahead. Experience has shown that locomotive engineers too frequently disregard such signals, relying on their watchfulness to avert an accident. The signal man in the tower having set a danger signal is powerless to take further action, and, in fact, has less incentive to do so, knowing that he will be held blameless as soon as it is shown that his signals were properly set. The natural tendency of the above situation is to cause railroad managers to somewhat lengthen their blocks, and thereby decrease the track capacity in an effort to increase the margin of safety. With an electric equipment, suitably placed switches enable the tower operative to cut off current from any section of track, so that an aggressive engineer who overruns his signal will promptly find himself without power, and with the certain assurance that the incident will be reported by his conductor and by the tower man, and that he will be promptly up for punishment. The result of this practice must unquestionably be a physical increase in safety and must have an excellent moral effect in enforcing an observance of rules by the operatives, with the ultimate result of enabling shorter blocks to be used and increasing the train capacity of any given track.

The foregoing are some of the possibilities of steam road electrification, entirely aside from these usually given the greatest prominence, *i. e.*, cost of installation and economy of service, freedom from smoke, cinders, etc. I will not comment on these matters, as they have been frequently and fully discussed, and as there are rapidly being accumulated facts and figures from actual service which will set at rest various and sundry disputed points.

There are many roads which it will obviously pay to electrify. There are others which it obviously will not, but in between these two extremes and grading one into the other by almost imperceptible steps come many cases which are debatable ground. Investment and economy will always play important parts in every decision, and if the single-phase system can reduce that investment and increase the economies, and if it will lengthen the stretches which can be economically equipped and operated, it has advanced the art of electric railroading by an appreciable degree, has placed a new and valuable weapon in the hands of electrical engineers, and has correspondingly broadened the field for the application of electric traction to existing steam roads.

Problems in the Chemistry of Rubber.[1]

There is no more important group of questions demanding attention from the chemist at the present time than those connected with the production of india-rubber or caoutchouc. An enormous increase in the demand for india-rubber has taken place in the last few years, and last year the production was not less than 60,000 tons. Until recently the supply of rubber came chiefly from two sources—the forests of Brazil, which contain the tree known as *Hevea Brasiliensis,* furnishing the Para rubber of commerce which commands the highest price, and the forests of Africa, where climbing plants, generally of the Landolphia class, also furnish rubber. The increased demand for caoutchouc has led to the extensive planting of the Para rubber tree, especially in Ceylon and in the Federated Malay states. Systematic cultivation and improved methods of preparation are responsible for the fact that the product of the cultivated tree, which begins to furnish satisfactory rubber when six or seven years old, is now commanding a higher price than the product of the wild tree in Brazil. It is estimated that within the next seven years the exports of cultivated india-rubber from Ceylon and the Federated Malay states will reach between ten and fifteen million pounds annually, and that after fifteen years they may exceed the exports of the so-called wild rubber from Brazil. The services which chemistry can render to the elucidation of the problems of rubber production and utilization are very numerous. Methods of treatment depending on a knowledge of the other constituents of the latex have led to the production of rubber in a purer condition. Much still remains to be elucidated by chemical means as to the nature of the remarkable coagulation of the latex. As is well known, the latex is a watery fluid resembling milk in appearance which contains the rubber, or, as I think more probable, the immediate precursor of rubber, together with proteids and other minor constituents. The constituent furnishing rubber is in suspension, and rises like cream when the latex is at rest. On the addition of an acid, or sometimes of alkali, or even on mere exposure, coagulation takes place and the rubber separates as a solid, the other constituents for the most part remaining dissolved in the aqueous liquid or "serum." The first view taken of the nature of the coagulation process was that, like the coagulation of milk by acids, it is dependent upon a process of proteid coagulation, the separated proteids carrying down the rubber during precipitation.

This explanation can not, however, be considered complete by the chemist, and there are peculiarities connected with the coagulation of the latex which are opposed to the view that it is wholly explained by the coagulation of the associated proteids. A number of experiments were made at the Imperial Institute with latex forwarded from India, and the results obtained, especially with reference to the behavior of certain solvents toward the latex, led to the conclusion that "coagulation" can take place after removal of the proteids, and that in all probability it is the result of the polymerization of a liquid which is held in suspension in the latex and on polymerization changes into the solid colloid which we know as caoutchouc. Although the nature of the process is not yet completely elucidated, there is little room for doubt that the coagulation is due to the polymerization of a liquid, and possibly of a liquid hydrocarbon contained in the latex. For the chemist the important question remains as to the nature of this liquid from which caoutchouc is formed.

The discovery of better methods of coagulation, preparation and purification will be effected through chemical investigation, as will also the determination of the manner of utilizing the various other plants which furnish rubber-like latices. That the physical properties of raw rubber, on which its technical value depends, are to be correlated with the chemical composition of the material there can be no doubt. The chemical analysis of raw rubber, as at present conducted, is, however, not always to be taken by itself as a trustworthy criterion of quality, and more refined processes of analysis are now

[1] Excerpt from an address delivered by Professor Wyndham Dunstan before the chemical section of the British Association, at York, on "Some Imperial Aspects of Applied Chemistry."

Digitized by Google

needed. Although the finest caoutchouc for technical purposes is only yielded by half a dozen plants, under whose names these varieties of caoutchouc pass, there can scarcely be a doubt that the elastic substance in each case possesses a very similar, if not identical, chemical structure. Nearly all the latices and similar fluids furnished by plants contain more or less caoutchouc. Even opium, which is the dried juice of the capsule of the poppy, contains caoutchouc, while the opium yielded by certain Indian species contains a notable proportion. Chemistry must determine the means by which caoutchouc can best be separated from these relatively poor latices. In view of the increasing production of the nearly pure caoutchouc which is furnished by *Hevea Brasiliensis, Funtumia elastica, Castilloa elastica, Ficus elastica,* and a few other plants which occur or can be cultivated in several of our tropical possessions, the question is not a pressing one at the moment. Moreover, it can not be doubted that chemical science will sooner or later be able to take a definite step toward the production of rubber by artificial means.

The production of caoutchouc by chemical means has, indeed, virtually been accomplished in its formation from isoprene. The exact nature of this change has still to be determined. When this has been done it will only remain to cheapen the cost of production to make the manufacture of synthetic rubber a purely practical problem. I should be the last to discourage the great extension of rubber planting which is now taking place. It is warranted by the present demand for the material. It has also to be remembered that the actual cost of producing raw rubber, which is at present about twenty-five cents per pound, will probably be reduced, and the market price of rubber may eventually be so considerably lowered that, as with quinine, the synthetic production could not be profitably carried on.

As I have said, our science is concerned with nearly every problem connected with the great rubber industry, and in concluding these few remarks I may allude to the production of vulcanized rubber depending on the formation of additive compounds of the hydrocarbon with sulphur. In this connection I should mention the recent experiments of Mr. Bamber in Ceylon, which appear to show that vulcanization may be accomplished by acting on the uncoagulated latex with chloride of sulphur. If this proves to be practicable, it may mean the transference to the tropics of the subsidiary industry of vulcanizaton, which is at present carried on in Europe.

Improving the Italian Telephone Systems.

United States Consul Paul Nash, of Venice, Italy, reports that the telephone systems of that country will be rapidly improved and brought up to a modern condition.

The telephone service in Italy, both urban and intercommunal, has hitherto been almost entirely in the hands of two great companies—the Societa Alta Italia, operating in Milan, Genoa and Turin, and the Societa Generale Italiana pei Telefoni ed Applicazioni Electtriche, controlling Bologna, Florence, Rome, Naples and the Sicilian towns.

In the beginning of 1904 the ministry of posts and telegraphs took over the Venice telephone system, extending the service, raising the pay of the employés, and reducing the rates, but, in spite of increased expenses, putting aside some $12,000 a year toward a fund for the changing of the entire system. The time has now come when bids for this change are being made, and already three have been received—one from an American, one from a French and one from a German firm. These bids are yet to be submitted to the ministry at Rome by the local director, and there is still time for other American firms to compete if they act promptly.

The ministry of posts and telegraphs recently appointed a commission to investigate the telephone service throughout the country, with the result that in many places a complete change was found to be necessary. In Rome, for example, the service was found to be extremely bad, and that town will probably be one of the first to be modernized in this respect. The appointment of this commission was the first step in the project of the ministry to take over control of the telephone service of the whole country. Thus the moment seems most propitious for investigation by our manufacturers, and because the government will undoubtedly prefer a uniform system throughout Italy an immense business might possibly be the reward of the successful bidder for the modernization of the service in the first large towns in which it is undertaken under government control.

The director of the local exchange says that the central-battery system is in use at Milan, and that as it gives perfect satisfaction the tendency will be to adopt it generally. He also says that of the three propositions already submitted to him for the new exchange in Venice that of the American firm seems to be the best, and that although the actual choice does not rest with him he believes the minister will award the contract to this firm, provided, of course, nothing better is forthcoming.

American desk telephones should find a ready sale in Italy. The only thing of the kind in use in Venice is a French production known as the Bailleux-Ader, which, although excellent as far as mechanism is concerned, is enclosed in a large wooden box, and is too heavy and cumbersome for convenience.

The Railway Signal Association.

The next meeting of the Railway Signal Association will be held at the Great Northern Hotel, Chicago, Tuesday, September 11, 1906. A paper entitled "Standard Specifications for Mechanical Interlocking" will be discussed and certain revisions recommended for consideration and action at the annual meeting.

"Identification Marks for Wires and Cables From a Maintenance Point," will also be considered.

The secretary announces that on account of the presence in Washington, D. C., of two other large conventions on October 9, 10 and 11 (dates noted for holding the annual meeting), and a scarcity of room to hold sessions and facilities to display apparatus and materials, the executive committee left it to a vote of the active members to select a new date, which is now fixed by this vote as October 16, 17 and 18.

The New Willard will be the association headquarters.

Improvements in the Tantalum Lamp.

It is reported in the foreign journals that some improvements have been made in the tantalum lamp as manufactured by the Siemens & Halske Company, of Berlin, Germany. The useful life of the lamp has been increased to 600 hours for the "H" type standard, and to 800 hours for the "L" type. The average total life may be taken as equal to that of the ordinary carbon lamp. These figures have been adopted provisionally for commercial purposes, although it is said that actual tests made on a large scale at the factory have shown better results. It has been found that if half of the bulb away from the base be frosted that a much better distribution of light is obtained, more being thrown downward. This method of construction will be adopted as standard practice.

Digitized by Google

LETTERS TO THE EDITOR.

Electric Motors for Operating Stone-Crushing Machinery.

To the Editor of the Electrical Review:

Have you any information as to the successful use of electric motors operating large stone-crushing machinery? We shall be obliged if you can give us some specific information as to the practicability and economy of such service. If you have not this information at hand, can you advise us where the same can be obtained?

The Genesee County Electric Light, Power and Gas Company,
R. M. Walker, Secretary.

Batavia, N. Y., August 29.

Electric Limiting Device.

To the Editor of the Electrical Review:

I understand that there is on the market a limiting device by the use of which electric lights will flash when a certain load is exceeded. I would be glad if you could give me any information concerning this device, or place me in communication with any of the manufacturers thereof.

Canadian Electrical Association,
T. S. Young, Secretary-Treasurer.

Toronto, Ontario, August 29.

Cost Table Wanted.

To the Editor of the Electrical Review:

If you have ever published a table or tables showing relative or approximate cost per kilowatt-hour to generate current under different conditions, please mail it to me and I will remit cost.

Greenwood Water and Electric Light Plant,
A. J. Sproles, Superintendent.

Greenwood, S. C.

A Unique Electric Motor Installation.

There are many mills, especially in New England, which depend on two sources of power for their operation, either using water under ordinary conditions, or having an auxiliary steam plant to carry the load when the water fails during the dry season. An interesting adaptation of electricity as an auxiliary motive power under these conditions is to be seen at the mills of the Joslyn Manufacturing Company, South Scituate and Hope, R. I. This company operates three mills for the manufacture of shoe laces and corset strings: the Richmond mill, on the Ponogansett river; the Ponogansett mill, two miles above the first on the same stream; and the Rockland mill, situated about three-quarters of a mile west of the Ponogansett mill.

The scheme in which electricity is used to adjust the differences between steam and water is highly interesting. The idea throughout the mills is to get along without using the steam engine. The Rockland mill, located between the other two of the series, contains a small power-house in which is installed a water-wheel-driven, 200-kilowatt, 2,300-volt, three-phase General Electric generator, with switchboard. The mill is driven by a 175-horse-power induction motor supplied from this generator. The steam engine with which the mill was equipped as a reserve is retained for that purpose, but will probably never be used, as at dry periods all of the available water is utilized by this mill alone, the pond near the Ponogansett mill serving as a storage basin against the droughts. The electrical equipment in the Rockland mill thus supplies power to operate that mill and assists, as well, to operate the other mills throughout the year.

The Richmond mill, the second mill of the three, operating twenty-four hours per day, ordinarily uses the water power of the Ponogansett river, but has a steam engine auxiliary for emergency. Here the electrical unit consists of a seventy-five kilowatt machine, which can be operated either as a generator or synchronous motor according to the following schedule: when the plant is operated by water power, this unit is belted to the line shaft and runs as a generator in multiple with the 200-kilowatt generator at the Rockland mill, taking its share of the load. When the water is low the unit is used as a motor, drawing current over the transmission lines from the Rockland mill generator. The Richmond mill engine is, therefore, seldom, if ever, used.

At the third mill, the Ponogansett, there is a ten-hour working day, and water power is depended upon entirely for operating the machinery. In this mill a sixty-horse-power motor is used to drive the line shafting, while a one-hundred-kilowatt synchronous unit operates either as a motor or generator in a similar way as in the Richmond mill.

Both the Richmond and the Ponogansett mills are lighted by electricity, taking current through transformers from the transmission line.

In addition to this ingenious method of obtaining the most economical operation, the installation is further noteworthy because of the use of high-voltage motors within the mills. The transmission line enters each mill in rubber-insulated, lead-covered cables, laid in galvanized-iron loricated conduit with the sheath grounded. The motor frames are likewise connected to earth, so that all danger of fire or shock is eliminated. The electrical equipment, including induction motors, synchronous motors (or generators, as the case may be), and exciters as well as the switchboards, was furnished by the General Electric Company.

Recent Advances in Steam Turbines—Land and Marine.

At the recent meeting of the British Association for the Advancement of Science, held at York, England, a paper entitled "Recent Advances in Steam Turbines—Land and Marine," was read by Gerald Stoney.

The author dealt first with the development in the use of steam turbines for driving dynamos and alternators, from the first one, made in 1884 by the Hon. Charles A. Parsons, of ten horse-power, to the great ones of 8,000 horse-power used in the great power stations of Carville, Neasdon, Chelsea, Paris, etc.

He then described the further development of the steam turbine for driving rotary air compressors of the turbine type now largely used for blowing blast furnaces and other work, and pointed out the advantages gained—light weight, small foundations, small consumption of oil, and, above all, high economy of steam. These are generally for about 20,000 cubic feet free air per minute, and a pressure of ten to fifteen pounds per square inch. A slightly different type is also made for about 30,000 cubic feet per minute, at about one pound per square inch pressure. These are used in several large iron works and elsewhere for dealing with the waste gases from furnaces, and for driving these gases through the recovering plant, etc., an important point being that they do not clog with tar and other matters.

Since it is almost, if not quite, impossible to utilize economically low-pressure steam at about atmospheric pressure in a reciprocating engine, the exhaust-steam turbine becomes of importance in many cases where there are non-condensing engines and other sources of exhaust steam. Several such installations were described and the high economy attained by such turbines was explained.

As a steam turbine can utilize the highest vacuum attainable to its full extent, the use of the vacuum augmentor described in a paper before the English Institution of Civil Engineers of Great Britain, read in December, 1905, was given, with some instances of the high vacua obtained in practice by its help.

In conclusion, the marine turbine was briefly touched upon, and the great development from the little "Turbinia" of 1897, to the gigantic Cunard express liners of to-day, was described.

Digitized by Google

Discovery of the Mariner's Compass.

We are indebted to a magazine published about seventy years ago for the following paragraph: "Much interest must forever attach to the discovery of this instrument, and yet there are few subjects concerning which less is known. For a period the honor of the invention was ascribed to Gioia, a pilot or ship captain born at Pasitano, a small village situated near Malphi, or Amalfi, about the end of the thirteenth century. His claims, however, have been disputed. According to some, he did not invent, but improved it, and according to others he did neither. Much learning and labor have been bestowed upon the subject of the discovery. It has been maintained by one class that even the Phœnicians were the inventors; by another that the Greeks and Romans had a knowledge of it. Such notions, however, have been completely refuted. One passage, nevertheless, of a very remarkable character occurs in the work of Cardinal de Vitty, Bishop of Ptolemais, in Syria. He went to Palestine during the fourth crusade, about the year 1204; he returned afterward to Europe, and subsequently went back to the Holy Land, where he wrote his work entitled 'Historia Orientalis,' as nearly as can be determined, between the years 1215 and 1220. In chapter xci of that work he has this singular passage: 'The iron needle, after contact with the loadstone, constantly turns to the north star, which, as the axis of the firmament, remains immovable, while the others revolve; and hence it is essentially necessary to those navigating on the ocean.' These words are as explicit as they are extraordinary; they state a fact and announce a use. The thing, therefore, which essentially constitutes the compass must have been known long before the birth of Gioia. In addition to this fact, there is another equally fatal to his claims as the original discoverer. It is now settled beyond a doubt that the Chinese were acquainted with the compass long before the Europeans. It is certain that there are allusions to the magnetic needle in the traditionary period of Chinese history, about 2,600 years before Christ; and a still more credible account of it is found in the reign of Chingwang, of the Chow dynasty, before Christ 1114. All this, however, may be granted, without in the least impairing the just claims of Gioia to the gratitude of mankind. The truth appears to be this: the position of Gioia in relation to the compass was precisely that of Watt in relation to the steam engine—the element existed, he augmented its utility. The compass used by the mariners in the Mediterranean during the twelfth and thirteenth centuries was a very uncertain and unsatisfactory apparatus. It consisted only of a magnetic needle floating in a vase or basin by means of two straws on a bit of cork supporting it on the surface of the water. The compass used by the Arabians in the thirteenth century was an instrument of exactly the same description. Now the inconvenience and inefficiency of such an apparatus are obvious; the agitation of the ocean, and the tossing of the vessel, might render it useless in a moment. But Gioia placed the magnetized needle on a pivot, which permits it to turn to all sides with facility. Afterward it was attached to a card, divided into thirty-two points, called Rose de Vents, and then the box containing it was suspended in such a manner that, however the vessel might be tossed, it would always remain horizontal. The result of an investigation participated by men of various nations, and possessing the highest degree of competency, may thus be stated. The discovery of the directive virtue of the magnet was made anterior to the time of Gioia. Before that period navigators, both in the Mediterranean and Indian seas, employed the magnetic needle, but Gioia, by his valuable improvement in the principle of suspension, is fully entitled to the honor of being considered the real inventor, in Europe, of the compass as it now exists."—*Electrical Engineer, London.*

The Electrical Discharge in Air and Its Commercial Application.

A paper was read before Section B (chemistry) of the British Association for the Advancement of Science during the recent meeting at York, England, by Messrs. Cramp and Leetham, dealing with "The Electrical Discharge in Air and Its Commercial Application." This paper described an apparatus for the production of bleaching and sterilizing gas obtained by causing an electrical discharge to take place through air, the gases being used for treating flour.

The paper was divided into three sections:

1. The Construction and Application of the Apparatus—This consists essentially of an alternator, transformer, ozonizer and spark-box, the two latter being in series on the high-tension side of the transformer. A current of air is caused to pass through these while they are excited, the general result being an extremely active modification of the air supplied.

2. The Electrical Phenomena Involved—This section includes an investigation of the laws which govern the various types of electrical discharge.

3. The Chemical Phenomena Involved—This section includes the results of analyses, etc., of the gases used, together with an account of their action upon the flour.

Lantern slides illustrating the construction of the apparatus, and the behavior of the different types of discharge, were shown.

The authors found that

a. All the types of electric discharge behaved similarly, and needed similar means for rendering them steady.

b. With a properly arranged circuit any desired type of discharge might be obtained, and, by proper regulation, might be gradually caused to pass to any other type.

c. The number and distance apart of the discharge points, the shape of these points, the air velocity, and the frequency, all effected the discharge produced.

d. So long as the air resistance was very high, the chief modification in the air was the production of ozone; but with a gradual breakdown of the air resistance oxides of nitrogen were yielded, though this change did not appear to depend upon the temperature of the apparatus, as might have been expected.

e. The gas yielded was always in a state of ionization—but the higher the air resistance, the less marked was this ionization.

f. Contrary to the statement of many authorities, ozone and oxides of nitrogen were found to exist side by side, without mutual destruction.

g. The bleaching action of the gas appeared to be due to oxidation.

h. Flour, treated by the gas, was found, for some unexplained reason, to absorb more water than similar flour untreated.

The Sons of Jove.

On Tuesday, September 11, 1906, it is expected that a large attendance of the present membership of the Rejuvenated Sons of Jove will attend a meeting and initiation at Niagara Falls, N. Y. This order is rapidly growing in numbers and is gaining strength throughout the entire electrical fraternity. The organization is for the promotion of goodfellowship and closer acquaintanceship among the workers in the electrical industry.

Digitized by Google

The Benefit of Enquiry to Lightning-Arrester Practice.

By N. J. Neall, Consulting Electrical Engineer, Boston, Mass.

IN REVIEWING the development of electrical apparatus one must be deeply impressed by the fact that almost at the beginning of modern electrical transmission work the necessity was realized of having protection against lightning and similar static disturbances. In fact the future of such electrical development hinged very materially on the ability to find some means of protection. The methods followed previously by workers in telegraphy could not now be followed absolutely, because of the presence of the electric current in comparatively large values, which necessitated the discovery of some device which would discharge the line of its static disturbance and yet at the same time not allow a short-circuit to maintain itself.

It is greatly to the credit of the manufacturing companies of a decade ago or more, and to such men as Thomson, Wurts and others, that the matter was not only thoroughly investigated in its essentials, but certain elements of protection were devised or discovered which have proven themselves of permanent value.

It is of course to be recognized that the manufacturing companies were not purely disinterested in thus investigating lightning disturbances, and any features of general interest which may have been discovered were accidental rather than purposely sought out. This limitation of interest was, of course, not so easily recognized years ago as it can be recognized to-day, simply because the development of electrical apparatus has been not only so great but in its main features so successful, that the performance of the lightning arrester has been relegated to a secondary position of interest. For example, generators, transformers, motors, measuring instruments and many other such devices have been developed to a point wherein failure from inherent defects of construction are rare, if not unlooked for. Recently, however, the transmission of power over long distances—and this is a relative expression which applies equally as well to hydroelectric installations as to our larger systems of electric railways—has once more brought the subject of lightning disturbances prominently to our attention. It also happens that the higher potentials now being taken up, such as 50,000 to 60,000 volts, have apparently reached the upper limit of electric strength of such protective apparatus as has heretofore been reasonably successful.

We therefore stand at the interesting point of investigation into the future possibilities of protection for very high voltages, as well as determining the degree to which all our systems must yet be protected. We thus find that by the gradual elimination of imperfect design electrical engineering of power transmission to-day is confronted by practically one problem, *viz.*, successful lightning protection. And it is a question to be discussed briefly in this paper in how far our present knowledge and facilities for investigation will enable us to make up for the large amount of neglect given lightning protection during the last decade.

There are several ways in which this subject can be approached, and probably the most successful, certainly the most systematic, will be by the manufacturer, principally the larger manufacturers of electrical apparatus. If such work as has been done in the past under the auspices of the Westinghouse Electric and Manufacturing Company and the General Electric Company, through whom engineering literature on this subject has been much enriched, is carried into the future, there is much to expect of a satisfactory nature. If it were not for the commercial considerations involved, probably the most effective way of investigating this subject would be by a combination of all the parties interested, thereby eliminating all needless repetition and effecting a greater economy of expenditure for the results obtained. This is perhaps asking too much, but it indicates an element which would mean much for the future of this branch of engineering.

There is a larger field of investigation in which the manufacturers can not freely operate and wherein it is unnecessary that they should. This is the field of operation. Every station manager, every superintendent of a transmission system, has within his power a very simple means of obtaining valuable information as to the behavior of lightning protective apparatus, and it is interesting to know that the degree to which this has been taken up has been not only quite meagre but only of recent date. Such a method of investigation as is here referred to consists in placing some form of telltale paper in the protective apparatus in such a way as to have a record of its operation. In the case of a large plant this means quite an extensive investigation, but still very simple. By means of a record kept of these discharges from week to week, or oftener as circumstances might require, the manager of a system has not only a knowledge of the extent of the disturbances to which it has been subjected, but also a definite elimination of a certain amount of uncertainty as to the cause of any failure of apparatus from lightning.

On the surface this method seems wonderfully simple, and it is possibly because of this very simplicity and the need of persistence in its continuance that it has not been more warmly taken up. In such cases where this method has been followed important results have been secured which have been of benefit from the standpoint of operation and even of significance to the manufacturers. In several cases they have pointed to further needs of protection which would not otherwise have been apparent. In addition to this, photography and test papers with time movement can be advantageously employed.

Inasmuch as the average station operator has so many harassing duties to perform the investigation of lightning-arrester operation seems on the surface rather trivial. When one considers, however, that this can be done at small expense, after it is once started, and realizes at the same time the value of the apparatus indirectly involved, the point of view can be readily shown to be mistaken. As a matter of fact the very improvement in apparatus hereinbefore mentioned is bringing the subject of lightning protection more vividly to the attention of the operator, and whether he wishes to do so or not the value of a reputation for uninterrupted service demands that all possible steps be taken to the end that lightning, at least, be rendered harmless to operation.

The recent reports under the auspices of the National Electric Light Association show the trend of sentiment in this direction, and indicate the great value which a combination of interests can have in this connection, wherein individual effort might fail or be fruitless. These reports have, of course, comprised the results of observation limited to the membership and are therefore not as universal as might be desired. The fact, however,

Digitized by Google

that in the report of the present year 113 companies have seen fit to respond, is not only significant of the interest felt in the matter but is also encouraging to the belief that the next five years will see a vast deal of misconception of the matter laid aside simply because of this sane method of presenting facts, not to speak of a greater efficiency in protection afforded thereby.

This report, entitled "Report on Protection from Lightning during 1905," is probably epoch-making in the regard which operators at large will henceforth give to this matter. It should not be understood that the report is perfect, because it still leaves much to be desired, but in its essential features there is much of value.

From this report we find that approximately fifty per cent of the companies affected suffered no damage whatever by lightning; twenty per cent had losses confined solely to lightning arresters and meters, so that the remaining thirty per cent—let us say one-third of the companies—suffered serious loss thereby. The total power is represented by 269,695 kilowatts, of which the foregoing percentages are not exactly but fairly closely matched by a slight change in proportionate loss; those not losing any apparatus being thirty-one per cent of the total output, those losing only lightning arresters and meters twenty-eight per cent, while those having heavy losses represent forty-one per cent. This last fact, coupled with the fairly large percentage of number of companies, throws a most important light at the very outset of the report on the performance of lightning protective apparatus. Let us examine further:

Over half of the stations were equally divided in three groups between 200 and 990 kilowatts output; the remainder is found about equally divided among five groups ranging from 1,000 to 5,000 and over kilowatts output, distribution voltages of 110 to 700 and 2,000 to 2,500 volts having a strong representation. Some of the companies evidently distribute at low voltage by means of lowering transformers from high-voltage transmission, ranging in this case from 3,500 to 55,000 volts, the largest number apparently operating at 10,000 to 13,000 volts. It seems at first sight surprising to find but a few companies operating with direct current—ten against eighty-two at sixty cycles; these must be as rare as the sixteen plants at 125 to 140 cycles. Three-phase service is used the most. In any of these cases there is no way of telling in the report as to which service is more vulnerable.

Of the types of apparatus in use the General Electric Company and Westinghouse Electric and Manufacturing Company predominate; the Stanley, Garton-Daniels and miscellaneous types being collectively about fifty per cent of either of the first two. From the method of tabulation it is impossible to say what particular types failed mostly, for it scarcely needs mentioning here that both the General Electric and Westinghouse companies manufacture several types according to the voltage of the system for which protection is required. The returns show, however, high percentages of failure and total loss, irrespective of type.

The employment of choke-coils does not show any special gain; in fact a bare analysis of the figures would indicate that it was more satisfactory not to use them, which seems incredible. Comparatively very few companies use overhead grounded wires, although the reduction therefrom in total loss, according to the table, seems most attractive. It should not be forgotten that all the foregoing values are based on companies, not upon the accounts of actual apparatus. This fact really changes the aspect of the report very materially, because it might be easily possible that the relative loss to one plant would not be as great as in another. Moreover, other conditions unnecessary of mention here might seriously affect the meaning of these indications if we take them as they stand. They are, however, valuable and even significant, because of the general idea which they give as to lightning protective apparatus practice throughout the country. A more direct result would have been obtained by referring to types of protective apparatus and the actual losses occasioned by their failure.

Of the apparatus injured in 1905 lightning arresters head the list with 107 companies total, reporting; transformers, meters, armatures and oil switches following successively in the order of extent of breakdown—the latter two being relatively insignificant in number. It would be interesting to compare this experience with that of street railway companies, where doubtless armature failures from this cause would make a greater showing. The larger proportions of transformers and meters follow naturally from the general disposition of such apparatus on the system. The natural inductance or resistance to static disturbances of nearly all measuring instruments, and the fact that they are often unprovided with choke-coils ahead of them, permits the disturbance to reach them, and lacking proper protection be thrown off by way of the case to ground. It is also probable that the failure of many lighting transformers arises from their exposed locations without full protection. In this connection it would have added to the interest of the report to state how often primary fuses are blown by lightning disturbances without any other consequence than interruption of service.

Of the special items of interest reported on it is found that a large majority of the plants did not suffer from shutdowns due to too violent discharges or to arcs holding on in the arresters. Moreover, almost as great a number of companies report no damage from this cause. There seems to be little criticism of the arresters failing to discharge. The poles and insulators destroyed by lightning discharges have affected approximately twenty-five per cent of the companies, although the total number of poles destroyed is about 100, while only twenty-two insulators are reported broken from this cause. It seems to be agreed that damage is done most frequently by severe storms, although the lines are thought by a large majority of operators not to be affected at a distance from the centre of the storm. Unfortunately, this opinion is interesting as showing a state of mind, but it is doubtful if there is as yet much positive evidence on this point. It is curious and pertinent to the record to observe that the number of times plants have been disturbed by sudden change of load or short-circuits is greater, nearly 100 per cent, than those reported from lightning directly. Moreover, a large proportion, thirty-nine per cent, of these companies suffered a shutdown—a fact which is often lost sight of in discussing lightning-arrester operations. A large majority of operators, however, did not consider the damage therefrom serious.

One of the amusing results of the canvass is to find that although some plants have had no trouble from lightning they do not consider their lightning protection satisfactory. On the whole, the expression for and against seems equally divided.

Aside from the direct loss due to failure of lightning arresters no serious criticisms can be made against them under the circumstances, because in so failing they may have saved much valuable apparatus. It is a characteristic, however, which should be eliminated more and more, because of the danger to which such a failure exposes a plant as a whole. Aside

Digitized by Google

from this the large number of failures of protective apparatus with attendant loss suggests forcibly the need of improving arresters or modernizing such installations in order that the protection may be the best obtainable. No mention is made of the methods of protection followed—the methods of grounding, the frequency of inspection, etc., all of which show that operators to be successful must go further than this to make such a report effective and indicative of the true weaknesses of modern lightning protective apparatus.

In addition to the foregoing report, certain other recent investigators in this field merit special mention. These are: Messrs. Wirt, Creighton, Osgood and Smith, who have contributed, respectively, through the channels of the American Institute of Electrical Engineers, very interesting data as to the performance of a new design of lightning arrester, its behavior in practice, and in the case of Smith, an important discussion of auxiliary protective apparatus for transmission lines against direct stroke. It would be impossible to go into these cases in detail, and mention is made here to show principally the fact that not only is the manufacturer still actively engaged in this work but that he has been joined by the operator, who has taken to investigation on his own account. In fact, in the cases spoken of by Smith, the transmission service was effected by direct strokes of lightning to such an extent that something had to be done. The manufacturing companies, apparently, could give no assistance, because their apparatus was intended solely for the protection of generating apparatus within the stations, so a cure had to be sought elsewhere.

Although the protection of transmission lines has been considered tentatively for several years, it has been only within the last year or so that the subject has reached an acute stage. This arises from the fact that whereas the long transmission lines on the Pacific coast were relatively free of lightning, those in the East are not, and therefore it might be said that for this reason the longer the line the more the disturbance to be expected from this source.

It is safe to say that the problem is now once for all strictly defined. It consists of two parts. First, station protection; second, line protection. The investigation of the former will doubtless remain for some time largely in the hands of interested manufacturers, the latter in the hands of operators. The service performances of both must, however, be investigated by the operators.

A concerted interest in this subject, together with the cooperation of the United States Weather Bureau, or a use of its methods, can undoubtedly effect great results. It may not be a surprising result if the larger systems, at least, maintain hereafter a special lightning-arrester department of their interests, wherein a vigilant record will be kept, not only of the operation of the protective apparatus, but also an account of its original cost, maintenance and expense involved through its failure.

It is not the purpose of this article to prophesy what the future will offer in protective apparatus, because that must be a matter of evolution. It should be clear, however, that the result attained will be materially affected and perhaps hastened by a vigorous inquiry persistently maintained. It has unfortunately been, heretofore, a subject arousing picturesque discussion. The dignity of its relation to operations in general merits more consideration, and it is safe to say that there is hardly any branch of the sciences in which general observation can be more successful.

Electric Power from Southern Waterfalls.

By J. W. Fraser, Assistant Chief Engineer, Southern Power Company.

ABOUT 10,000,000 spindles, using approximately 300,000 horse-power, are now in operation below the Mason and Dixon line. Less than one-third of this is furnished by water power, while something like 2,000,000 horse-power is still undeveloped in the very heart of the cotton field, and in a climate where ice can not materially affect this development. From a casual review of the situation it would seem that the South has been a little slow in developing this natural resource, but on second thought it appears that this slowness may prove beneficial in the long run. For under the more scientific treatment which it is now possible to bring to bear on the problems involved, the advance may be more rapid than it would have been had the development begun earlier. However, this may be, it is evident to every Southerner that a few years will see an enormous development of water power in the South.

Previous to 1894 mechanical drive was used in all water-power developments, and until within the last two or thee years the hydroelectrical developments were mostly local in scope, furnishing power to a few mills in the immediate neighborhood of the power plant or at the end of a comparatively short transmission line. But the indications at present are that the next ten years will produce networks of systems extending over hundreds of square miles and rivaling in amount of power transmitted any of the great northern or western systems.

Several large plants are now under construction, but before calling attention to the progress of this work let us review the water-power situation since the introduction of the electric drive.

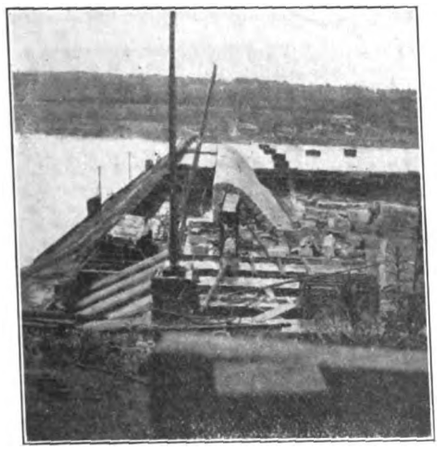
On June 27, 1894, the hydroelectric plant of the Columbia Cotton Mills, Columbia, S. C., commenced operation. This event marks the first milestone in the development of large water powers in the South. I say "large" because of the fact that a great many small streams had been utilized for the direct drive of all kinds of mills and factories, but on account of the drive not being adapted for large mills, small powers were developed in preference to large. Further, this was the first textile mill in the world to be equipped throughout with electric drive, and up to this time the feasibility of transmitting power by any other means than gear, belt or rope was thought impracticable by the mill engineer, and much credit is due to the pioneers who led the way to what must prove such an asset to the South. The distance of transmission in this case was only 800 feet, and a voltage of 570 was sufficient.

Another important step in advance was made when the Anderson Water, Light and Power Company, of Anderson, S. C., began the transmission at 5,500 volts, of 175 horse-power in the latter part of 1895. This power was used for pumping the water supply of the city of Anderson and for light and motors. The development was at High shoals, on the Rocky river, six miles from Anderson, and marks the second milestone—the first long-distance power transmission in the South. Three years later this company developed Portman shoals on the Seneca river and transmitted its output of 1,200 kilowatts to Anderson, a distance of ten miles, at 10,-

Digitized by Google

000 volts. Later this output was increased to 4,500 kilowatts.

Almost on a par with respect to date and on a much greater scale than the first development of the Anderson Power Com-



THE DAM ON THE YADKIN, WHITNEY DEVELOPMENT, NORTH CAROLINA.

pany was that of the Pelzer Manufacturing Company, on the Saluda river; this plant was put in operation in the early part of 1896 and transmitted 3,000 horse-power three miles at 3,300 volts, three-phase to Pelzer. This output was afterward increased to 5,000 horse-power.

The next plant was that of the Fries Manufacturing Company, at Winston-Salem, N. C., where 1,000 horse-power was transmitted from the Yadkin river to Winston-Salem, a distance of thirteen and one-half miles, the latter part of April, 1898. This was the first transmission plant in North Carolina.

SPILLWAY AT THE WHITNEY DEVELOPMENT, NORTH CAROLINA.

About the same time the Columbia Water Power Company completed an installation of 3,000 horse-power (which may be increased to 10,000), making a total of a little over 5,000 kilowatts in generator capacity installed in the South before the close of the century.

Other plants of over 1,000-horse-power capacity completed since this date are the following:

The plant of the Montgomery Water Power Company, at Tallassee falls, on the Tallapoosa river, nine and one-half miles from Milestead, which, although under construction, was not completed until 1902. Its output of 5,000 kilowatts is transmitted to Montgomery, twenty-seven miles, at 30,000 volts and used for light and power.

Atlanta Water Power Company's plant, at Morgan falls (Bull Sluice), Ga., on the Chattahoochee river, eighteen miles from Atlanta. It was begun September, 1902, and completed October, 1904. The output of 10,500 kilowatts is transmitted to Atlanta at 22,000 volts, and after being transformed to 6,600 volts is disposed of to the Georgia Railway and Electric Light Company.

The Columbus Power Company's plant, on the Chattahoochee river, just north of the city limits of Columbus. Two power-houses were built, one to supply 3,000 horse-power direct from the water-wheels to the cotton mills by means of rope drive, and the other to supply commercial electric power. In the latter is installed five 1,080-kilowatt, sixty-cycle, two-phase, 6,000-volt generators, the output of which is used by the various cotton mills and other industries of Columbus.

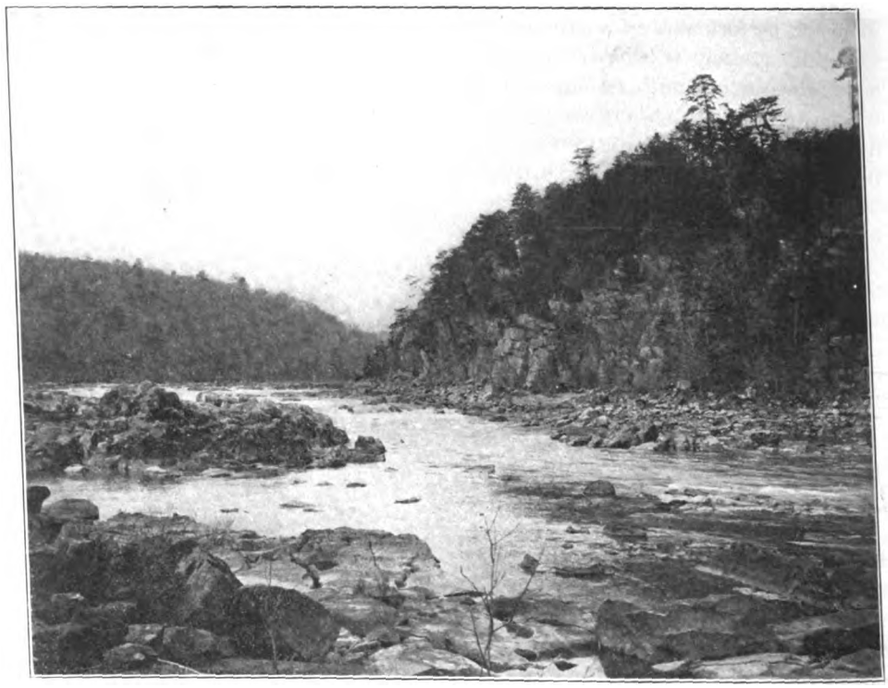
The Weaver Power Company's plant, on the French Broad, near Asheville, N. C., where two 750-kilowatt generators are furnishing power for commercial service in Asheville. (Provision has been made for four.)

The North Georgia Electric Company's plants, one at Gainesville, Ga., on the Chattahoochee river, above the Atlanta Water Power Company's plant, and another at a shoal four miles below Canton on the Etowah river, with a total of 4,000 horse-power. This power is transmitted to Atlanta on a forty-two-mile steel transmission line at 40,000 volts.

The Union Power and Manufacturing Company, on the Broad river (a tributary of the Congaree), with a total capacity of 7,000 horse-power.

The Catawba Power Company's plant, at India Hook shoals, on the Catawba river, seven and one-half miles from Rock Hill, S. C., and eighteen miles from Charlotte, N. C. This plant commenced operation in March, 1904, with three cotton mills and a small lighting load. This amounted in all to 900 horse-power, and to-day it is driving fifteen cotton mills—a motor load of 8,000 horse-power for eleven hours per day, and a peak load of 10,000 horse-power, the maximum capacity of the plant.

The Dan River Power and Manufacturing Company's plant, on the Dan river, about two miles above Danville, Va. The flow of the river at this point, with a twenty-five-foot head, gives 4,000 horse-



THE NARROWS OF THE YADKIN AT THE WHITNEY DEVELOPMENT, NORTH CAROLINA.

Digitized by Google

power, which is utilized to drive a large cotton mill.

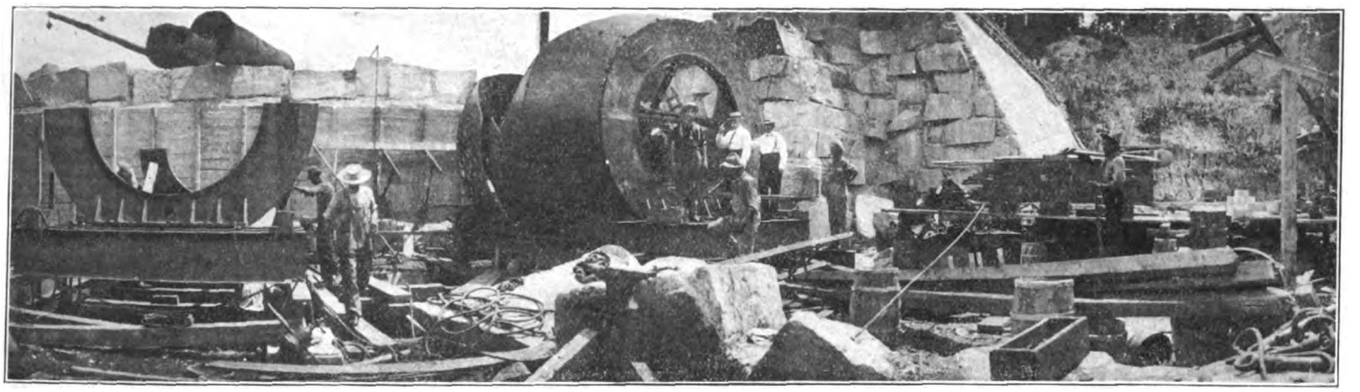
The Belton Power Company's plant, on the Saluda river, eleven miles below Pelzer, with a capacity of 5,000 kilowatts. This power is transmitted to Belton, S. C.

The Ware's shoals, on the Saluda river, sixteen miles from Greenwood and twenty-four miles from Anderson; capacity, 3,000 horse-power.

give some idea to the extent of this development.

We shall refer first to the work now under way above the narrows on the Yadkin river, about sixty-five miles above the South Carolina state line, the most famous water power in North Carolina. Preliminary work was commenced on this plant about four years ago by the Whitney Company, under the general management of all masonry structure is constructed of large irregular undressed stones, filled in with concrete. From one-half to two-thirds of the dam and canal are completed. Somewhere about 25,000 additional kilowatts are available on the same river within the boundaries of the land owned by the Whitney company.

Within a radius of eighty miles of this plant there is enough power used in cot-



WHEEL CASING OF 5,200-HORSE-POWER TURBINE, GREAT FALLS STATION, SOUTHERN POWER COMPANY.

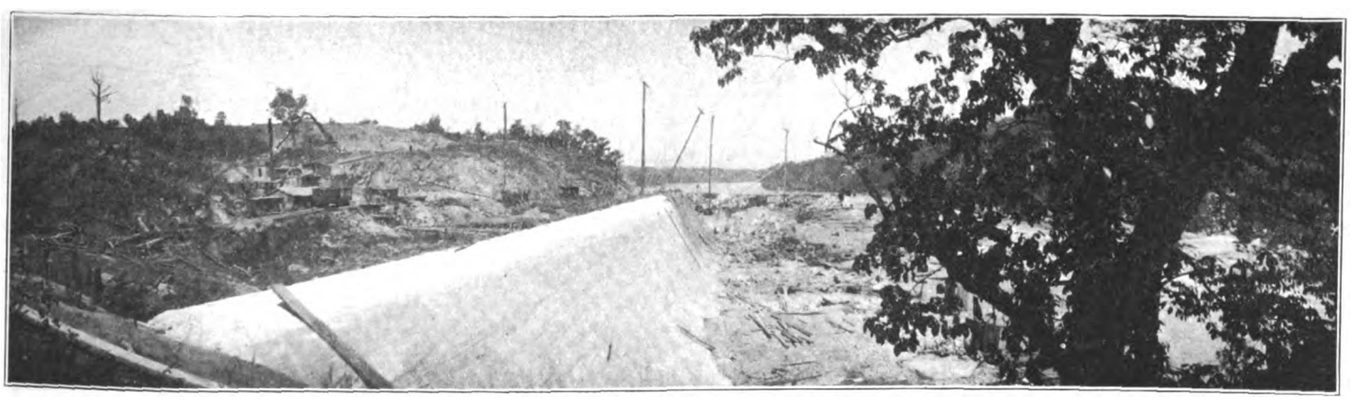
The Virginia Passenger & Power Company's plant on the James river at Richmond, Va. This plant is designed for an ultimate capacity of 10,000 horse-power in twin turbine units of 1,200 horse-power each, seven of which have been installed. Turbines are direct connected to 700-kilowatt generators.

The above comprises all or nearly all the hydroelectrical developments of 1,000

of the late E. B. C. Hambley, vice-president. A head of 129 feet will be obtained by the completion of a dam 1,000 feet in length and thirty-eight feet in height and a canal four and one-half miles in length. The hydraulic equipment will consist of six vertical turbines of 9,000 horse-power each, only five of which will be installed at first. It is intended that the generators will be direct-connected and will give

ton mills alone to absorb the total output of both developments. But the company purposes to induce manufacturers to locate in the immediate neighborhood, where it has holdings to the extent of 14,000 acres.

Another large plant under construction is that of the Chattanooga & Tennessee River Power Company, thirty-three miles below Chattanooga, at Hole's Bar. The dam



DAM AND HEADGATES FOR TURNING RIVER INTO CANAL, GREAT FALLS STATION, SOUTHERN POWER COMPANY.

horse-power and over now in operation in the South. The growth has certainly not been rapid, but these few scattered plants have paved the way for the many large developments now under construction or projected. The projected plants are so numerous that it is beyond the scope of this article to refer to them, and it will only be necessary to outline some of those actually under construction in order to

an output of 25,000 kilowatts at 11,000 volts, three-phase, sixty-cycle, but the electric equipment has not yet been decided upon. The canal will be forty feet at the bottom, 112 feet at the surface of the water and eighteen feet deep. The canal spillway will be 1,400 feet in length. Coursed face masonry is used for both faces of the dam and the river face of the abutment and spillway. The interior

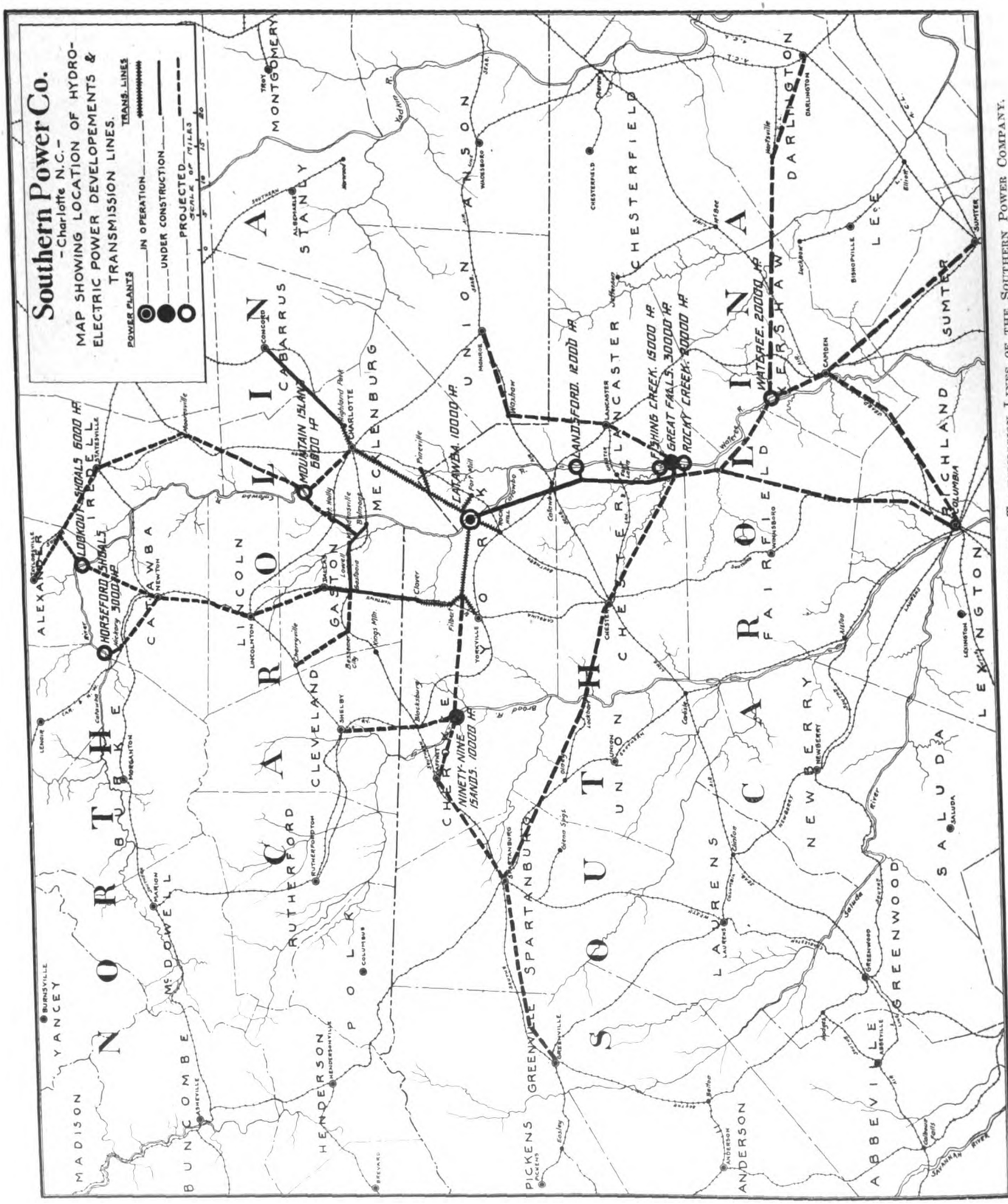
will have an average height of fifty-two feet, will give a head of thirty-nine and one-half feet at low water, and will back the water to Chattanooga. The variation in volume of water runs from about 5,000 cubic feet per second to 250,000 cubic feet per second, and the minimum average flow for two months in the year is about 8,000 cubic feet per second. Designs for the electric equipment have not

Digitized by Google

yet been completed, but it is expected that this site will develop in the neighborhood of 50,000 horse-power. This company was organized about two years ago by C. E. James and J. Guild, of Chattanooga, and it expects to complete this plant by the end of next year.

I have already referred to the North Georgia Electric Company in the list of completed plants as owning and operating one plant on the Chattahooche river and another on the Etowa river, and it should be noted that this company, under the direction of General A. J. Warner, has acquired several other powers which it expects to develop.

The Rockingham Power Company has also commenced the construction of a large plant at Bluitt falls, on the Peedee river, near Rockingham, N. C. A head of fifty feet will be obtained by backing the

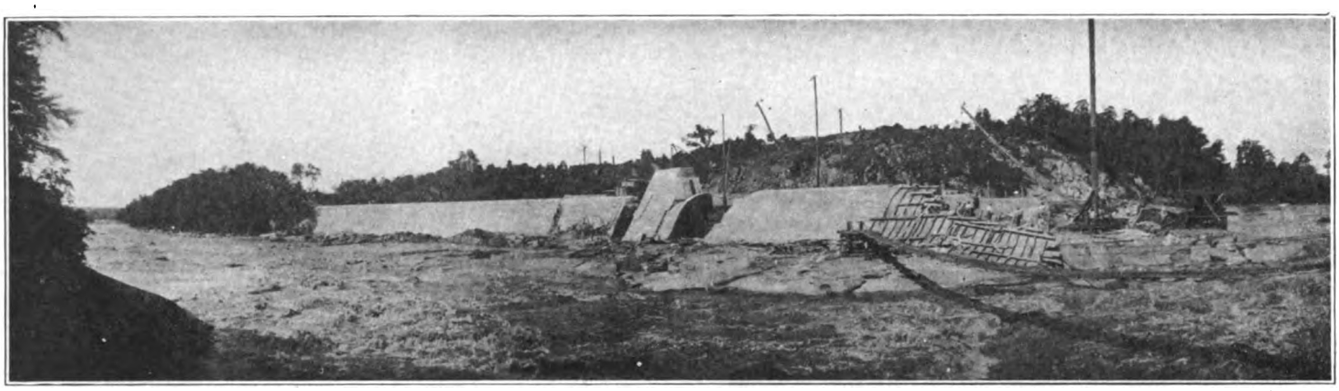


MAP SHOWING THE LOCATION OF THE HYDRO-ELECTRIC POWER DEVELOPMENTS AND TRANSMISSION LINES OF THE SOUTHERN POWER COMPANY.

Digitized by Google

water six miles. This will require a thirty-eight-foot dam 1,650 feet in length, and it is estimated that this will give a capacity of 28,000 horse-power, but only 12,000 horse-power will be developed at present.

Some other smaller plants are that of the Savannah River Power Company, at Gregg and Cherokee shoals, on the Savannah river, near Anderson—6,000 horse-power; Spencer Mountain Power Company, on the South fork of the Catawba river—3,000 horse-power; Electric Manufacturing and Power Company, at Nesbit's shoals, on the Broad river—5,000 horse-power for transmission to Spartanburg, S. C.; Saluda River Power Company, five miles from Greenville. Here in 500 yards the river has a fall of sixty-four feet, which will give about 3,000 horse-power.



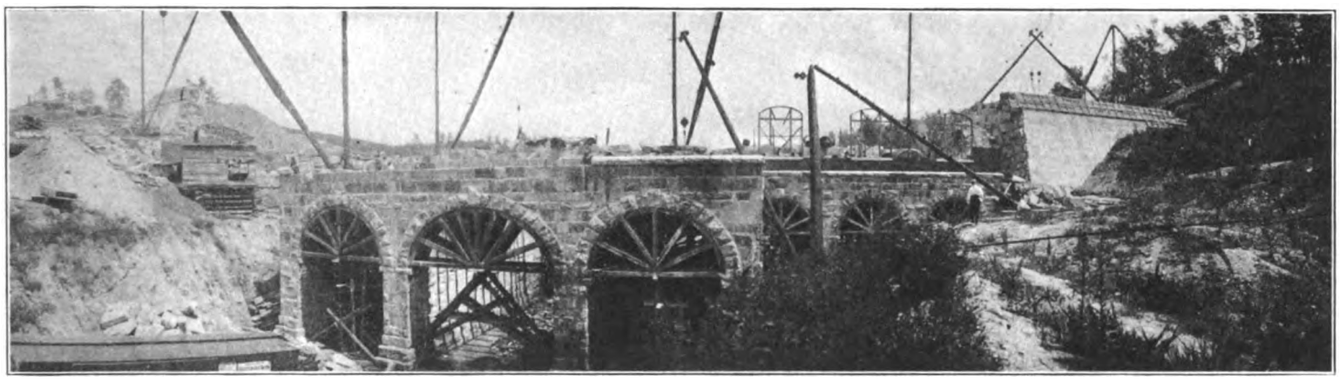
Dam and Headgate for Turning River into Canal, Great Falls Station, Southern Power Company.

In a preceding paragraph I referred to the quick sale of the total output of the Catawba Power Company's plant, near Rock Hill, S. C. This company by its practical distribution of power has gained the confidence of the mill owners of that district and furnishes power to fifteen cotton mills within the radius of twenty miles of the plant. The Catawba Power Company was financed by Dr. W. Gill Wylie (president), who was a pioneer in long-distance transmission in the South, having been connected with the Anderson Water, Light and Power Company from its organization. The great demand for power in the immediate neighborhood of the Catawba station led Dr. Wylie to consider the advisability of developing other plants in different parts of the country, with the result that a company was formed with Dr. Wylie as president (with a capital of $7,500,000) to acquire and develop a sufficient number of water powers to furnish power to a section of country 160 miles in length and sixty miles in breadth in the heart of what is know as the "Piedmont region," the richest and most fertile section of the Carolinas. This section is dotted with cotton mills throughout its length and breadth, and over 150,000 horse-power is used, generated mostly by steam.

Eight undeveloped water powers on the Catawba river, besides the Catawba station, were taken over, and one on the Broad river. The water rights cover a distance of 110 miles on the Catawba river and form an aggregate head of 500 feet; in all, about 150,000 horse-power. The advantages obtainable from this control of water rights are very obvious to the hydraulic engineer. The flow of water can be regulated from one plant to another and from one storage to another to suit the demand at different points on the network of transmission.

And as this company is leaving no stone unturned to make its whole system as modern and up to date in every respect as possible, we shall describe in some detail the work now in progress.

Hardly was the company formed when preliminary work was commenced at Great Falls, S. C., fifty miles below Charlotte and fourteen miles above Camden. This site was selected because of a possibility of quick development. There is a total fall here of 175 feet in seven miles and the choice of either two or three developments. However, it was found by turning the river into a natural canal about the middle of the shoal and building the power-house and main dam (or bulkhead wall) 6,000 feet further down a quick development could be made with a head of seventy-two feet. As this plan did not interfere with the other developments and promised to be the least expensive method of dealing with the situation it was de-



Power-House, Great Falls Station, Southern Power Company. Transformer House in Front. From Bottom of Foundation to Top of Bulkhead Wall, 105 Feet.

Digitized by Google

cided upon, and work was commenced at once. It was necessary to build a branch railroad, twelve miles long, in order to facilitate the movement of cement and machinery. Surveys were commenced on railroad and dam site in May, 1905, and the first stone was laid at the dam on February 2.

Contracts already signed made it necessary that this plant be in operation by January, 1907, and at this writing everything points to its completion by that time. The dam and head-gates to the canal are two-thirds completed and the greater part of the power-house bulkhead is placed. The draught tubes and water-wheel casings are nearly all set and the transformer house is well under way.

The electric problems involved in this proposition are somewhat different from any other comparable in size with it. The Niagara system receives power at one point and distributes to the surrounding country; the California Gas and Electric Company feeds, always in one direction, from a number of other points into one great reservoir (with a few small exceptions), but the power to operate the immense network of lines that will be necessary for this system will be taken in at various points in the neighborhood of distribution and may be fed in any direction from any one of these points. This will be better understood by examining the accompanying map.

Another problem was how to arrange for the variation of voltage necessary for a station that might be feeding into an immediate neighborhood at one time and feeding into a system sixty miles distant a few hours later. This was arranged for by having the generators, transformers and complete station apparatus designed capable of carrying continuously a fifteen per cent increase in voltage.

Taking into consideration the amount of country to be covered, it was desirable to have the transmission voltage as high as practicable; against this was the fact that the larger part of this power would be tapped off at a great many cotton-mill substations having a capacity of from 250 to 750 horse-power. After calculating the copper loss for an assumed (probable) distribution, 44,000 volts was decided upon as an electromotive force most suitable for this system. This worked in well with the pressure of the Catawba station, which is 11,000, and the installed transformers on the Charlotte lines, which are wound for 11,000 and 22,000 volts.

In the Great Falls station there will be eight 3,000-kilowatt, three-phase, 2,200-volt Westinghouse generators, direct-connected to six horizontal turbines of the Escher-Wyss pattern made by the Allis-Chalmers Company, and two Hercules turbines made by the Holyoke Machine Company. The 400-kilowatt, 250-volt exciters will each be capable of carrying the total exciting current.

The plant is so designed that two generators and their three transformers will form a complete unit, which, if necessary can be entirely separated electrically from the other units. All transformers will be in separate compartments and will be mounted on trucks. Both the high and low-tension switch structures will be in separate rooms. Low-tension switches will be Westinghouse type "C," and high-tension, type "G." Instrument pedestals to control stands will be arranged in a semicircle so that the operator can see all meters without moving. A bench-board was not deemed advisable to meet conditions.

The main transmission line will connect this plant with the Catawba station at Rock Hill, S. C., thirty-two miles distant, where a transformer station is being built to step up the voltage of the Catawba plant from 11,000 to 22,000 and to step down that of the main transmission line to 22,000 to feed the Charlotte division. It will also connect with Gastonia and Concord. Proposed connections can be seen by inspecting the map.

Steel towers will be used for all main lines of transmission. The first 600 under order are now being shipped and will be erected as soon as received. They will carry two three-phase circuits of No. 000 seven-strand hard-drawn copper and two grounded wires above the transmission cable. Besides this lightning protection, both horn and water arresters will be used. Surveys for these towers have been completed, and most of the feet have been concreted in position ready to receive the superstructure.

Transformers for substations, whether purchased by the Southern Power Company or by consumers, are being built under standard specifications and of selected size, so that in case of breakdown a new transformer can be quickly substituted for the damaged one.

Several new features have been incorporated in the power-house and transmission line design which will be described in a more detailed account of this system.

Small Railway Substations.

By W. L. Waters, Chief Engineer, National Brake and Electric Company.

THE conditions of operation, and consequently the equipment of railway rotary-converter substations, vary so widely that we can hardly consider all such substations as coming under one broad class. We have substations such as those on the Interborough system in New York city, each station containing six or eight 1,500-kilowatt units and carrying a practically steady load. And we have small interurban substations with perhaps two 100-kilowatt units carrying a load which at times fluctuates violently.

The first-mentioned type, the high-power substation for city work, operates under the most favorable conditions. Usually no expense is spared in regard to equipment. A sufficient number of rotaries are installed to carry the load easily even under extreme conditions. Auxiliary motor generators or induction motors are provided for starting the rotaries, and probably a storage battery is provided to help out on heavy overloads. The switchboard is conveniently located in a gallery and equipped with remote-control oil switches, time-limit and reverse-current relays, and all the modern refinements for controlling a high-power station. The attendant in charge of such a station is highly trained and capable, and the supervision and operation of the machinery is usually as perfect as can be expected. The only danger for such a station lies in the immense reserve power in the main generating station, and in the capacity and low resistance of the high-tension cables and in the low resistance of the direct-current feeders. The combined effect of these may produce disastrous results in the case of short circuits or careless manipulating of switches, or in the case of the small breakdowns or failures of equipment that are certain to occur occasionally in any system.

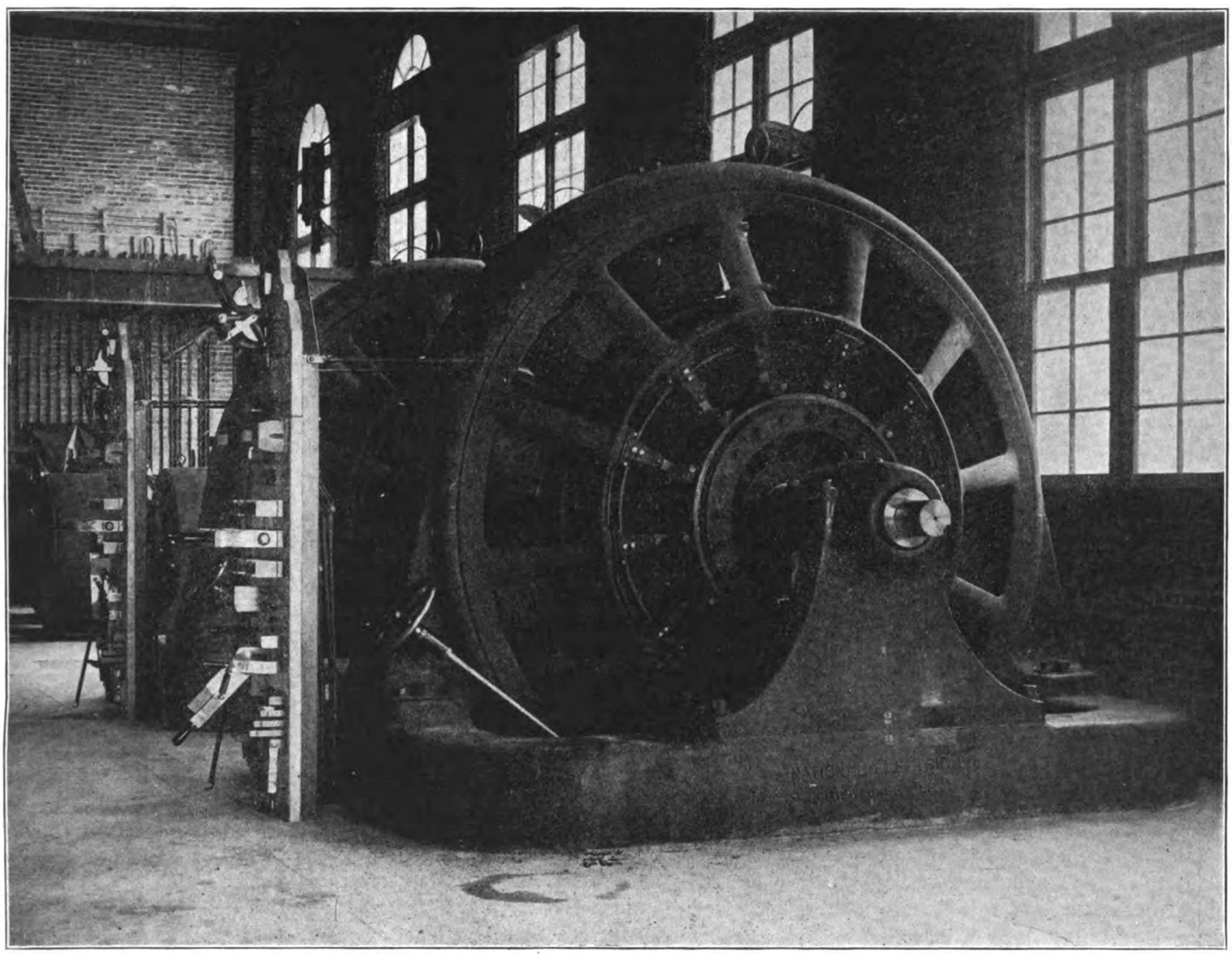
Contrasting this with the small interurban station, the difference is very great. In such small stations the first cost of the

Digitized by Google

equipment has to be reduced to an absolute minimum. The switchboard equipment is incomplete, the rotaries are often heavily overloaded, and the attendants and supervision in the station are usually very unskilled. The reserve power is not so great and the resistance of the feeders is higher, so that the results of mistakes in operation and breakdowns are not so disastrous. But the treatment the equipment gets is usually so bad that it is a much more severe test for the machines than is ever put on the larger station.

The small or interurban type of substation can usually be considered as having an output of less than 1,000 kilowatts in units of 100 to 500 kilowatts. When laying out such a station the main thing usually considered is economy in first cost. The power is generally transmitted to such a station by means of overhead feeders. This means a probability of more or less lightning trouble. Lightning arresters are provided, but no particular care is used in their selection, the cheapest being usually installed. This means that oil-insulated transformers are a necessity, and as a water supply can not usually be obtained for cooling purposes, self-cooling transformers are practically always used. The usual arrangement of switch-panels is to have the complete switchboard at one side or one end of the station. In this position the operator has his back to the machines when operating switches. A variation from this arrangement is shown in the illustration herewith. The rotary panel in this case is located at the side of the machine and so arranged that the operator faces the machine when operating switches. This design is due to O. M. Rau, chief electrician of the Milwaukee Electric Railway and Light Company, and has the advantage that the operator can watch the rotary at all times. It is, however, slightly more expensive than the standard layout. The switchboard equipment in small substations is always the simplest that will handle the equipment. Oil switches on the high-tension side are seldom installed. The transformers are connected direct to the high-tension mains by means of disconnecting switches, these switches being capable of breaking only the no-load current of the transformers. In case of trouble on the high-tension side the power station is instructed by telephone to disconnect the substation feeder.

The characteristic feature of the load on a small or interurban rotary substation is the violent fluctuations that take place. The car service is infrequent and the station normally carries a light load, the load being distant from the substation and being partly carried by other substations. But at intervals we get suddenly thrown on the station the load of starting one or two cars or trains. This usually heavily overloads the station for a short time, and then the load gradually drops back to normal. The most suitable way of dealing with such heavy loads depends somewhat upon the layout of the system. If we have a long line with a number of substations and with all the trolley sections



SUBSTATION, MILWAUKEE ELECTRIC RAILWAY AND LIGHT COMPANY.

Digitized by Google

tied together and paralleled by feeders, we get the best arrangement by using shunt-wound rotaries, standard transformers and no reactance coils. As the load comes on any substation we get an increasing drop in the alternating-current feeders and in consequence a lower alternating-current voltage at the station. And as the ratio of the voltage on the direct-current side of the rotary to that on the alternating-current side is constant, this means that with shunt-wound rotaries we get a direct-current voltage which falls as the load comes on the station. The voltage will probably be about 650 with no load, falling to about 550 for overloads. With such a system consisting of a number of substations tied together, this gives the desired result that the lightly loaded stations running at higher direct-current voltage tend to help out the heavily loaded stations running at lower voltage. This prevents the whole of the heavy load coming on one station and enables us to make our substations of smaller capacity. If, on the other hand, we have conditions in which one substation feeds a long line, then shunt-wound rotaries would not be suitable. Because in this case we must have the direct-current voltage at the station rise as the load comes on in order to compensate for the increased drop at the end of the long direct-current feeder. In this case we should install compound-wound rotaries and reactance coils. By suitable adjustment of the compounding of the rotaries and of the reactance coils we can get the desired rise in the direct-current potential as the load comes on the station. In this case the direct-current voltage would probably be arranged for 550 volts at no load, rising to 650 volts at full load. It would take too long to discuss the comparative advantages and disadvantages of shunt and compound-wound rotaries. This question is dealt with in the author's paper on "Synchronous Converters for Railway Work," read before the annual convention of the American Institute of Electrical Engineers, May, 1906, and the reader is referred to that paper for further and more detailed information. The compounding of rotaries is a great advantage in the one case in which we sometimes have a heavy load to be carried at the end of a long direct-current line or feeder. Otherwise this method of compounding rotaries is not so satisfactory as would be expected, the system being quite complicated and much less under control than in the case of shunt-wound rotaries. And as the ability of the attendants employed in such substations is usually quite limited, it is always a great advantage to have everything as simple as possible.

The usual way of starting rotaries in a small substation is from the alternating-current end by means of half-voltage taps on the transformers. The rotaries are run up to speed, the field circuit is closed, and the polarity and voltage tested by means of the voltmeter and the machine then thrown on the direct-current line. This method is much preferable for such substations to that of starting from the direct-current side, because the direct-current voltage is usually fluctuating anywhere from 300 to 500 volts. In consequence, the speed of the rotary running as a direct-current motor varies rapidly, and often the alternating-current frequency fluctuates at the same time so that it becomes impossible to even attempt to synchronize. The result often is that the attendant finally gets tired of trying to synchronize and throws the machine in when the speed is very different from synchronism. The rotary then flashes over and has to be pulled off and started again.

One of the chief requirements of the equipment in such a substation is ability to carry sudden and extreme overloads. Fortunately rotary converters, when well designed and liberally rated, are capable of carrying easily quite heavy overloads. And standard rotaries are, or should be, rated so that they will carry about three times full load for sixty seconds without flashing over. The transformers will of course carry heavy overloads if they are not long continued. The usual mistake made in considering the overload capacity of such a substation is that too small a circuit-breaker is provided. The usual rotary-converter circuit-breaker is capable of breaking only double the normal rated capacity of the rotary, and this circuit-breaker is generally set for fifty to seventy-five per cent overload on the rotary. The attendant soon finds out that the rotary will carry without danger considerably heavier overloads and that the circuit-breaker opens quite frequently. So the result is that the automatic attachment is finally removed from the circuit-breaker, and any overloads or short-circuits are left on the station till the circuit-breaker is tripped by hand. This is very bad practice, as a sudden or continued short-circuit, or a sudden opening of the field circuit, or throwing the rotary on the line badly off synchronous speed, will practically always cause a rotary to flash over and damage the brush gear. A circuit-breaker should be provided capable of being set to open at three or four times the full load of the machine. This circuit-breaker should be set so as to open at three to three and a half times full load on the rotary, and then the machine left to take care of itself. Anything less than about three times full load the rotary can pull, and anything greater than this should be taken off as soon as possible.

One of the most important items in the operation of a small rotary substation is the cost of attendance. This is such a large proportion of the total cost that it is always cut down to a minimum. This means that the station is usually operated with cheap and incompetent men, and this is very severe on the equipment. We find substations of 500 to 1,000 kilowatts capacity in charge of boys who have had absolutely no experience. They soon become accustomed to the routine work in a station and do fairly well as long as nothing unforeseen happens. But when anything happens slightly out of their routine they either lose their heads or are at a loss what to do, and generally do the wrong thing. They start up a compound-wound rotary from the direct-current side without first short-circuiting the series winding. They start from the alternating-current side, and, finding perhaps that the fields do not excite, they decide to throw it on the direct-current line anyhow in the vague hope that the fields will then excite and the rotary take its share of the load. They start from the direct-current side and then close the alternating-current switches regardless of the speed of the rotary. These are only a few of the things that happen every month in a small rotary-converter station with this kind of attendance. And when the manufacturer hears that a rotary of his own or of a competitor's make has burned up in one of these stations his only surprise is that it has run as long as it did. It is much better to have no attendant at all than to have such boys in charge of a station. Send a competent man to start up the substation and see that everything is operating satisfactorily, then set the rotary circuit-breakers for three to three and a half times full load and leave the station to take care of itself, only sending a man perhaps two or three times a day to see that everything is operating satisfactorily. In this way a single competent man can operate half a dozen substations with much better results than could be obtained by incompetent men permanently in each substation. The worst that could happen would be that a short-circuit would cause a circuit-breaker to open and cut a substation off the line. And in all probability the other substations or the power-house could in this case

Digitized by Google

pull the load at a lowered voltage till the short-circuit was cleared and the rotaries put on the line again.

Small rotary substations for railway work operate probably under worse conditions than any other class of station. The conditions imposed by the first cost of the station, by the nature of the load, and by the handling the equipment gets, makes this class of work the severest possible test of the design of the station and of the machinery in the station. Competition has reduced the price of the equipment to a minimum, and there is a great temptation for the manufacturer to rate his machines very closely. It is usually impossible for the operating engineer to know just what will be the capabilities of the machinery he is buying until he actually has it in operation. So considering everything, it is quite remarkable that such uniformly good operation is obtained from these substations, and it is certainly greatly to the credit of the operating engineers and manufacturers. The only improvements that may be looked for in the near future are in the direction of closer standardization of voltage and equipment. When this has been done and when the operating engineer and manufacturer have got a little closer together in coordinating the design and operation of the machinery, the small railway substation will rank second to none as an example of first-class engineering results obtained under very difficult conditions.

Report of the British Association Committee on Practical Standards for Electrical Measurements.[1]

In the last report reference was made to a conference of representatives of standardizing laboratories which had been invited to meet in Berlin as a preliminary to the more formal conference on electric units suggested at St. Louis. The question of this preliminary conference was brought before the committee at a meeting on October 19, 1905, and attention was called to the importance of clause 2 of the provisional programme—*viz.*, "Shall the three units, the ohm, ampere and volt, be defined independently, or shall only two be defined, and, if so, which?" and it was agreed unanimously that two units should be defined independently, and that these two should be the unit of resistance and the unit of current. The secretary was instructed to report this to the conference at Berlin.

This conference took place in October last at the Reichsanstalt in Charlottenburg, and was attended by representatives from America, Austria, Belgium, England, France and Germany. Agenda prepared with great care by the president of the Reichsanstalt were very carefully discussed, and, as a result, the conference expressed the wish that an international convention should be summoned in order to arrive at agreement in the electric standards which are in use in the different countries.

The following resolution was further adopted:

"In view of the fact that the laws of the different countries in relation to electrical units are not in complete agreement, the conference holds it desirable that an official conference should be summoned in the course of a year with the object of bringing about this agreement."

The conference further expressed the opinion:

1. That the information before it is not sufficient to enable it to propose any alteration in the formerly accepted value for the ampere.

2. That the information before it is not sufficient to enable it to lay down exact directions in respect to the silver voltameter and the standard cell.

3. That if a proposal for a change in the accepted value of the ampere is to be brought from any source before a formal congress to be held later, an agreement in writing on the point should be come to previously between the parties interested. If differences of opinion in the matter can not be removed, a new preliminary conference should be held.

The same procedure should be observed in regard to the specification for the silver voltameter and the standard cell, in the event of such specifications being submitted to a formal conference from any quarter.

The following formal decisions were agreed to:

1. That only two electrical units shall be chosen as fundamental units.

2. The international ohm, defined by the resistance of a column of mercury, and the international ampere, defined by the deposition of silver, are to be taken as the fundamental electrical units.

3. The international volt is that electromotive force which produces an electric current of one international ampere in a conductor whose resistance is one international ohm.

4. The Weston cadmium cell shall be adopted as the standard cell.

Recommendations were also made as to realizing the ohm, and some particulars as to the cadmium cell were agreed upon.

These results were laid before the Board of Trade, and a departmental committee, of which the secretary was a member, drew up a report recommending that an official conference should be invited to meet in London, and it is understood that negotiations are now on foot with view to summoning such a conference.

During the year the work in connection with the absolute ampere balance has been in progress, and is practically complete. Under the supervision of Professor Ayrton and Mr. Mather a large number of determinations have been made, and are most satisfactory. Detailed particulars are reserved until the work is complete; but there is little doubt that the balance is a most excellent absolute instrument, and that the probable error of a determination of current by means of it is only a few parts in 100,000.

The investigation of the silver voltameter has been extended beyond the limits originally thought to be necessary. The results so far obtained are very valuable and appear to indicate that a satisfactory form of silver voltameter is realizable. It is hoped that the publication of the results will take place at the same time as those of the ampere balance.

An appendix (not yet available) by F. E. Smith describes the methods of comparing resistances in use at the National Physical Laboratory, and discusses the sources of error and the accuracy attainable.

The grant of £25 made in 1905 has been expended in materials for the work on the ampere balance and the silver voltameter. In connection with the latter a large amount of work involving considerable expense remains to be done. For this purpose the committee ask for reappointment with a grant of £50. They recommend that Lord Rayleigh be chairman and Dr. R. T. Glazebrook secretary.

[1] This report was issued during the recent meeting at York. The committee consisted of Lord Rayleigh, chairman; Dr. R. T. Glazebrook, secretary; Lord Kelvin, W. E. Ayrton, J. Perry, W. G. Adams and G. Carey Foster, Sir Oliver J. Lodge, Dr. A. Muirhead, Sir W. H. Preece, A. Schuster, J. A. Fleming and J. J. Thomson, Dr. W. N. Shaw, Dr. J. T. Bottomley, Rev. T. C. Fitzpatrick, Dr. G. Johnstone Stoney, S. P. Thompson, J. Rennie, E. H. Griffiths, Sir A. W. Rücker, H. L. Callendar and George Mathey.

Digitized by Google

Fuel, Water and Gas Analysis for Steam Users.[1]

By John B. C. Kershaw, F I. C., Analytical Chemist and Electrochemist.

I.—Natural and Artificial Fuels: Their Origin, Composition and Methods of Sampling.

The form in which fuel may be used under steam boilers, in order to produce the heat energy which it is desired to utilize in the form of steam, is exceedingly diverse. Natural fuels are either solid or liquid, but both varieties may, by aid of suitable apparatus and plant, be converted into gaseous fuel. A natural gas which may be used as fuel is also found in certain localities in Europe and America. In the latter country it is largely used for lighting and heating purposes. At the present time there is a decided tendency to employ fuel-gas in place of solid fuel for many purposes in the arts and industries. The control of the combustion process is much more easily carried out when employing fuel-gas than when using solid fuel; and the loss of heat which occurs in the gas-producing plant is to some extent balanced by the value of the ammonia and tar products, obtained by suitable treatment of the producer-gases. The sulphur impurities of the coal may also be removed—and obtained as valuable by-products. Although gaseous fuel has not been applied on any considerable scale to the firing of steam boilers in this country, this method of steam raising will receive increased attention and application in the future; and, in the writer's opinion, the increased use of fuel-gas is likely to prove one solution for the smoke problem which now confronts manufacturers using solid fuels for heating purposes in large cities.

Carbon and hydrogen are the essential heat-producing elements in all natural or artificial fuels. The amount of heat produced by the complete combustion of one pound of fuel depends upon the percentage of these two elements present in the free or combined state. Combustion is in reality an oxidation process. The products of the complete combustion of fuel are carbon dioxide gas (CO_2) and aqueous vapor (H_2O). The incomplete combustion of fuel produces a number of secondary products, chief of which are carbon monoxide gas (CO) and various hydro-carbon gases—methane, ethylene and acetylene; these latter being either present as such in the fuel, or formed by combination of the carbon and hydrogen of the fuel when it is first heated. On further heating, in presence of an adequate supply of air, these gases burn with evolution of heat and production of carbon dioxide gas, or carbon dioxide gas and aqueous vapor. The further chemistry of the combustion process will be dealt with in Article IX of this series. It may, however, be stated here, that the exact nature of the physical and chemical changes which occur when coal is heated is still unknown. Chemists have not yet discovered whether the hydrogen present in solid fuels exists in the free or combined state. Boernstein has recently published an investigation bearing on this subject (see J. Soc. Chem. Ind. 15-3-06, p. 213).

Natural solid fuels may be classified in the following order: Wood, peat, lignite, bituminous coal; semi-anthracite and anthracite; while petroleum and its by-products stand as the representatives of liquid fuels; and coal-gas, coke, peat-coke and briquette fuels represent the artificial derivatives of the above natural fuels.

All naturally occurring solid fuels are held to be modifications of wood and woody fibre; absence of air, heat, and pressure being the agencies which bring about decay and fossilization of the vegetable matter.

Geologists assert that anthracite is the oldest of the natural solid fuels. Cellulose, the chief constituent of wood and woody fibre, is represented by the formula—$C_6 H_{10} O_5$, and contains forty-four per cent only of carbon; while anthracite contains ninety per cent. The process of conversion of wood into coal is thus accompanied by a gradual escape of a portion of the oxygen and hydrogen, which make up fifty-six per cent of the weight of cellulose, and a gradual increase in the density and hardness of the product of this change. Lignite, soft or bituminous coal, and hard or steam coal, are the successive stages in the conversion of wood into anthracite. Peat is a similar product from plant life which grows in bogs, of less age and therefore of less fossilized character than coal. In peat, the percentage of volatile matter which is given off on heating is often as high as sixty-five per cent, and the solid carbon is thus less than one-third of the total weight of the peat. Time, heat, and pressure would no doubt convert peat into a fuel resembling coal.

Petroleum and natural gas are fuels that have been produced by another series of changes in the strata of the earth's crust; but limits of space will not permit of any discussion of the various theories relating to the formation of these products.

Wood—Although wood is not used to any great extent as a fuel in countries with extensive and available supplies of coal; yet as the original material from which our coal supplies have been derived by natural processes, its composition and characteristics deserve some mention here. Wood in its natural state is composed of thickened plant cells, which on microscopic examination reveal three constituents: the woody fibre or cellulose; the sap, and the mineral salts taken up from the soil.

The sap consists chiefly of water, with the organic salts, required for nourishment of the tree or plant, in solution. In freshly felled timber the water present in the sap may amount to forty-five per cent of the total weight of the wood; by air-drying this can be reduced to from ten per cent to twenty per cent according to the nature of the wood and density of its fibres. The woody fibre contains from forty to forty-four per cent of carbon, and is the real heat-producing element of wood. Owing to the large amount of hydrogen and oxygen present in the molecular proportions of aqueous vapor, in cellulose ($C_6 H_{10} O_5$) the thermal value of wood as a fuel is not high. Direct tests have shown that one pound of air-dried wood on the average will only evaporate 4.5 pounds of water. Owing to the low percentage (under one per cent) of mineral matter present in wood, however, after dry distillation has removed the water and other volatile constituents it is one of the purest forms of carbon, and wood charcoal, as the product is called, has an evaporative efficiency more than double that of the wood—from which it is derived. The cost is, however, prohibitive of its use as a fuel on a large scale.

Peat—Peat is formed from plants and shrubs which find their habitat in swampy districts, under conditions which produce decay, in the absence of oxygen or air, *i.e.*, under water.

Owing to the peculiar conditions under which peat is formed, the amount of water and ash which it contains is always high, and these two constituents on an average amount to more than three-fourths of its composition by weight. The following are approximate analyses of typical samples of peat:

	Irish Peat. Air-Dried. Per Cent.		English Peat. Air-Dried. Per Cent.	
Moisture	21.60		20.36	
Ash	2.90	On dry sample	1.30	On dry sample
Coke	27.90		35.00	
Volatile matter.	72.10		65.00	
Fixed carbon..	25.00		33.70	

Air-dried peat still retains from twenty

[1] All rights of reproduction and translation are reserved. Copyright, 1906, by John B. C. Kershaw.

Digitized by Google

per cent to thirty per cent of water, and on this account its value as a fuel is very low. By mechanical and chemical treatment this water can be reduced to from ten per cent to fifteen per cent, and peat in this state then becomes a fuel comparable in appearance and evaporative value to bituminous fuel—though still high in ash.

It is probable that as the coal fields of this and other countries become exhausted, the immense reserves of peat which exist in nearly all countries will be drawn upon, and that by modifications of processes now in use, supplies of peat-coke and peat-fuel will be made available for industrial and household use.

Lignite or Brown Coal—This is a natural fuel intermediate between peat and bituminous coal in age and appearance.

Lignite is formed by the gradual decay of shrubs and trees under conditions which have excluded air and oxidation, but have differed materially from those which have obtained in the formation of peat. The percentage of water present in freshly won lignite is, however, high—varying from forty per cent to fifty per cent—and even after air-drying, twenty per cent of water is still present in the fuel. The ash contents vary from five per cent to ten per cent—while the carbon present ranges from seventy per cent to eighty per cent. Though lignite is not used to any great extent as a fuel in this country, its evaporative value is fairly high. When the deposits of lignite lie close to the works where they can be used, and the cost of cutting and transport are low, this fuel can compete in price and efficiency with the more generally used bituminous coal, and there are many works in Germany using lignite alone for steam-raising purposes.

Bituminous Coal—This is the type of coal employed most generally on land for firing boilers, since it is much cheaper than the anthracite and semi-anthracite fuels, and when burned under scientific conditions, can be used so as to produce high efficiency and little smoke. The following are analyses[1] of a typical bituminous fuel from the Lancashire district; but all fuels containing over twenty per cent of volatile matter come under this classification.

APPROXIMATE ANALYSIS.

Volatile matter	29.10 per cent	
Fixed carbon	58.04 "	70.90 per cent coke
Ash	12.86 "	
	100.00 per cent	

[1] From tests made by Dr. Hethrington.

ELEMENTARY ANALYSIS.

	Per Cent.
Carbon	72.60
Hydrogen	4.79
Oxygen	7.28
Sulphur	1.64
Nitrogen	0.71
Ash	12.86
	99.88

The calculated calorific value of this fuel was in round numbers 7,000 pounds centigrade thermal units, equivalent to 12,600 British thermal units. It is interesting to note that it contained 3.89 per cent of hydrogen over and above that required to combine with the 7.28 per cent of free oxygen present in the coal; while 14.56 per cent of the carbon was present in some form which yielded volatile hydrocarbons on heating. Although much has been written upon the subject of coal, the exact constitution and state of the various chemical elements before heating is still unknown; and it is an undecided point as to whether the oxygen and hydrogen and volatile portions of the carbon, are present in coal in the free or combined state.

Approximate analyses of other bituminous fuels, with their calculated calorific values in pound-centigrade units, are given below:

No.	Ash.	Volatile Matter.	Coke.	Calculated Calorific Value.
	Per Cent.	Per Cent.	Per Cent.	
1....	12.45	27.90	72.10	7,565
2....	13.80	31.00	69.00	7,347
3....	6.20	33.30	66.70	8,041
4....	7.75	34.00	66.00	7,764
5....	6.50	36.50	63.50	7,703

All the above tests were made on samples dried at 230 degrees Fahrenheit, and the low percentages of ash contained in samples Nos 3, 4 and 5 were due to these being washed slacks of exceptional cleanliness. When the percentage of volatile matter, yielded by a fuel on heating, rises above thirty-five per cent, the fuel is exceedingly difficult to burn without smoke production. The percentage of volatile matter given off by a fuel, is in reality a measure of the difficulty of burning it under the boilers, with perfect combustion of its component parts. Bituminous coals containing over thirty-six per cent of volatile matter are known as "cannel" coals, and are used chiefly for gas-making purposes. All bituminous fuels require careful management and large brick-lined combustion chambers, if they are to be burned without smoke.

The length of flame produced by bituminous coals depends upon the percentage of volatile matter, and this in its turn depends upon the amount of hydrogen they contain, over and above that required to form water with the oxygen present in the coal.

This surplus hydrogen combines with the carbon to form Methane (CH_4) Ethylene (C_2H_4) and Acetylene (C_2H_2), three hydro-carbon gases which yield carbon dioxide and aqueous vapor when burned under perfect conditions of combustion. When the air supply or the temperature is insufficient, partial oxidation only occurs, and portion of the carbon of these gases separates in the form of soot. The percentage of surplus hydrogen, is, therefore, another measure of the difficulty of burning bituminous fuel. This difficulty increases with the ease and rapidity with which these hydro-carbon gases are evolved by the fuel, on heating.

Nearly all bituminous fuels contain sulphur in the form of iron sulphide (FeS_2) as an impurity. The percentage of iron sulphide or "brasses," varies greatly in different classes of this fuel. On heating, half of the sulphur is liberated and burns with evolution of heat to form sulphurous acid gas (SO_2), which sooner or later condenses in the form of sulphuric acid (H_2SO_4). It is this compound and not the carbon or soot, which produces the larger part of this destruction of vegetation and of buildings in the neighborhood of industrial districts and of large cities. Recent calculations[1] have been made to show that in London over 500,000 tons of sulphuric acid are produced annually by the sulphur impurity contained in the coal burned in the metropolitan area. A similar calculation for the coal burned annually in the whole of the United Kingdom gives 5,000,000 to 7,500,000 tons of acid. The use of lime has been advised for fixation of this sulphur in the form of calcium sulphate in the ash of the fuel, but a far more certain and safer method would be to pass the products of combustion through scrubbing towers filled with flints. The sulphur contained in the exit gas could then be recovered in the form of a valuable by-product, namely, hyposulphite of lime or soda. As already stated it is the sulphur and not the more visible soot and smoke which is the chief cause of the damage effected by smoke. The carbon blackens, but the sulphur corrodes metal, destroys brick and stone and kills vegetation. Any practical method which would remove the sulphur from coal, or its products from the waste gases, deserves, therefore, most careful consideration by steam-users. Until such method has been generally adopted the sulphur contents of coal ought always to be kept as low as possible by careful picking of the fuel and removal of the veins of pyrites or "coal brasses." In large purchases of fuel by contract a clause ought to be added with respect to the amount of this impurity—and no coal should be accepted containing over one per cent of sulphur.

(Chapter I to be concluded.)

[1] Dr. Rideal, at London Smoke Abatement Conference, December, 1905.

Digitized by Google

The Sao Paulo Tramway, Light and Power Company.

By F. M. Felker, Electrical Engineer, General Electric Company.

THE Sao Paulo Tramway, Light and Power Company was formed under the laws of the Province of Ontario, Canada, for handling a concession covering electric lighting, power distribution and street railway operation in the city of Sao Paulo, the capital of the state of that name in southern Brazil. The installation of this company is representative of the difficulties of engineering work prosecuted under the peculiar local conditions existing on the southern continent.

At the time of the development a careful consideration of the local conditions was made, and inasmuch as fuel was very high, a thorough examination of the possibilities of water power was conducted. This examination extended over a period of two months, during the season of least rain, and as a result the locally famous Cachoeira do Inferno (Rapids of Hell) were decided upon as offering the desired conditions for power development. As the distance was only twenty-three miles from Sao Paulo, and no other available power existed within transmission limits, the location was favorable not only from an engineering but from a commercial standpoint.

The city of Sao Paulo is well built and well arranged, and is located upon a plateau 2,500 feet above the sea and about forty-five miles from its seaport, Santos, Brazil. It has a population of about 275,000, and is steadily growing. The business of the city is dependent upon the shipments of coffee, and it acts as a sort of clearing-house and supply depot for the annual export of 10,000,000 bags, holding 132 pounds each. The tributary country of Sao Paulo produces sugar, cotton and other products of the soil in abundance, while cotton, flour and woolen mills, with factories for the manufacture of hats, shoes, bricks, coffee and sugar bags are plentiful.

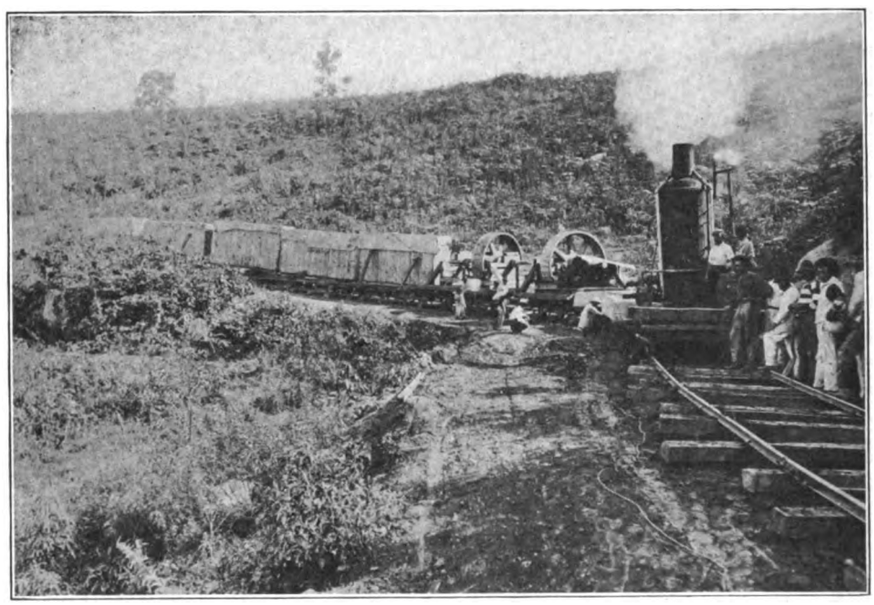
In a general way, then, the foregoing were basic conditions upon which was founded an investment of $6,000,000, which covered complete street railway and lighting and power systems, together with a water-power and distribution plant.

The "Rapids of Hell" previously mentioned are situated where the river Tiete flows through the village of Parnahyba, twenty-three miles from Sao Paulo. This river drains a watershed of 2,700 square miles, having an annual precipitation, as shown by well-kept government records, of an average of fifty-nine inches of rain on forty-five per cent of its area, and 130 inches on its remaining fifty-five per cent. Periods of drought are unknown, and the months of minimum rain show two inches of precipitation. Inasmuch as the entire basin is overlaid with heavy vegetation, the supply of water is excellent. The gauging of the stream, verified by actual measurements over the finished weir of the dam, shows that, allowing a shrinkage of forty per cent in the estimated lowest possible water, there will still remain a sufficient quantity of water to generate 20,000 horse-power for each twelve hours during the period of least water.

In developing this water power two dams were constructed, known respectively as Dam No. 1 and Dam No. 2. Dam No. 1 is located across the head of the rapids, and creates a pond up river approximately eight miles long, and having a width averaging 1,000 feet. The water is conducted down stream for a distance of 2,300 feet through the main pipeline, twelve feet in diameter, to the secondary reservoir above dam No. 2. From dam No. 2 the water is conveyed to the power-house through a set of four steel pipes, each eight feet in diameter for the generators, and thirty-inch pipes for exciters. Dam No. 1 raises the original level of the water thirty-nine feet. The fall in the river from below dam No. 1 to the tail-race at the power-house is 38.4 feet, making a total static head of 77.4 feet, or a working head of seventy-five feet on the turbines.

The main dam (No. 1) is 860 feet long, with a spillway of 462 feet. In building this dam the river was shifted twice in seventy-eight days; 2,000 feet of coffer dams were built to hold back a head varying from three to eighteen feet, and 9,000 cubic yards of masonry were put in place during this time.

Foundations for the dam were all solid granite ledge, proved by exploration drills, Foundations were trenched to receive the dam, which varied in height above the foundations from forty to seventy-three feet, with a width on the base line of thirty-six feet. The exposed faces of the dam are granite Ashlar, cut to one-inch joints. The interior is filled with heavy granite backing set in concrete.



THE SAO PAULO TRAMWAY, LIGHT AND POWER COMPANY—MOVING HEAVY ELECTRICAL MACHINERY BY STEAM POWER AND PORTABLE TRACK.

The main pipe-line starts at dam No. 1, at a point twenty-four feet below the level of the crest of the dam. The pipe is twelve feet in diameter, is of three-eighths-inch boiler steel, and is 2,300 feet long. It is supported every twelve feet in its length by steel saddles, resting on stone pedestals. The pipe is straight in alignment, and is provided with three expansion joints which divide the pipe into four sections of 575 feet each.

The water from the pipe-line is discharged into an open reservoir, the reservoir being made by building dam No. 2 across a ravine. The object of this reser-

Digitized by Google

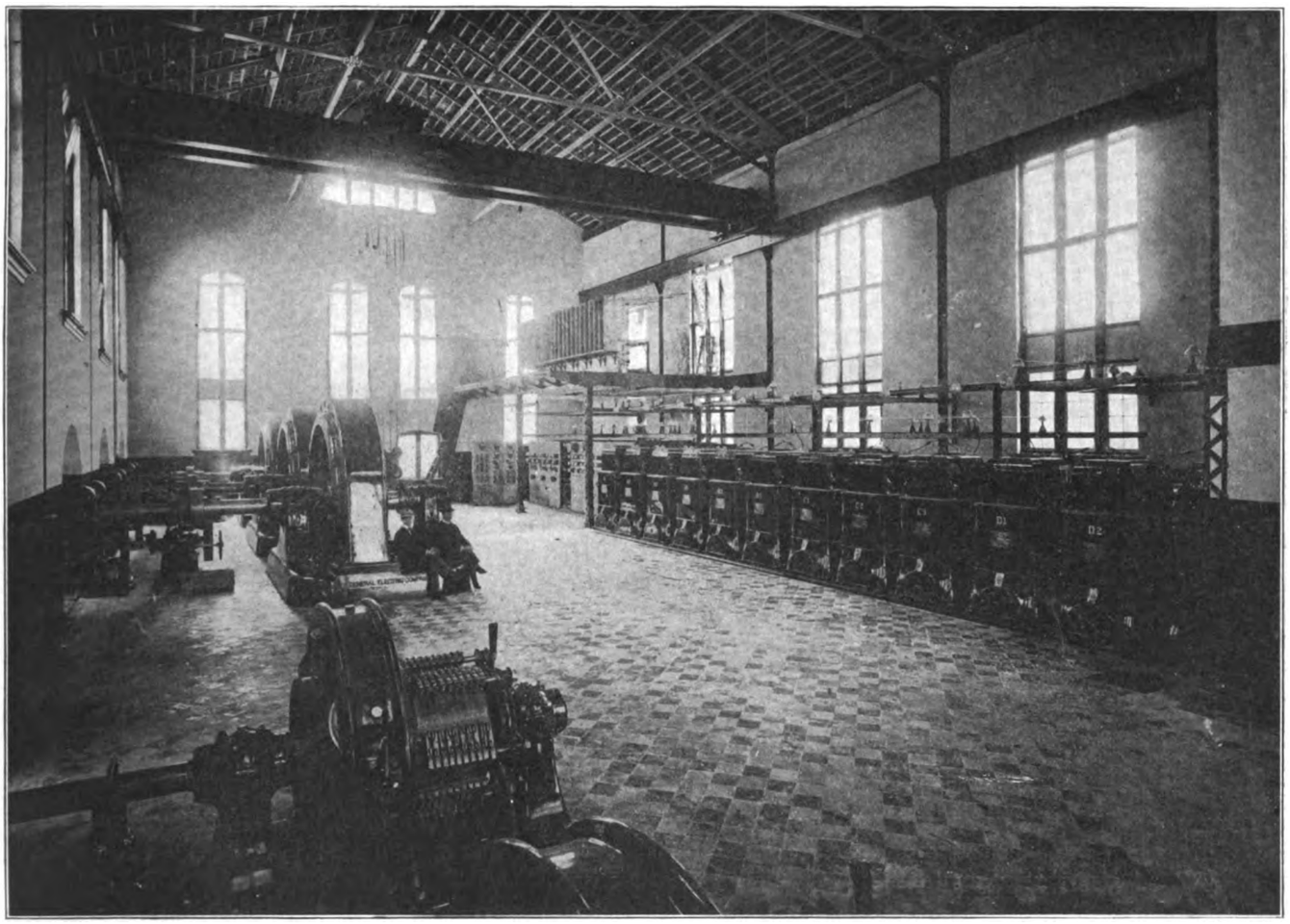
voir is to form a cushion for the elimination of impacts in the main pipe-line, due to changes in velocity, and also to provide a quick water column for the secondary feeders to the turbines proper. The use of this method of eliminating the disasters commonly found in attempts to obtain first-class regulation where long pipe-lines are in use is believed by the designing engineer to be original. Original or otherwise, the results have been most satisfactory, and turbines operating 2,500 feet away from the impounding dam are being regulated with a variation of one and one-half per cent from normal, upon a circuit carrying only a street railway load, and subject to excessive variations in current, owing to heavy and frequently occurring grades in the track.

The power-house is a fireproof building of steel, brick and concrete construction. Dividing walls are built of concrete with concrete floors, and the building has a tile roof. The complete electrical apparatus was furnished by the General Electric Company, and consists of four 1,000-kilowatt, sixty-cycle generators and one 2,000-kilowatt generator; twelve 333-kilowatt air-blast transformers, arranged in four banks of three each, stepping up from 2,300 to 25,000 volts and three 666-kilowatt transformers; three blowers and two 100-kilowatt exciters, with switchboard for the control of this apparatus. The switchboard is arranged with duplicate bus-bar system for both high and low tension, and is so arranged that any one of four transmission lines can be thrown in or out of service, with division of load for lighting and railway work. The water-wheels are controlled by Lombard governors, and the general operating conditions have proven very satisfactory. The main station equipment has recently been increased by a sixth generator of 2,000 kilowatts capacity built by the General Electric Company. Additional transformer capacity has also been necessary, all the new apparatus including the switchboard panels being of the same American manufacture.

The power is transmitted twenty-three miles to Sao Paulo over the company's own right-of-way. Duplicate pole-lines have been erected, the two lines being separated about thirty feet. On each pole are two sets of three-phase transmission lines, consisting of three No. 0 copper wires. The right-of-way is cleared to about thirty feet each side of the pole-line.

At the substations the equipment includes twelve 22,000/2,200-volt, 333-kilowatt step-down transformers; two 500-kilowatt railway generators, driven by 700-horse-power induction motors, and two 500-kilowatt railway generators driven by 700-horse-power synchronous motors. There is also a booster, compressed-air outfit and large feeder switchboard, as well as the main controlling boards for the apparatus outlined above.

The transportation problems in connection with the hydraulic development were quite serious at the start. It was necessary to build an entirely new road from the railroad to the power-house site, and the first examples of transportation by local methods were very discouraging. The only vehicles were carts hauled by oxen, with solid wooden wheels, rigidly fastened to the axle, the axle turning in wooden bear-



THE SAO PAULO TRAMWAY, LIGHT AND POWER COMPANY—INTERIOR OF POWER-HOUSE, PARNAHYBA, BRAZIL.

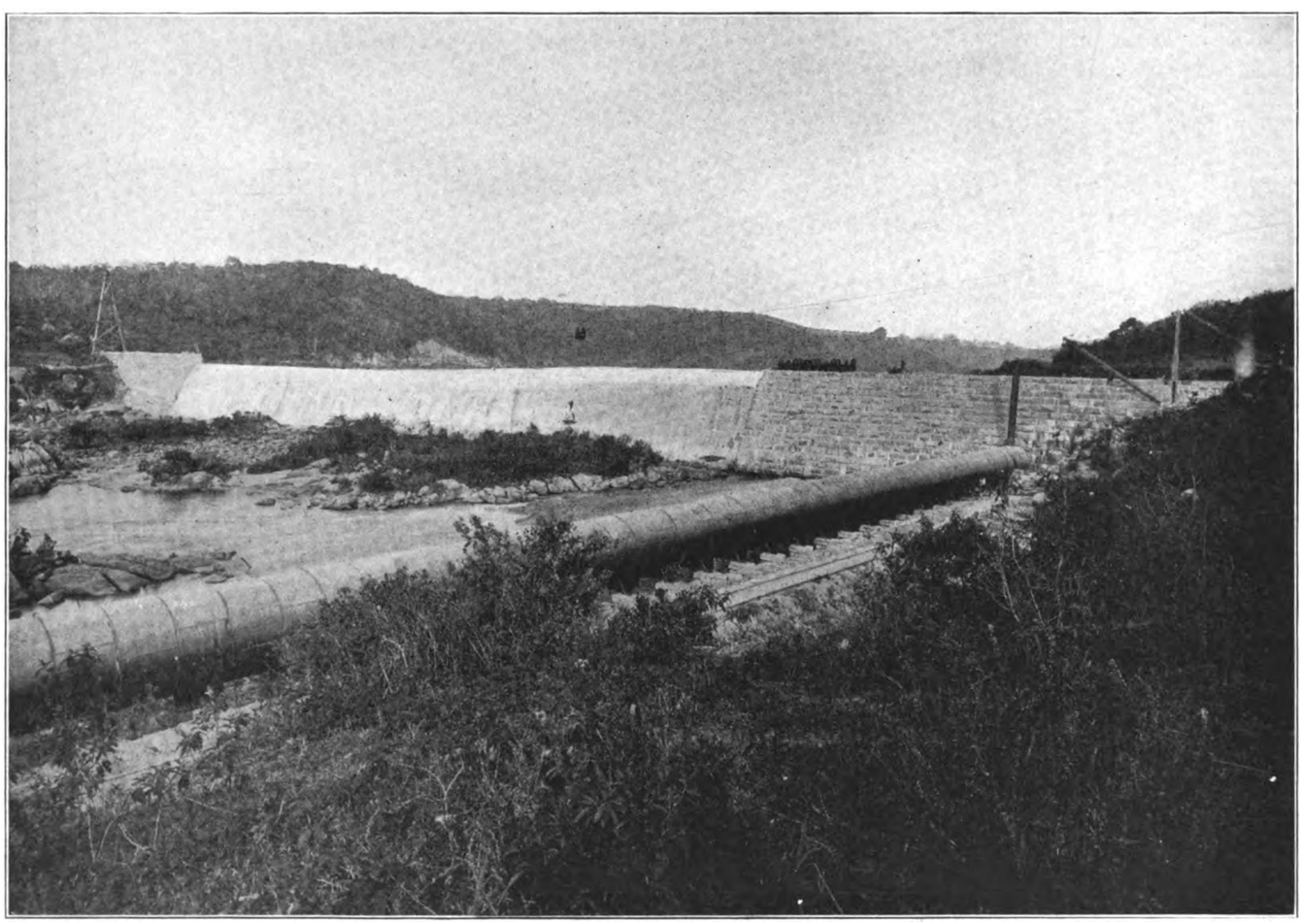
Digitized by Google

THE SAO PAULO TRAMWAY, LIGHT AND POWER COMPANY—HAULING PIPE SECTIONS BY OX-TEAMS.

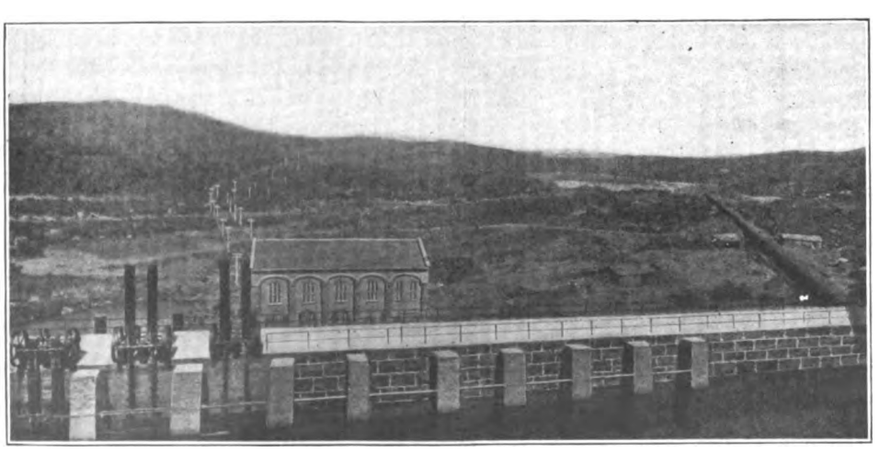
ings. The natives naively claimed that the oxen would not pull these carts if they were greased, as the noise made by the axle turning was absolutely necessary to urge the animals to their task. They stated also that the friction was an advantage, as it acted as a brake going down-hill, but said nothing about going up-hill.

In regard to the load that the oxen were capable of pulling, for example, it required ten oxen to haul one pole (weighing 1,500 pounds), and the first mules which were employed took four to six barrels of cement on two-wheel carts.

Steps were immediately taken to import some American wagons, and a lot of wild mules were purchased and broken on the ground. After two months of modern methods, they were able to haul with six mules twenty-four barrels of cement, making the trip in one-half the time that was required previously with the natives.



THE SAO PAULO TRAMWAY, LIGHT AND POWER COMPANY—MAIN DAM, LOOKING UP STREAM.



THE SAO PAULO TRAMWAY, LIGHT AND POWER COMPANY—PANORAMIC VIEW OF POWER INSTALLATION, SHOWING TRANSMISSION LINES.

The transformers weighed five tons each, and in order to draw these over the local roads it was necessary to use a truck with twelve-inch tires, and special frame or cradle to carry the transformers, swinging on steel cables, so that they could not tip over. Fourteen mules were required for each wagon, and one round trip was made in one and one-half days. It was

Digitized by Google

found that five tons was the limit of load with wagons, and some other scheme had to be devised for hauling the remainder of the electrical machinery, which was in pieces weighting ten tons or more. An attempt was made with the first piece, weighing ten tons, to haul it over in a wagon, and the trip took three weeks, because for the entire distance it was necessary to pull the wagon along with heavy block and tackle, and slow-moving animal power.

For transportation of the heavy material, a number of small cars were made, and a 1,500-foot section of track was arranged to be laid without spikes. One of these cars carried a small hoisting engine, which was run ahead to the end of the 1,500 feet of track, and the cars loaded with machinery were drawn up to the engine. While the machinery was being pulled ahead, men and teams tore up the track back of the cars and carried it ahead, laying it as rapidly as possible, so that as soon as the last car had been pulled up to the engine the track ahead was again ready for operation. By this means seventy-five tons were hauled seven miles in twenty-eight days, while it required three weeks to haul ten tons the same distance by wagon.

Many difficulties similar to the foregoing are of course always incident to the establishment of modern machinery in the newer countries, and other difficulties were met with in the work even in this more advanced community. It was found impracticable, for instance, to let contracts for the work owing to the absence of reliable contractors. Accordingly, the entire plant was built by "day-work," and the construction plant, and organization therefor, were shipped from North America. This included seven good American foremen, twelve derricks, three pumps, one aerial cable-way, one rock crusher, eight steam engines, one air-compressor plant, five boilers, and all necessary small tools for the work.

Work on this development was commenced in September, 1899, and the plant was completed and in operation during the same month, two years later. From the beginning there has been a healthy growth in the adaptation of electric power, and at the present time the company operates seventy-three electric cars over about seventy-five miles of track in Sao Paulo and its suburbs. Power is also supplied over the same territory to about 36,500 lights, and nearly 5,000 horse-power is used in various manufacturing enterprises.

The head office of the company is located at Toronto, Canada, the officers being: Wm. Mackensie, president; Frederic Nichols, vice-president, and J. M. Smith, secretary-treasurer. The complete electrical equipment was furnished and installed by the General Electric Company.

The Telephone Situation in Chicago.

By a Staff Correspondent.

WITHIN the past few years there have been developed in the city of Chicago conditions respecting the telephone service rendered by the Chicago Telephone Company which are both complicated and unusual, and in order to understand them it is necessary to go back to the early history of the company and its development.

During a number of years previous to 1889 two companies had operated exchanges in the city, and the large majority of users found it necessary to pay for the service of both. The properties were finally united, and in 1889 an ordinance was passed granting the Chicago Telephone Company for twenty years the right to operate in the city, which then embraced an area of thirty-seven square miles, the company undertaking to pay to the city, three per cent of its gross receipts from its telephone business done within the city for the privileges afforded. It also agreed not to increase its "rates for telephone service now established" beyond $125 for unlimited service on a business line within a territory known as the "Blue Line" and embracing an area a little less than half of the city limits as they then existed. Beyond this line, $25 per year per mile was to be charged. As this was before the introduction of long distance lines and metallic circuit service in Chicago, the rate referred only to the grounded single-wire service which was then in use. Outside of the Chicago city limits the company operated under franchises obtained from various towns and villages which adjoined Chicago, such as the village of Hyde Park; the town of Lake, etc., and under these various franchises the telephone service was developed.

Late in 1892 the long-distance wires from New York were constructed through to Chicago, and it was found that service rendered over them by means of the grounded exchange lines of the Chicago company was not satisfactory. To make this long-distance service available it was necessary to construct special metallic circuits and install long-distance instruments. This was done for long-distance service and no other at a rate of $96 per annum. Many subscribers had both telephones; one for local service at $125 and one for long-distance service at $96. Later on, these and other subscribers desired to combine the two services in one set of instruments. Special switchboards were installed by the company to make this possible, and about July, 1893, a rate of $175 per annum was made for the combined service. The company at the same time continued to furnish the grounded line exchange telephone service at the $125 rate.

Meantime the city of Chicago had annexed a number of the surrounding towns and villages and had increased in area from 37 to 191 square miles. The company at the same time extended its exchange boundaries at the $175 rate beyond the old "Blue Line" and gradually took in a considerable portion of the territory which had been annexed, greatly reducing its mileage charges.

The work of developing the service continued, and improvements in the way of operating exchange lines and switchboards were introduced as rapidly as they became available. Indeed, a considerable number of the improvements which have since become standard and which are now used throughout the world were first put into use in Chicago. Among them may be mentioned the incandescent electric light used as a telephone signal. This and many of the devices which have made it so valuable were the inventions of employés of the Chicago Telephone Company. Methods for operating party lines were also developed and successfully introduced, and service to residences was rendered by means of it at rates which were little more than half those the company had the right to charge. When measured rates were introduced in New York and elsewhere this plan of charging was introduced by the Chicago company, and by means of it large numbers of telephone users secured all the service required at a reduced cost. Still later, the prepayment or nickle-in-the-slot plan was introduced in which the service is paid for at the time rendered. This plan, originally introduced in San Francisco, was carefully studied by officials of the Chicago company and after a trial in one

Digitized by Google

of the exchange districts was extended throughout the entire city. An initial guarantee of the minimum amount which should be paid to the company was made by subscribers to the nickel service who paid at the rate of five cents for an exchange call. If the receipts were less than the amount per day which had been guaranteed, the subscriber undertook to make up the difference. Rates were made with guarantees as low as five cents per day for ten party-line telephones in residences. These were operated at special switchboards under special designations and numbers and in no way interfered with the general exchange service of other subscribers.

The prepayment or nickel service was immediately popular and developed more rapidly than any other, so that the growth of the exchange continued to be rapid, requiring the erection of fireproof buildings to accommodate the sixteen exchange offices now in operation, and the installation of relay multiple switchboards of the best and most modern type.

After the introduction of the metallic circuit service, the question as to the company's right to charge $175 per annum was taken up by the city council, and the corporation counsel advised that as long as the company continued to provide the $125 service it had a right to charge a higher price for a different and a better service. The same question was brought up at another and later date, and a second corporation counsel ruled in the same manner.

The company therefore continued to give the $175 service as well as the $125 service and a large number of other classes at rates lower than $125 and believed that it had a right to do so. The question was finally taken into the courts, where a different ruling obtained in 1902, and the company was enjoined from charging more than $125 for its exchange service within the ordinance "Blue Line" and the mileage as named in the ordinance for points beyond it.

This suit against the company had been started in behalf of a small number of plaintiffs. A corporation known as the Chicago Telephone Adjustment Company was immediately organized by outsiders and set about to canvass among subscribers of the Telephone company to take their claims against it for amounts which they had paid the company in excess of $125. This Adjustment company engaged the same counsel as represented the former case, then under way, and these clients were included in the suit as rapidly as their interests had been secured by the canvassers of the Adjustment company, which company was to receive one-third of all sums collected. These clients under the injunction paid but $125, and bond was given for the balance. The Telephone company then, in response to enquiries from other subscribers, arranged that they might pay at the rate of $125 and give a bond to pay the balance if the $175 rate was finally upheld. To a number of other subscribers who continued to pay $175, the company agreed in a letter to repay the excess amount if the rate did not hold good. The Adjustment company continued an active canvass in its endeavor to secure the claims of as many subscribers as possible.

Suits also were brought against the company by subscribers who at one time had paid at the rate of $175 but who had not continued to be subscribers. This suit was tried out and all of the points involved in the controversy were taken up in it. It had been claimed that the subscribers were obliged to pay $175 and had paid this rate under duress. It was proved that the contrary was the case and that subscribers, had they so chosen, might have continued the $125 service and that there was no force or duress on the part of the company and that they were not forced to take the combined local and long-distance service or pay the $175 rate. This suit was decided in favor of the company, it being stated that as the subscriber had voluntarily entered into the contract and at the time of taking it had not objected to it or taken it into court, he had no claim for repayment, but must abide by the terms of the contract which he had executed.

In 1905 the city of Chicago, through its corporation counsel, who did not agree with the former corporation counsels, began another suit against the company: first, to oblige it to charge only the $125 1889 ordinance rate for its exchange service, and second, to oblige the company to pay three per cent of its gross receipts from its telephone business throughout the entire present city limits of Chicago, and, although it was shown that the $125 service had always been continued by the company and was used by several thousand subscribers at the time the suit was brought, and, although it was shown that the company with the concurrence of the city had continued to furnish service and operate in the annexed territory under its various ordinances, in the village of Hyde Park; the town of Lake; the town of Jefferson, etc., the Supreme Court of Illinois decided in favor of the city on both counts. The final trial and decision has not yet been had, but the company has paid to the city on account, without prejudice, the amount of the compensation claimed and has proceeded to charge for the combined exchange and long-distance service facilities at the rate of $125 instead of $175, which had been the rate since 1893. The Court's decision astonished lawyers, for it substituted the Court's opinion as to the meaning of the ordinance in place of the meaning openly acted upon for over ten years by the city and the company between whom the ordinance is a contract.

The suit in behalf of clients of the Adjustment company and others who sought to have the company repay all amounts received in excess of $125 was still continued.

Outside of the complainants in this suit, certain subscribers had paid at the $125 rate and given bond for any excess. Some others had received the letter from the company agreeing that it would pay back if the higher rate did not prevail, and a large number, indeed the majority of all users of this class, had continued to pay at the $175 rate.

It was finally decided by the company that it would pay back in full to all subscribers any amounts received from them in excess of $125, back to the date on which it had first been enjoined from charging at a higher rate. This was in January, 1902, and subscribers are now being paid in accordance with this arrangement as rapidly as their claims are received.

Meantime, as the exchange continued to grow at an ever-increasing rate, and the number of telephones increased so rapidly as to require the expenditures of greater sums each year for plant, it was considered advisable to take up with the city the matter of an extension of the company's ordinance granted it in 1889 and which expired in January, 1909, and negotiations were entered into with the committee of the common council and are still under way.

In these the company has submitted the fullest explanation of its affairs and invited the closest scrutiny into its rates and methods. It has been shown that the stock of the company has not been "watered" but for every dollar of stock a like amount has been invested in its plant, which has been well built and maintained and represents the best developments in telephone engineering and operation. It has been found that about ninety per cent of all subscribers are paying for service upon some one of the many forms of meas-

Digitized by Google

ured rates now offered and that out of more than 116,000 telephones only about 8,000 are the so-called flat-rate-business telephones. It has been shown that a very much lower rate of measured rates, particularly for the small users, can be offered if subscribers of all classes pay for the amount of service rendered to them and that a continuance of a flat rate for a few will necessarily require the maintenance of a higher measured rate for the many. The company's proposal, therefore, has been to charge for its exchange service at measured rates. This would bring about not only a great improvement in the service, doing away with the ten-party lines which have tremendously increased because of their low cost and changing the service of these to four-party lines for residences and two-party lines for business places, but it also would lead to a very great growth in the exchange which would increase the value of the service to all subscribers. The proposal also has been to include the entire city limits in the exchange area, thus including within one zone and upon one basis of rates a larger area than any exchange in the world and at lower rates. The proposal has been also to continue the operation of neighborhood exchanges in outlying portions of the city where very low flat rates are charged for the comparatively small number of telephones required by these various communities, and to charge a toll rate of five cents from these neighborhood exchanges to any other telephones within the city limits outside of their own districts.

In the course of negotiations public hearings were called at which many patrons of the company appeared, and the general evidence was overwhelmingly to the effect that a good service was being rendered by the company; that lower rates and extended service would be desirable and that a comprehensive service rendered at fair rates by one company would be best for the community.

At other hearings, representations were made in behalf of the Manufacturers' Association, one of the associations of manufacturers and business men of the city, that this association proposed to go into the telephone business and ask for a franchise. A considerable number of the members of this association protested against the use of its name in this connection, and the proposal was later modified to the statement that some members of the Manufacturers' Association intended to form a company and apply for a franchise.

Another company proposed to operate telephones at a lower scale of rates than had been proposed by any other and then in five years to give the entire plant to the city without any recourse. At one meeting of the committee no less than five separate propositions of various kinds were made by people desiring telephone franchises. The general expression of telephone users, however, has continued to be that one comprehensive service at low rates, fitted to all classes of users, was much to be desired, and that the extensive operation of two or more companies would greatly add to the public's expense and to the confusion of the service. The situation to-day is, therefore, that the company is paying to all subscribers upon request any sums which they have paid in excess of the ordinance rate back to January, 1902, and continues to defend the suits against it by subscribers who do not wish to settle on that basis, and it is proceeding in its negotiations with the city council in the matter of an extension of its ordinance.

Some $16,000,000 have been expended by the company in its plant and the extension of business in Chicago and surrounding counties. About one-half of this has been paid by Chicago stockholders. A majority of the directors of the company are Chicago men who have been and are identified with the best interests of the city. They have authorized the extension of the service to meet, as satisfactorily as possible, the requirements of the public. Extension of exchange boundaries and reductions in rates have been made from time to time as the development of the various classes of service has warranted.

Without waiting for further action in the matter of its application for an extension of the ordinance, the company has just made a substantial reduction in exchange rates, affecting measured rates, private branch exchanges, extension telephones, ten-party lines and others, and in connection with its ordinance extension has offered very many more reductions which will affect not less than ninety per cent of all telephone users in the city.

The management of the company has believed in Chicago and believes that its endeavors to provide a first-class telephone system and service will meet with the fair and just consideration of the city's council and its executive officers. At the very low rates proposed by the company, Chicago should be not the second but should again lead all cities in the world in the number of telephones. It is evident that the best interests of the greatest number of people will be served by meeting the Chicago telephone situation with a square deal.

The Liberal Education.[1]

If it be held that one must needs have the so-called liberal education in order to be well rounded, it is pertinent first to determine whether roundness is what is really wanted and the fitness of the subject to the end. We don't build walls of round stones. We hew them square—some are better rough hewn and others are better when polished. It is not well to attempt to take all the corners off humanity. They should be left on to dent something.

When it is observed that in our modern universities which offer to students wide ranges of educational courses, less than one-quarter follow classical pursuits when left to free choice and that over three-quarters elect professional and industrial education, there is good reason to believe that this is about the proportion in which minds are fitted to receive benefit from the acquirement of the respective classes of knowledge and training. I therefore maintain that instead of decadence in the humanities they are elevated by this natural selection because their representatives become only those whose minds are fitted to take such education and who will therefore conspicuously represent the best possibilities of classical training applied to those to whom it is adapted.

In addition to the several agreeable and desirable attributes of classical training, its fundamental benefit comes through the melting down and recasting of thought, which to some minds is a stimulating and cultivating process. There are other processes of like kind and quality that are adapted to other minds, notably the melting down of the laws of nature and recasting them as applied science. Another cultivating and most useful process, too little practised, is the melting down of one's own thoughts and so recasting them that they can be understood.

We have heard too much about knowledge for its own sake *versus* knowledge for use. All knowledge is for use. All education is for action. The engineer uses mechanics and thermodynamics in a certain direct way. The architect uses art and constructive knowledge in a similar way. The lawyer uses his knowledge in a less material way. The classical or philosophical man uses his acquirements in a different way, but if he does not use them they are useless. The older I grow the more I think there is no such thing as liberal education, liberal arts, or liberal anything, as distinct from specialized departments of knowledge. As to the so-called specialized courses, these are only names. They are no more special than the humanities. Some are scarcely so highly specialized. All education is liberal or all is technical, according to our definitions, but all is for use.

[1] Excerpt from an address delivered by Walter C. Kerr before the graduating class of Staten Island Academy.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Apparatus for Automatically Connecting in Parallel Polyphase Machinery.

An apparatus for automatically throwing in parallel polyphase alternating-current machinery is described here by Dr. Gustav Benischke. The author discusses first the conditions which must obtain in order to carry out this operation successfully and shows how advantage may be taken of the conditions existing at the moment of synchronism of the two or more machines to be coupled together. The device consists of three parts—a synchronizer or apparatus which comes into action at the moment of synchronism; a time relay operated by the former, but which closes an auxiliary circuit only when the conditions of synchronism last for a certain definite period; and an electromagnetic switch operated, in turn, by the time relay, which is actuated whenever the latter is closed and which connects the machines together. The synchronizing apparatus is an electromagnetic device actuated by two or three windings, depending upon whether the system is a two or three-phase one. When these windings act together a switch is closed, bringing into play the time relay. If the period of closure lasts long enough, the time relay closes the circuit of the electromagnetic switch and thus throws the machines in parallel. The device employed for this is illustrated and described, and the theoretical conditions are considered somewhat in detail. It is pointed out that these devices may be combined. For example, the synchronizing apparatus and the time relay may be made as one instrument.—*Translated and abstracted from Elektrotechnik und Maschinenbau (Vienna), July 22.*

Regenerative Control and the Bow Collector.

Certain unfortunate accidents occurring on British trolley lines have led G. Hooghwinkel to call attention to certain protective features which he thinks are inherent in the so-called regenerative system of control and in the bow or sliding bar collector. The regenerative control system makes automatic and sure braking possible, and since it is employed with shunt motors, constant and fixed speeds for every position of the controller are obtained. As early as 1896 the author used these motors is the town of Essen, Germany, but, as copper brushes were employed, sparking occurred, causing the throwing out of the system. This trouble may be avoided by employing auxiliary poles and carbon brushes. Experience with such systems of control in rolling mills, where the service is equally severe, indicates that it would be entirely successful if applied to railway work. With respect to the bow collector, the advantages claimed are the impossibility of its flying off the wire, the little attention required, and the possibility of reducing the number of switches and pull-off wires on curves. This collector has been employed by the Sheerness electric tramways, where it has been most successful. Some trouble was encountered at first due to the breaking of the cast-iron standards which had, by mistake, been substituted for steel. Replacing these with steel did away with the trouble. During the whole of the time these tramways have been in operation (over three years) no repairs have been necessary to the overhead equipment, beyond renewals of section insulators and about half a dozen span wires. The trolley wires are still in very good condition. The bow is of aluminum and runs about 5,000 miles. It costs about $1.60 to renew it, neglecting the value of the scrap, which is about sixty cents. It weighs about eight pounds. The author suggests that the substitution of this collector for the trolley, which does away with a good deal of the ugly overhead equipment at switches and curves, may prolong the use of the overhead system in cities. He is convinced that the trolley wire will last longer when this collector is used than when the wheel is employed.—*Abstracted from the Tramway and Railway World (London), August 9.*

Charging Storage Batteries when Employed as a Reservoir of Energy.

The advantages of storage batteries employed as a reservoir of energy are discussed here by M. F. Loppé, and the conditions which must be met for successful charging and discharging without excessive loss of energy. The main trouble is due to the wide variation in voltage of the batteries according to the condition of the charge. In order that the voltage of the batteries may be equal to that of the system during discharge, it is necessary that the voltage at which they are charged be considerably greater. To accomplish this either a booster may be employed, or the battery may be cut into sections, which are charged independently or in parallel. Several possibilities are open here. The battery may be cut into two equal sections connected in parallel and charged in series with a rheostat, in which case the loss is considerable. Or it may be cut into three sections, charged one section in series with the other two in parallel, or any other grouping desired. Or a third plan, now employed by Herr Micka, in Germany, who uses a peculiar arrangement, may be adopted. If the voltage to be delivered require N normal cells, he employs $\frac{2N}{3}$ cells having the necessary capacity and $\frac{2N}{3}$ additional cells having one-half the capacity of the former. During charge each set of batteries is connected in series across the line, the current being regulated by rheostats. During discharge the smaller set of batteries is divided into two equal parts, which are connected in parallel in series with the larger set. In this way all batteries charge and discharge similarly.—*Translated and abstracted from L'Industrie Electrique (Paris), August 10.*

Electrical Cutting of Steel I-Beams and Girders.

The fire at San Francisco, Cal., following the earthquake of April 18, has left some difficult problems to be solved in the clearing away of débris for new buildings. One of the most serious of these is the removing of the tangled mass of structural steel. It occurred to R. E. Frickey that the electric arc might be employed here to advantage, and he has carried out at the University of California some experiments to determine the possibilities of this use of the arc. As a result of extensive experiments an electrode has been evolved which has proved successful. By means of this electrode a fifteen-inch I-beam was cut in two in twenty minutes. To make a corresponding cut with a hack

Digitized by Google

saw would require several hours. For the best and most economical results a current of about 250 amperes at from 90 to 100 volts is required, although a lower voltage would be more economical. Since the counter-electromotive force of the arc is about forty volts, any potential but slightly greater than that would not give a current sufficiently constant, as slight variations in the length of the arc would produce very serious changes in the current value. A considerable resistance is employed when the higher voltage is used, which maintains the current constant and does away with the difficulty of starting. A further advantage is that the higher voltage gives an arc less likely to be blown out by wind, as it is not so sensitive to external conditions. Since the positive side of the arc is the hotter, the electrode is always negative. In starting, a resistance is employed, but this may be cut out after the arc is formed. One necessary condition for success is the satisfactory protection of the operator. Not only the eyes, but the face and hands, must be covered, or they will be badly burned. An oilcloth hood having a rectangular opening in front of the eyes is employed, this opening being covered by a mask of oilcloth having a window of specially prepared glass when the arc is in operation. Gloves must be worn. Since it is not practical to obtain 110 volts for the work in San Francisco, and as it was not advisable to use the 220-volt system, since the neutral is grounded in that city, a portable generating set consisting of a gasolene engine driving a dynamo was arranged. This consists of a twenty-five-kilowatt, direct-current generator belted to a forty-horse-power single-cylinder gas engine mounted on a truck. The selection of the equipment was limited to a considerable extent by the apparatus available in the city. Although it can not be said to what extent this method will be employed in clearing the San Francisco ruins, it is believed by the author to be considerably cheaper than mechanical cutting.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), August 11.*

The Electrical Installations of the City of Schaffhouse.

The hydroelectric system described here by M. J. Reyval is particularly interesting, since it replaces one of the earliest attempts to transmit over some distance the power of a waterfall. As early as 1858 the city of Schaffhouse, Switzerland, realized the advantage to its industries which would be secured if the hydroelectric power of the Rhine at that point could be developed and distributed to the various shops. The plan was taken into consideration, carefully studied, and in 1860 the plan was put under the guidance of M. P. Reuleaux, and work was begun in 1863. The plant was completed and put into operation in 1866. A canal was dug so as to conduct the water of the river to a suitable point to utilize the fall. Three discharge gates were built and fitted with hydraulic turbines. These drove, through bevel gears, ropewheels, and the power was transmitted along the river banks and distributed to various points by means of ropes. The first plant consisted of three turbines, rated, respectively, at 200, 260 and 300 horse-power, making a total of over 700 horse-power to be disposed of. This old system continued in use until 1900, but in 1886 the demands for more power led to the adoption of a hydroelectric system. The old company then built a second power-house, somewhat lower down the river than the first, and equipped this for five 300-horse-power turbines. In 1890 two turbines were put into service, each driving a six-pole dynamo producing current at from 700 to 750 volts, and rated at 300 horse-power. The speed of rotation of the turbines was sixty revolutions per minute, and the dynamos were driven by means of bevel gears. In 1891 the three other turbines provided for were put into service, two of them being coupled to alternators generating single-phase current at 2,000 volts. The frequency employed was fifty cycles. The efficiency of these machines was ninety-two per cent at half load, and eighty-seven per cent at full load. In 1897 the company decided to suppress the old rope system, substituting for it a modern electric plant. The following year the company's plants were bought by the municipality and plans drawn to replace all the old machinery by new. The new stations were put into service in 1901. Single-phase generators rated at 350 horse-power, generating current at 2,000 volts, fifty cycles, were adopted. Modern switchboard and transformer equipment was installed, rotary converters put in place to supply the local railway, a storage battery connected in parallel with the system to balance the load, and the two plants made entirely modern throughout.—*Translated and abstracted from L'Éclairage Électrique (Paris), August 18.*

An Arrangement for Measuring Alternating-Current Frequencies.

Since the natural period of vibration of any electrical circuit depends upon its capacity and inductance, this fact may be utilized to determine such frequencies. By bringing into electrical or magnetic relation with the circuit, the frequency of the current of which is to be determined, another circuit whose constants may be varied, until resonance occurs, the known electrical conditions of the latter circuit enable the frequency of the former to be measured. Practically, however, the conditions are not so favorable, but they can be made fairly satisfactory, as is shown by Professor W. Peukert. The first trouble is due to the change in the value of the coefficient of self-induction of any coil with the frequency. This change may produce a considerable error, though for low frequencies it is usually negligible. Another difficulty is that the change in the self-induction of a coil depends upon the value of the self-induction itself. For example, the author shows that, for a certain spool having at a frequency of 145 cycles a coefficient of self-induction of 1.0003 henries, the coefficient rose to 1.0059 henries with a frequency of 870 cycles, an increase of one-half per cent. A coil having a coefficient of self-induction of 0.001 henry showed practically no change from low frequencies to a frequency of 2,000 cycles. With a coefficient ten times as great the change was 0.2 per cent, with the same change in frequency. With a coefficient of 0.1 henry the change was 0.55 per cent. When the frequency was increased to 10,000, the three coils mentioned showed changes in coefficients of one, two and 3.49 per cent, respectively. The same trouble is encountered in the condensers usually employed, but, fortunately, the error is in the opposite direction, so that one tends to compensate for the other. The author then describes several coils which he constructed in order to test his idea, and gives the results of his experiment. The frequency to be measured is that set up by the alternations produced by a singing arc. Measurement was made by suspending the test coil from a delicate balance and weighing it with a certain direct current passing through it. Then the circuit containing the coil was put in inductive relation with the arc circuit, and its constants changed until the effective value of the alternating current, as shown by the balance, was equal to the direct current, showing practically resonance. Knowing then the constants of the circuit, the frequency was computed. The results were found to be in fair agreement, although it was difficult to maintain the conditions at the arc constant, and for this reason the frequency there varied somewhat. The conclusion, however, reached is that the frequency of an alternating current may be measured by the arrangement described, and that this is particularly suitable for measuring high frequencies.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), August 16.*

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

ORGANIZATION AND CONDUCT OF A NEW-BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.[1]

BY J. M. ROBB.

(Concluded.)

Give your newspaper talks direction. Select some person or prospect in your city, as nearly typical as possible of the prevailing type of people whose business you are going to get, and address all your talks to him. It has been demonstrated, in training street-car conductors to call streets and stopping-places, that announcements are much more easily understood if the conductor will direct his talk to some individual in the car, instead of just talking into space.

The same thing holds good in advertising.

You are going to persuade people to buy your service.

Very well! Point your arguments for some particular individual. Be direct; come to the point at once.

Use old-fashioned, plain English, the kind that says "Keep out" instead of "No admittance," or "Come in" instead of "Visitors are welcome."

Here are some suggestions:

"LET ELECTRICITY DO YOUR WORK."

"Get an electric iron. Then your ironing will be done with half the time and work. One will be sent to you on thirty days' trial if you 'phone to No.——."

"Get an electric warmer for baby's food. Then you won't have to chase down-stairs nights to the gas stove."

"Put up a porch light, with the street number on the globe; keep it lighted evenings. Let your friends know where you live when they call."

"How about the wear and tear that clothes-wringer takes out of your clothes? An electric centrifugal clothes-wringer will save it."

Change your copy every day. This is important, and it will lead many people to look up your advertisements to see what you will say next. The more people whom you can get to think about your business, the faster will it increase.

Keep a scrap-book file containing copies of every advertisement you run. If you will arrange your scrap-book in the order in which your advertisements appear, it will form an excellent means of checking your monthly newspaper bills.

Study every advertisement that comes to your notice in your endeavor to make your own advertisements different from the others with which it is printed. The effort will pay big returns.

DIRECT-BY-MAIL ADVERTISING.

A campaign of direct advertising by mail will still further increase your solicitors' efficiency. Mail will easily reach customers who will never see a solicitor, or get to them at times when a solicitor's call would be considered an intrusion and resented.

Be chary, however, of your use of circular letters, and do not place too much faith in the selling power of multicolored direct-by-mail stuff, artistically folded like a tablecloth or bedsheet.

Business men to-day are busy. A sentence in black type on a plain postal will make an indelible unconscious impression, where a choice collection of pictures on a square yard of wrapping paper will only produce an emphatic cuss-word and a vigorous shove toward the waste-basket.

The chief value of a circular letter is its personal appeal. Therefore is the necessity for its preparation with consumate care, to give it all the effect of a personal appeal to the reader.

If you do send out circular letters, enclose with each one an addressed postal (not a mailing card without a stamp) so that, when your letter makes the desired impression, the postal will be mailed before your prospect changes his mind in hunting for a one-cent stamp.

Be sure, too, that the postals are numbered for identification, for sometimes prospects mail cards, forgetting to sign them.

If you have an addressing machine, have the addresses of your respective customers set up for it, and arrange to keep it up to date. This will put you in position to effectively and quickly reach your prospects with any proposition you want to push.

Number consecutively the printed matter, mailing cards, circular letters, etc., that you send out; keep a scrap-book with copies of all such matter and have the date and number stamped upon your possible-business index sheets. By tabulating the orders secured from each lot of matter mailed out, as shown by the entries on the possible-business index, you are in position to judge the effectiveness of what you are distributing.

COOPERATION WITH EMPLOYES.

Do not end your work among your own men with training your solicitors. Work up the interest of every man connected with the company. Make them all see the possibilities that can be obtained if every man makes use of the opportunities for boosting the company's business that come to him every day.

Organize a progress club among the men, with meetings to be held monthly, or oftener, at which matters relating to the service, the sales of appliances, their use, the betterment of the service, etc., can be discussed. Invite their criticism and study their suggestions. This work will cost much in time and energy, but better results will be secured than can be obtained in any other manner.

SALESROOM.

Your salesroom is a most important adjunct of your new-business department.

First impressions count for everything with some people and for something with everybody. Your condition will govern the quantity of apparatus you can display, but even if you show only a flat-iron, you can show it, if you will, so that it will attract interested attention.

Don't neglect to have a glass-case watt-meter connected up so that you can demonstrate its operation any time.

Make use of the pamphlets, etc., that manufacturers of electrical apparatus will supply you for the asking. Everything helps.

CATALOGUES.

Keep carefully filed, for reference, every catalogue of current-using apparatus you can obtain. Study your catalogues and have your solicitors study them. They will suggest endless applications demanding the use of current, many of which can be profitably used by your consumers.

APPLIANCE POLICY.

Make your selling prices for appliances bring you the same rate of profit a dealer

[1] Winner of the third prize offered by the Cooperative Electric Development Association.

Digitized by Google

would expect, but scrupulously put into advertising or soliciting every cent of such profit. This practice will encourage dealers to handle electrical appliances. Cooperation is what you need, and the more people in your territory who can be induced to push electrical appliances, the better will it be for you. The practice of selling appliances at cost, or less than cost, further has the tendency to confirm the popular opinion of the profits from the sale of the current. Then, too, many people measure the value of an article by its price, and emphasizing the low price of what you are selling depreciates it to them.

Selling electrical appliances is more a matter of salesmanship than price.

Convince your customers of the value of your service. Create in them the desire to use it. It can be done by persistent work. Make your terms easy; small payments on long time, and they will buy.

Offer every appliance you handle on trial long enough to thoroughly demonstrate its convenience and utility.

Follow up every appliance sold, with a careful inspection, to ascertain that it has been properly set and that its operation is thoroughly understood.

COOPERATION WITH CONTRACTORS.

Display in a prominent place in your office a wall directory of all the electric contractors in your territory. Arrange to send them immediately any tips coming to your notice concerning wiring work, etc.

Keep in touch with your contractors, establish friendly relations with them and consider their criticisms and suggestions. Their cooperation is a valuable means of extending your business and is well worth your strenuous efforts to secure and hold.

Keep informed of the local work your architects have in hand and arrange for regular reports from the building inspector's office.

Knowing in advance of projected new buildings or remodeling work, you can furnish advance information to your friends, the contractors, and their self-interest in securing the work will make them effective solicitors for you.

PUBLICITY.

Make use of every legitimate means of securing desirable publicity for your company.

Establish friendly relations with the editors and reporters of your newspapers.

In most small towns, news items are not plentiful and much profitable publicity can be secured through tactfully acquainting your newspaper men of current happenings, such as contracts closed, contemplated improvements, etc., or handing them an occasional clipping describing some electrical appliance or some new application of electricity.

Should you, unfortunately, have an accident, prepare your own version for your papers. It will save them the trouble of writing it up and insure your public having the story as you want it told.

Remember, your business is bound to receive a certain amount of attention from the press. If you will make the effort, you can direct it to your advantage.

Make every piece of company property carry its advertising message. If there is no ordinance prohibiting it, put a permanent enameled sign on every one of your poles. You need not incur the expense of equipping all the poles at one time, but by buying permanent signs you can put them up on the instalment plan, without finding the expense too heavy a burden.

The benefit to be obtained by circulating a monthly bulletin among their customers and prospective customers is not properly appreciated by central station men.

Energetically pushing forward the many advantages of electric service, both to the customers and to the community as a whole, will do more than anything else to disarm the hostile spirit too often manifested against central stations.

There is no one to do this save the central station men themselves, and no better way to accomplish it than the monthly bulletin.

The practice of advertising appliances on or with monthly bills for service is of doubtful value. The recipient of the bill is then in the least receptive mood for suggestions to increase his use of current.

The bulletin method is more costly, to be sure, but it deserves careful consideration among your other plans for extending your business.

Give your wagons, tool carts, etc., especial attention. Paint them often and keep them clean.

Make your entire equipment carry its message of wide-awakeness and progressiveness to your community.

CULTIVATING POPULARITY.

Aim to be considered in your community as a public benefactor.

Use a portion of your new-business appropriation for purchasing advertising space in programs for church entertainments, etc.

The space so purchased has little advertising value, but when the character and energy of the people behind church and charitable organizations are considered, the importance of securing their good will is apparent.

The amount paid in each case need only be a small one, but it is important that this matter be so handled as to build up a cooperative spirit and that your customers appreciate that you are anxious to lend your assistance to anything promoting the public welfare.

In this line of work, beware of the professional advertising-scheme promoters.

If possible, arrange to loan cooking and other apparatus to church and charitable organizations free of charge, including current used. Stipulate, however, that a representative of your company shall superintend its operation to demonstrate the apparatus and to make use of any opportunity to promote your interests that may occur.

Never let any adverse criticism of your company, by any individual in your community, go unanswered.

Public service companies have so generally neglected to answer hostile criticisms that the public generally has come to consider that they have no answer.

Whenever you hear of a disgruntled individual, ascertain as quickly as possible what his grievance is, and either show him where he is wrong, or right his trouble. A few people you will find whom you can not convince, but your efforts in this direction, persistently followed up, will bear rich fruit.

CONCLUSION.

It would perhaps be difficult for any one man to follow all of the lines suggested, but every man doing central station work can, if he will, start with some one line of effort in this direction.

The start is the all-important thing, for, if the work be followed up, new ways and methods will be constantly suggested to the persistent worker.

Thoreau says: "I learned this—that if one advances confidently in the direction of his dreams he will meet with a success unexpected in common. If you have built castles in the air, your work need not be lost; that is where they should be—now put the foundation under them."

This also applies to the new-business work.

Dream your dreams of satisfied customers lighting their homes, their factories and their stores with your current, driving their machines with your power; cooking their meals with your appliances; advertising their business with your signs. Then work, work day and night to make your dreams come true.

Work—everlasting, never-tiring, patient, persistent work—that is the secret of a successful new-business department.

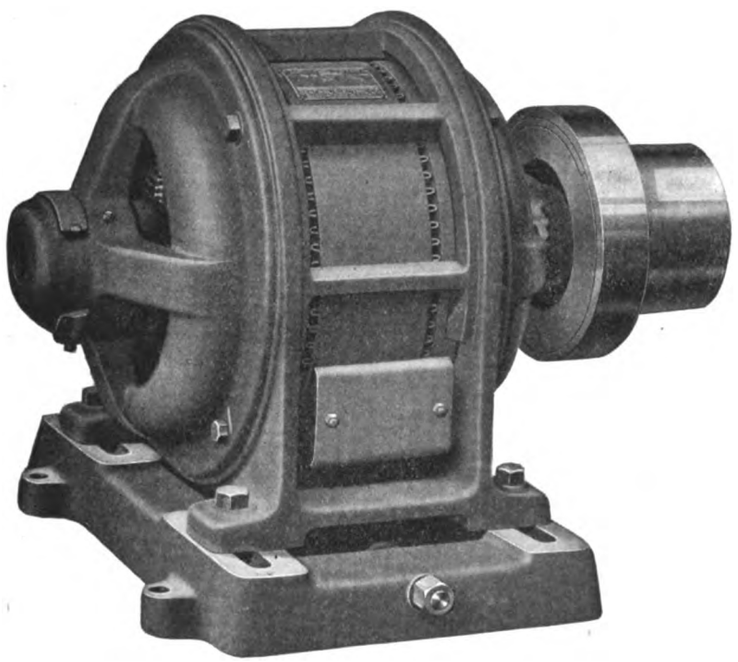
Digitized by Google

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Single-Phase Induction Motors.

The field for the use of single-phase motors of moderate capacity is constantly growing by reason of the increasing tendency of central stations to generate polyphase current and feed a large portion of the lighting load through single-phase distribution. Power is frequently required near such circuits for the operation of light machinery, and this is conveniently furnished by the installation of the General Electric Company's type IS, form KG single-phase motors.



NEW TYPE GENERAL ELECTRIC SINGLE-PHASE INDUCTION MOTORS.

The new motors are of the same simple, sturdy design as the company's polyphase induction motors and are also similar in appearance. The frames are cylindrical in form with removable end shields, the position of which can be shifted 90 or 180 degrees for wall or ceiling suspension, respectively. The fields are made up of a large number of thin punchings of the best quality of soft steel assembled under heavy pressure between the end frames. Since this motor has no complicated, internal, automatic devices for starting, the resulting machine is of the simplest mechanical construction.

The armatures are of the high-resistance squirrel-cage type, consisting of a number of slotted soft-steel discs assembled upon a shaft and carrying in the slots copper bar windings, which extend beyond the core at each end and are permanently connected to short-circuiting rings. The windings are similar to those of a three-phase motor, consisting of a large number of coils placed progressively in the slots. Some of the motors are fitted with three terminals, while the others have six terminals. The feet of the one-quarter and one-eighth-horse-power motors are slotted to facilitate tightening the belt. With the larger motors iron sliding bases are provided for this purpose, although motors can be supplied without bases, if so desired. All bases are designed for supporting motors when installed on floor, side wall or ceiling. Motors of one horse-power and larger are fitted with clutch pulleys, so that they can be started under full load while drawing only two to two and one-half times full-load current. The clutch is so arranged that pulleys of various diameters may be substituted for the ones ordinarily supplied. This is accomplished by the use of a sleeve, in connection with the moving member of the clutch, on which the pulley itself is carried. The sleeve is slotted and arranged to take standard pulleys, which are held in place by a key and set screw. Should it become necessary to change the pulley, it can be readily removed and replaced by one of the desired diameter or by a pinion.

The motors are rendered self-starting by means of a starting-box containing a resistance and reactance and a double-throw switch. This is first thrown to the starting position, and when the armature has attained almost full speed it is quickly thrown over to the running position, the object being to first throw the resistance reactance in circuit with the motor and later to disconnect it.

In the case of motors provided with six leads, the winding connections are changed through the starting box at the time of throwing over the switch from Y to delta connection. By this arrangement a starting torque of approximately 150 per cent is obtained with 200 per cent of full-load current. The small motors without clutch pulleys develop a starting torque of approximately 125 per cent of full-load torque. The speed of an induction motor is regulated by the frequency of the supply circuit, and is not materially affected by variations of voltage, so that the motors will operate at full load at from two per cent to five per cent less than synchronous speed.

The standard motors are wound for 110 or 220 volts, sixty cycles, in sizes from one-quarter to five horse-power, inclusive. The standard winding for larger motors is 220 volts. Satisfactory operation can be expected over a range of voltage or frequency considered together of fifteen per cent either above or below normal. In addition, motors of all sizes with special windings and accessories for fifty-cycle, and from one-quarter to one horse-power, inclusive, for forty-cycle circuits, can be furnished to order by the General Electric Company.

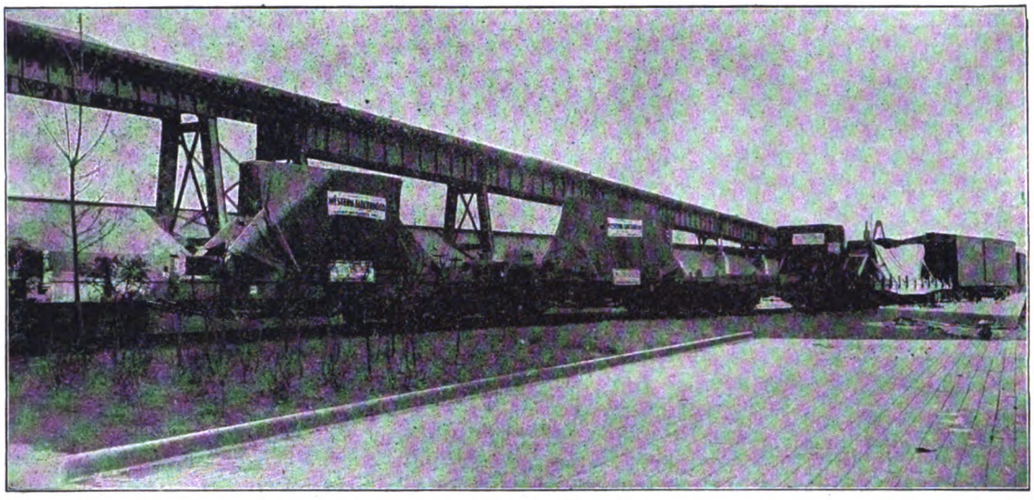
When these motors are operated from the regular lighting circuits no appreciable effect is produced upon the lamps, provided the circuits are well laid out and supplied with sufficient transformer capacity; or, if preferred, they can be placed upon separate transformers. In either case, one kilowatt of transformer capacity should be allowed per horse-power of motors installed.

General Electric single-phase motors are well adapted to the operation of all kinds of machinery by means of belts and gears, or when direct-connected to loads requiring only moderate starting torque, as in the case of governors, blowers, etc., to which they may be direct-connected with rigid couplings. When greater torque is required at the moment of starting, as in case of pumps under head, clutch couplings should be used. When gearing is to be employed, the ordinary pulley can be removed from the clutch sleeve and a pinion substituted; this is preferably made of rawhide, in order to reduce the noise.

Digitized by Google

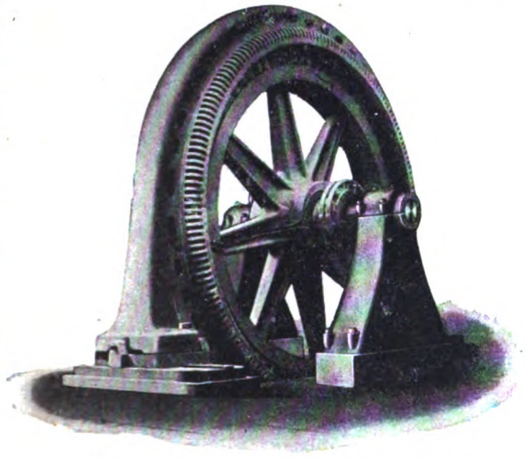
New Generators for the Ottumwa Railway and Light Company.

The accompanying photograph was recently taken in the railroad yards of the Western Electric Company at its new manufacturing plant at Hawthorne, Ill. The view shows a line of five cars, just loaded and ready to be moved, consigned to the Ottumwa Railway and Light Company, of Ottumwa, Iowa, which is remodeling and modernizing its power plant. The Ottumwa company has lately changed hands and is now under the management of H. M. Byllesby & Company, who are installing new apparatus to increase the capacity. This company furnishes power for both the Ottumwa Street Railway and the city's commercial and street lighting systems.



CONSIGNMENT FOR THE OTTUMWA RAILWAY AND LIGHT COMPANY LEAVING RAILROAD YARDS OF THE WESTERN ELECTRIC COMPANY, HAWTHORNE, ILL.

These cars are loaded with two Western Electric generators. The first is one of the new type R revolving-field alternating-current generators of 500 kilowatts' capacity, 1,150 volts, three-phase engine type, operating at 100 revolutions per minute, a view of which is shown herewith. This machine embodies in its design the latest ideas in the art of designing alternating apparatus. The ventilating spaces



WESTERN ELECTRIC ENGINE-TYPE, REVOLVING-FIELD, 500-KILOWATT, 1,150-VOLT, THREE-PHASE GENERATOR.

provided at frequent intervals ensure uniform and minimum temperature of the core, and by the arrangement of the coils at the end of the stator the windage of the rotor is utilized for ventilation of the armature coils, as well as the core, thereby preventing excessive or injurious rise of temperature under heavy overload.

The second machine referred to is a 500-volt, direct-current railway generator. This machine is one of the Western Electric Company's well-known type L generators, so many of which are used by street railway companies throughout the country. This is also of 500 kilowatts' capacity of the engine type and will operate at 100 revolutions per minute.

Enlargement of Equipment of the Locke Insulator Manufacturing Company, Victor, N. Y.

The rapid expansion of the business of the Locke Insulator Manufacturing Company, Victor, N. Y., has taxed to the utmost all the facilities of the old power plant, until at the present time the construction of a new and larger one has become imperative.

The new building, for which foundations have already been laid, is to be ninety feet by ninety feet, of approved concrete construction; one side being parallel to, and fifteen feet below, the tracks of the New York Central & Hudson River Railroad, enabling hard and soft coal to be unloaded directly to the bunkers.

The boiler room, which measures approximately forty-five feet by ninety feet, will contain 600 horse-power in horizontal tubular boilers, hand-fired with a mixture of buckwheat and soft coal, necessary draught being provided by a large engine-driven fan.

Engines, generators and high-tension testing transformers will occupy the remainder of the building. There will be two power units, one for day load and a smaller one for night load, the demand for power being practically continuous. The smaller unit of sixty kilowatts' capacity is made up of a Skinner engine running at 300 revolutions per minute, direct-connected to a three-phase sixty-cycle, 440-volt alternator. The larger unit, a low-speed Corliss, will be direct-connected to a three-phase, sixty-cycle, 440-volt alternator of 150 kilowatts. These two machines will supply light, power and current for testing all through factory as well as supply power for street and residence lighting in the village of Victor.

The plant has been laid out for the most economical working under the peculiar conditions existing in an electrical porcelain pottery, and while the present plans as outlined will provide ample power for the present needs, provision has been made for future increase.

Meeting of the Sales Managers and Representatives of the Buckeye Electric Company.

During the week of August 20 the sales managers and representatives of the Buckeye Electric Company, Cleveland, Ohio, held a three-day meeting at Cleveland. The representatives of the company all expressed themselves enthusiastically concerning the year's business and the prospects for a large demand for the coming season. The company announces that it has been working at its fullest capacity in order to create a supply of stock which would place it in a position to make instant shipments of orders of any magnitude. The Buckeye tantalum twenty-two-candle-power lamp, the focal type "Gem" lamp and the high-efficiency, high-candle-power "Gem" units manufactured by the company are all meeting with great success and the company expects a very large business during the coming year.

Digitized by Google

Meeting of the Shelby Electric Salesmen's Association.

The accompanying illustration shows a group picture of the sales department force of the Shelby Electric Company, Shelby, Ohio. The company has organized the Shelby Electric Salesmen's Association, including the personnel of its sales departments. C. W. Cartwright, of the Boston office, is president of the association; W. E. Groves, Philadelphia, vice-president; J. G. Van Horn, Shelby office, secretary. The company holds a meeting each year and the entire corps of factory employés is taken to some resort along Lake Erie for an outing. At these meetings everything pertaining to the lamp situation is gone over. The company endeavors to take into consideration the desires of the users of incandescent lamps when framing its policy for the year's work. The company is very widely represented; in fact, it is asserted that its representation is the most complete of any exclusive lamp manufacturer in the country.

CONVENTION OF OFFICE REPRESENTATIVES AN D BRANCH-OFFICE MANAGERS OF THE SHELBY ELECTRIC COMPANY, SHELBY, OHIO.

Reading from the right the make-up of the group is as follows: J. R. Dudley, Buffalo; W. Love, Michigan; E. H. Allen, Louisville; William Ellis, Portland, Ore.; C. W. Cartwright, Boston; J. C. Fish, president of the Shelby Electric Company, Shelby; W. E. Groves, Philadelphia; F. M. Haskell, eastern Pennsylvania and New Jersey; George W. Sheeler, Baltimore; C. A. Schettler, Cleveland; F. M. Brown, Pittsburg; George Austry and H. W. Strock, Indianapolis. Directly behind Mr. Strock is T. P. Gleeson, and then F. B. Smiley, St. Louis; Col. Jonas Feighner, Ohio; P. M. Fletcher, New York city; J. G. Van Horn, Shelby; W. S. Reynolds, Detroit; H. K. Bowman, Cincinnati; George Loring, New York city; C. M. Hopwood, Wisconsin; R. P. Bricker, Shelby; G. W. Fowler, western Indiana; C. C. Skiles, W. W. Van Horn and W. H. Myers, Shelby; W. P. Clawson, Chicago; O. D. Pierce, San Francisco.

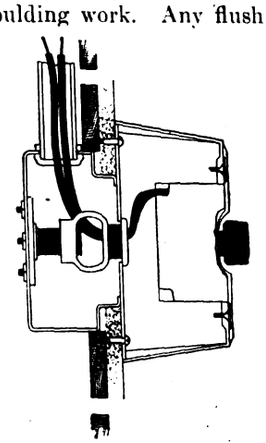
The Gleason Universal Moulding Box.

The Gleason universal moulding box, made by John L. Gleason, 290 South street, Jamaica Plain, Mass., illustrations of which are shown herewith, is designed to facilitate the mounting of any fitting for electrical purposes in conjunction with moulding work. Any flush switch or receptacle will fit this box, and its flush plate will just cover the face of the box. For mounting surface fittings, such as safety switches, wall sockets, rosettes or bracket or pendant tubes, a universal lid is furnished. This feature is shown in the accompanying illustrations. For use as a junction box a blank lid is furnished in place of the universal lid.

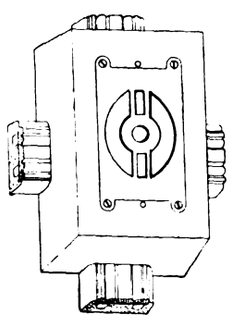
For connecting to a conduit system an orifice is left in the back of the box, where the conduit may enter, and the box is fastened to the conduit system with a conduit bushing making up against the back plate. These back plates are separable, so that if it should be necessary to enlarge any of the moulding ports to use a three-wire moulding or any unusual size, it would facilitate the use of a hack saw, file or emery wheel in making the alteration in the ports. The moulding ports are steel chills shrunk into the iron. The chill may be knocked in or knocked out, leaving a perfectly clean port, without detriment to any other part of the box.

These appliances are sufficiently deep to allow for the conduit bushing and wires under the deepest push-button switch or flush receptacle. The appliances are also useful for protecting flush receptacles on floors, the conduit entering from underneath.

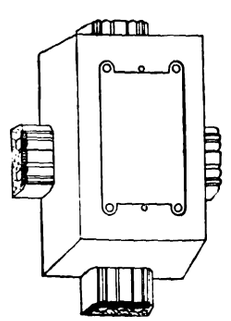
Mr. Gleason also manufactures a similar box arranged for exposed iron conduits.



CROSS-SECTION SHOWING APPLICATION TO CONCEALED OUTLET ON WALL OR CEILING WITH FLUSH SWITCH MOUNTED.



PERSPECTIVE VIEW, SHOWING UNIVERSAL LID.



PERSPECTIVE VIEW, SHOWING BLANK LID

Digitized by Google

The "Star" Toggle Bolt.

The accompanying illustrations show the application of the "Star" toggle bolt, manufactured by the Star Expansion Bolt Company, New York city, for making fastenings to tile, hollow brick, metal, thin marble, wood, and metal or wire lathing.

The "Star" toggle bolt consists of a head and a regular machine screw. Any machine screw will fit the toggle heads.

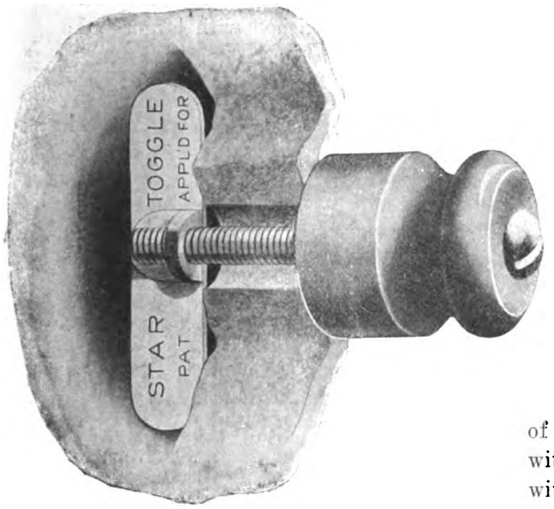


FIG. 1.—"STAR" TOGGLE BOLT INSERTED IN WALL.

Fig. 1 shows the toggle bolt being inserted into the wall. The screw is put through the article to be fastened and into the nut in the toggle head. The toggle is inserted through the hole in the wall and fastened tight, and, after having turned, automatically adjusts itself in place.

Eureka Electric Flat-Irons.

Probably no form of electrically heated apparatus for domestic service has won so wide and rapid a popularity as the electric flat-iron. The numberless little conveniences which can be effected with this apparatus has gained for it instant recognition.

One of the most successful irons on the market to-day is the line designed and made by the W. J. Barr Electric Manufacturing Company, of Cleveland, Ohio. This company, in addition to a wide range of electrical heating apparatus, manufactures the "Eureka" line of flat-irons in thirty different styles, ranging from the diminutive traveler's iron, weighing three and one-half pounds, to the thirty-pound tailor's goose.

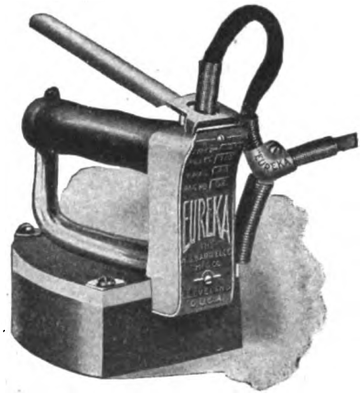
Not a little of the success of this line of irons is due to their attractive appearance. The irons are designed on artistic lines, and the heavy nickel finish ensures a lasting good appearance. Because of an improved form of construction the makers are able to claim a very high efficiency and a great length of life. In fact, it is stated that, with reasonable care the heating element in the "Eureka" iron will last at least ten years. A feature of this apparatus, however, is the ease with which renewals may be made, if, through accident, this should be desirable. The top

"EUREKA" ELECTRIC FLAT-IRON.

of the iron has no electrical connection with the bottom, and the heating element with its cord connection may be easily removed with a screw-driver.

Another feature of the design is the arrangement of the heating coil. This is so placed that heat is delivered without loss to the surface where it is needed, the coil covering the entire bottom and extending into the point, where for certain kinds of work a well-heated surface is essential.

A patent spring cord-protector takes the strain where the cord enters the iron and eliminates wearing at that point.



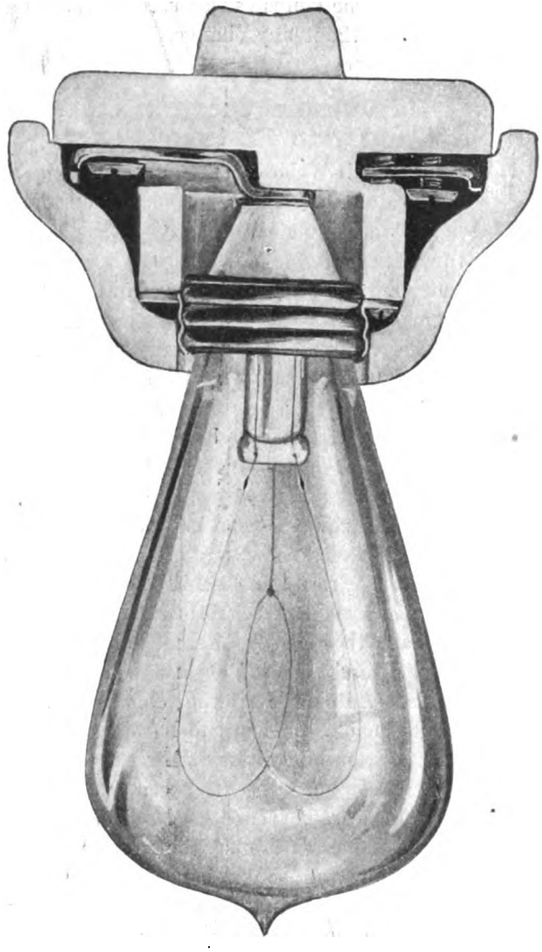
"EUREKA" ELECTRIC FLAT-IRON WITH AUTOMATIC CUTOUT.

Where conformity to the underwriters' rule necessitates an automatic cut-off when the iron is not in use, the patented device for accomplishing this, recently brought out by the company, will satisfy this condition. This automatic cut-off is placed in a small box, conveniently placed, and heavily nickeled, and fitted with a removable face-plate, facilitating examination and repair.

In line with the development now taking place throughout the country, the company has worked out a plan for cooperating with central stations in the introduction and sale of these irons and other apparatus, which is meeting with a vary satisfactory measure of success.

Weatherproof Incandescent Lamps.

The accompanying illustrations show an incandescent lamp and socket placed on the market by the Rooney Electric Lamp Company, 155 East Twenty-third street, New York city, for use particularly on circuits where conditions of exposure render a weatherproof installation



WEATHERPROOF INCANDESCENT LAMP AND WEATHERPROOF SOCKET.

necessary. Thus, for signs, spectacles, outdoor decorations and the like, these lamps and bases will be especially applicable.

As may be readily noticed there is a considerably increased insulating distance

Digitized by Google

between the metal parts of the lamp base. Glazed porcelain buttons are used as separators, these shedding the moisture, and the non-absorptive properties eliminating the danger of electrolytic action or short-circuit.

An interesting application of these lamps is found at Luna Park, Coney Island, where it is customary in cleaning to flush the board-walks around the lagoon with salt water. In draining off the walks the salt water runs over the lamps around the sides of the lagoon, so a special socket is used, extra thicknesses of porcelain being used between all live parts of the device, and the socket is so constructed that it sheds water very readily.

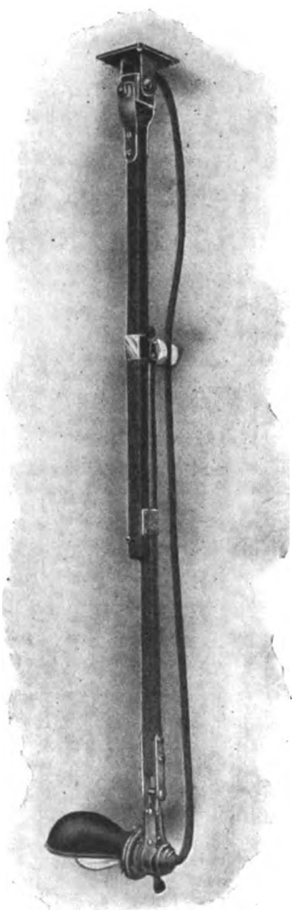
Prior to the installation of these sockets and bases numerous circuits were found defective after every heavy storm, but since the change has been made these troubles have been in large part eliminated. The lamps can be used in Edison sockets without any change.

Adjustable Incandescent Lamp Fixtures.

The Gail-Webb Manufacturing Company, Buffalo, N. Y., has placed on the market a complete line of adjustable fixtures and portables for use with incandescent lamps in shops, offices, draughting rooms, etc.

The Universal electric light holders, one of the company's products, is shown in the accompanying illustration. This form of fixture is designed to meet the demand for a thoroughly practical and durable low-priced adjustable fixture for shops, draughting rooms, etc. It allows the lamp to be swung to any point within a circle ten feet in diameter, to be raised or lowered through a distance of half the length of the holder and twisted and turned to any conceivable angle. Automatic friction clamps at all joints enable the lamp to be moved into any position and to stay wherever placed. The holder has recently been improved by using case-hardened steel swivel joints in the universal joints, wing nuts on the lower joint, and offset bands at the sliding joint, allowing free motion of the wooden rods under all conditions. The use of this fixture in shops not only does away with all temptation for the workman to tie his lamps back with strings or to hang the drop-cords on nails or on the machinery itself—a common source of danger in many shops—but also allows the light to be brought to any desired point and protects the workman's eyes while giving direct light on his work. In draughting rooms this device is of great service in furnishing the light at any point over the drawing board. It is made in three finishes, plain black, nickeled or oxidized.

Another style, a neat and attractive adjustable wall fixture, is manufactured by this company, the main features of which are also incorporated in an adjustable ceiling fixture and an adjustable portable. The wall type, which is two and one-half feet long when telescoped and four and one-half feet extended, has a ball-and-socket joint at the upper end, allowing the rods to stand at any angle, while the joint at the lower end and the sleeve attached to the arm afford means of turning the lamp in any direction. Once adjusted, the joints require no further attention. The ceiling type differs from the wall type only in the bracket, which is made suitable for ceiling attachment; and in the lengths of the arms, these being varied to suit different heights of ceilings.



Adjustable Incandescent Lamp Fixture.

The portable has the ball-and-socket joint at the base and the same means of turning the lamp as are used in the wall and ceiling types. It is provided with a neat iron base, sufficiently heavy to ensure stability under all conditions.

These fixtures are proving very desirable for offices, draughting rooms, etc.

New Type Midget Plug and Receptacle.

The Marshall Electric Manufacturing Company, Boston, Mass., has recently made improvements and alterations in its No. 521 midget plug and receptacle, which is now furnished with larger holes

Midget Plug and Receptacle.

to take the ordinary screw-driver for fastening the cord wires.

The points of the plug contact are also tapered for quick insertion in the receptacle. Where desired, these receptacles are also furnished with an insulating paper sleeve around the receptacle which can be easily rotated to expose the contact wires and screws.

These receptacles are carried in stock at the New York office, 227 Fulton street, and the Chicago office, 169 Adams street, of the Marshall Electric Manufacturing Company, as well as at the Boston works.

The Buckeye Two-Cycle, Single-Acting Gas Engine for Generator Driving.

The Buckeye Engine Company, Salem, Ohio, has developed a new type of two-cycle scavenging and single-acting engine particularly adapted for direct-coupled generator driving, and fed by suction producer-gas. The engine will work equally well with other fuels, such as natural, illuminating and blast-furnace gas, gasolene, distillate, etc. The engine here described is built in sizes from twenty-five brake-horse-power to 500 brake-horse-power. For powers above 500 brake-horse-power the Buckeye Engine Company builds double-acting engines of both the two and four-cycle types, of any capacity required.

The single-acting engine has two motor cylinders, two fuel-pumps, and two air-pumps, and is equipped with two cranks set 180 degrees apart. This gives two

Digitized by Google

working impulses to each revolution of the crank shaft. The cranks are exactly opposed, and are equipped with two sets of pistons of equal weight, the engine needing no counterweighting and turning with a nearly perfect running balance.

ber (1) through valve (11) and port (19), forcing out the spent gases. A section through the combustion chamber at AA is circular, and the conical form of the combustion chamber assists in spreading the scavenging charge evenly behind the

When piston (2) has covered ports (14) on the return stroke the compression begins in the motor cylinder, provided valve (10) has closed; this feature being discussed later.

The compression being complete, the

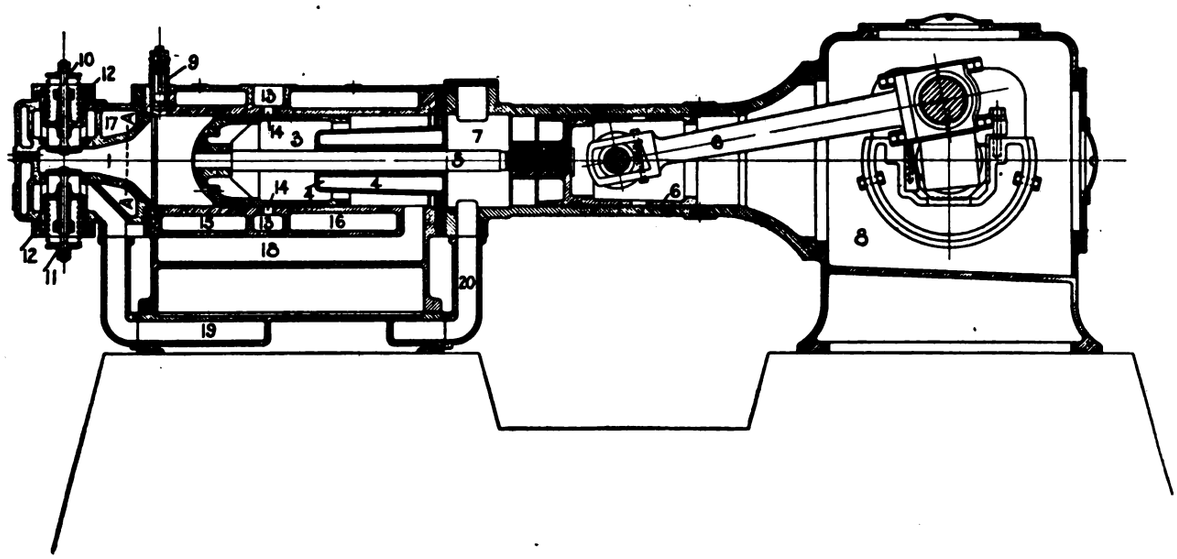


FIG. 1.—VERTICAL SECTION THROUGH ONE MOTOR CYLINDER, ONE GAS AND ONE AIR PUMP.

The cycle of operation is as follows:

The piston in crosshead barrel (46) Fig. 2 furnishes air at a pressure of about eight pounds per square inch for scavenging combustion chamber (1), Fig. 1, and piston in crosshead barrel (45), Fig. 2, compresses air at the same pressure

spent charge. Somewhat later, valve (10) opens, admitting into the cylinder a charge of explosive mixture which has been compressed in chamber (3) in front of piston (2). It is thus seen that each motor piston compresses its own explosive mixture but receives its compressed air for

charge is fired in the usual way, firing occurring alternately in the two motor cylinders.

A valuable characteristic of this engine is that so much sought for by all intelligent gas engine designers, namely, constant compression and constant mixture

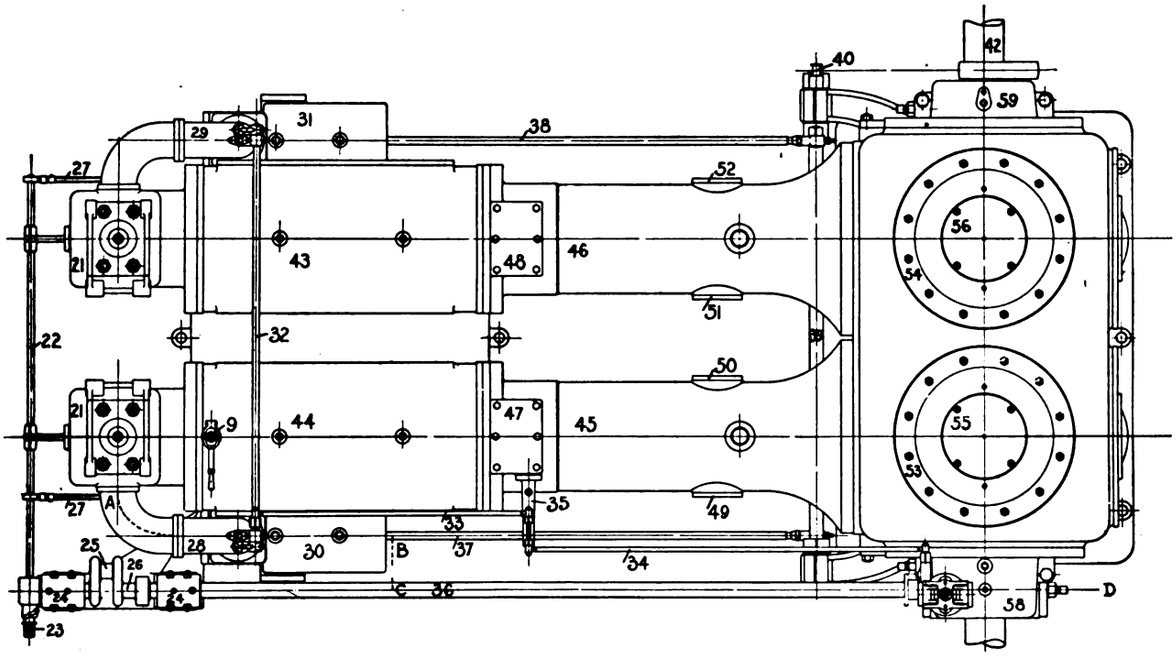


FIG. 2.—PLAN OF ENGINE.

for scavenging combustion chamber in cylinder (43), Fig. 2. Assuming Fig. 1 to be a section through the right-hand engine, and piston (2) just uncovering ports (14), Fig. 2, enters the combustion cham-

scavenging from the opposite engine. Since valves (10) and (11) are independently driven, the relative timing of the admission of the scavenging air and the mixture is under perfect control.

at all loads combined with quick and certain response to sudden change of load.

The quantity of air passing through the air-pumps is constant at all loads, but the amount of air and gas handled by the

Digitized by Google

fuel-pumps varies according to the load carried.

There are two sets of igniters in each combustion chamber and the engines are also provided with jump spark ignition apparatus. The change from one system to the other can be made in a few minutes' time.

The head is equipped with a water-jacketed sleeve. This sleeve is babbitted and bored out, and on account of its considerable length, the speed of reciprocation, and low pressures on either side, there is no leakage through the sleeve and it is subject to no wear.

In the wrist end the connecting rod has wedge adjustment, and in the crank end is of the marine type.

The main bearings are fitted with babbitted shells of ample area and have complete means for alignment and taking up wear.

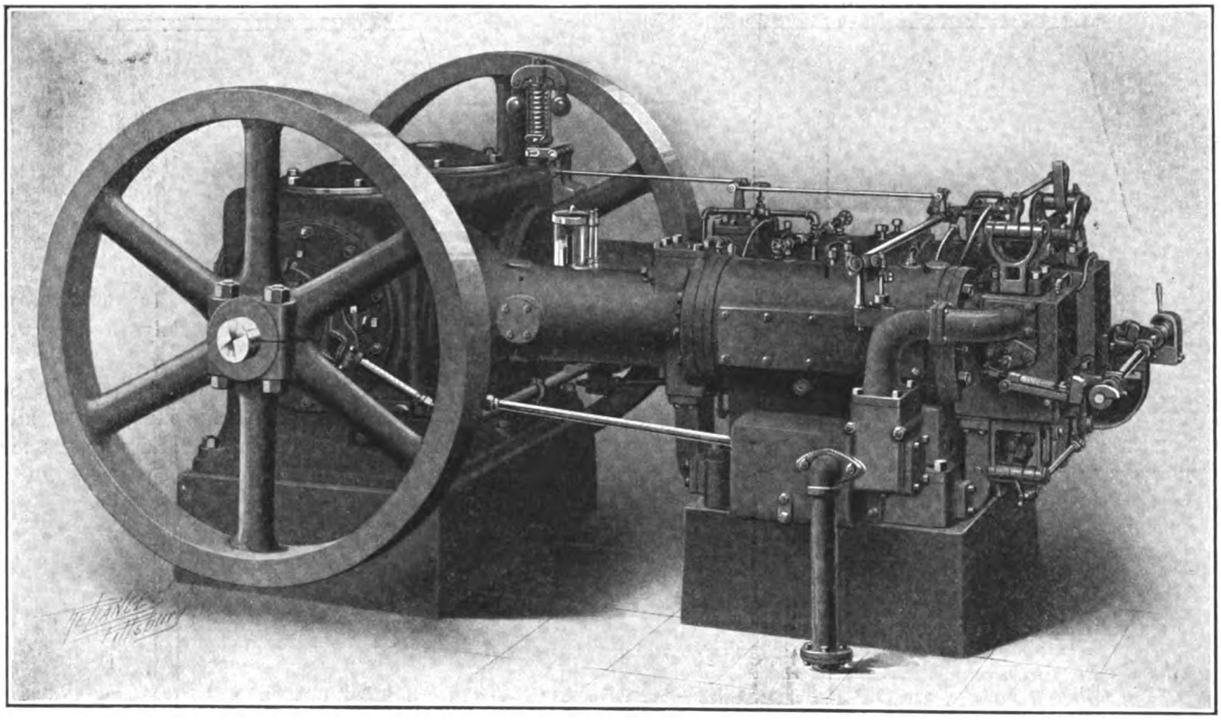
The crosshead pistons and main bearings are oiled by splash oiling. The spiral gears driving the lay shaft are immersed in oil. Bearings for the valve cranks and cranks for operating fuel-valves have ring oilers.

On account of the combined cooling action of the water jackets and the scavenging air, a very high degree of compression can be carried. Another important feature in this engine is that expansion can be carried to any point whatever. The fuel-valve can be so set that the compression may begin, say, at half stroke; in this case expansion would be to twice the volume admitted. In the smaller sizes this feature will not be made use of, but in the larger sizes an increased thermal economy is thus available.

Suction producers require a variable amount of draught in their operation, due to varying conditions of the fuel-bed. Here advantage is obtained, since the fuel-pump in this engine has ample capacity to supply the engine with fuel, no matter what the draught may be within large limits, and a producer can in emergencies be forced beyond its rated capacity without seriously diminishing the power of the engine.

The engine is also self-cleaning, making it unnecessary to take off heads and valves for cleaning. All dirt is blown out, and after many months of continuous service on suction producer-gas the combustion chamber has been found absolutely clean.

An engine of about seventy-five horse-power, with cylinders of nine inches diameter by twelve inches stroke, has been found by repeated tests to develop a mechanical efficiency over eighty-five per cent, the pump-work being included as friction.



TWO-CYCLE, SINGLE-ACTING GAS ENGINE BUILT BY THE BUCKEYE ENGINE COMPANY, SALEM, OHIO.

The directors of the Midland Railway, England, have approved of a scheme to convert a portion of their line to electrical working. The full details of the project are not yet settled, but it is said that the commencement of the scheme will be the equipment of the lines between Lancaster, Morecambe and Heysham Harbor, and that a single-phase system will be adopted.

National Air-Compressors.

The National Brake and Electric Company, Milwaukee, Wis., has completed a new line of motor-driven compressors, several views of which are shown in the accompanying illustrations. This compressor differs from other types in that the motor is placed on top of the crank chamber. The motor and compressor are both separate, self-contained and distinct units, making the complete compressor a compact and rigid unit. The motor bearing at the pinion end forms a cover for the top of the gearing. There is a one-half-inch space between the crank chamber cover and the motor base, which prevents the heat being communicated from the compressor to the motor. This separate cover for the crank chamber provides the necessary bracing and stiffening for the crank chamber casting.

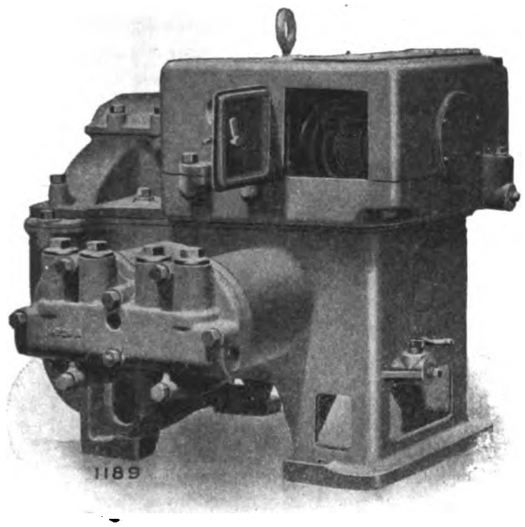
The crank shaft is provided with a third bearing in the centre, which steadies the crank shaft and supports it at its weakest place, doing away with any tendency of the shaft to fracture in the centre. The compressor runs very quietly and free from vibration with this third bearing, and the efficiency and life of the pump and gearing are materially increased. The crank shaft and gear are removed by lifting them straight out of the crank chamber, it being unnecessary to first remove the gear from the shaft. This increases the accessibility of the pump and

Digitized by Google

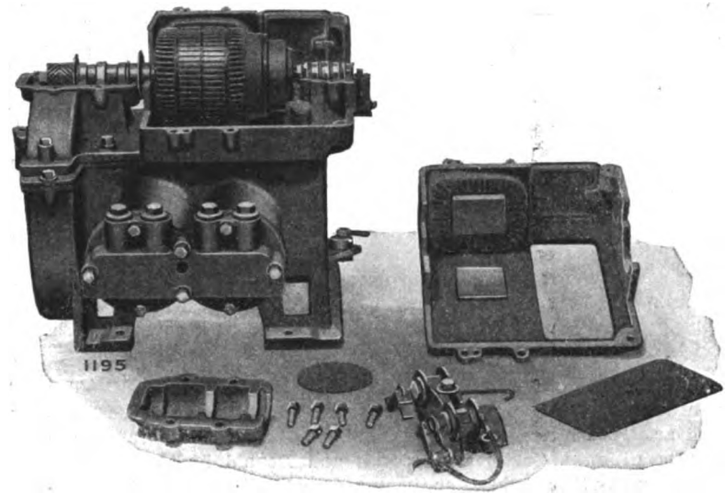
considerably reduces the time of taking apart and putting together again.

The standard method of splash lubrication is used for the working parts of the compressor. The gear and crank move in a bath of oil and splash it all over the moving parts of the compressor. The gear case is cast as an integral part of the crank chamber, making a very rigid pump base and reducing the number of loose parts.

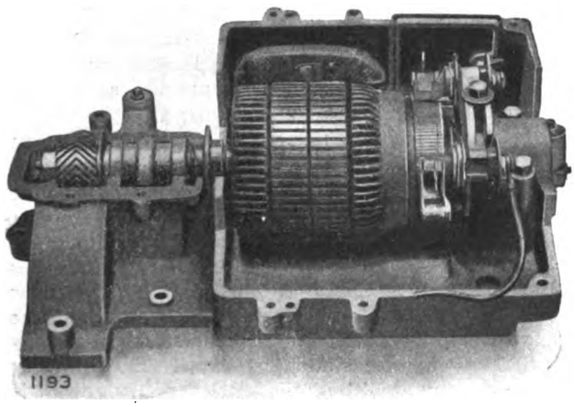
The compressor is a standard two-cylinder, double-action type with trunk pistons. The piston rings are of the Dunbar type. The sections of the rings are carefully fitted by hand, and the complete ring is then ground true. The pistons are each provided with one piston ring. The piston wrist pin, on which the tail end of the connecting rod works, is of hardened steel ground true and pressed into place. The connecting rod head is connected to the body of the rod by means of a hinge and hinged I-bolt.



TYPE A-4 NATIONAL AIR COMPRESSOR COMPLETE.



UPPER HALF OF MOTOR FRAME REMOVED, SHOWING ACCESSIBILITY.



LOWER HALF OF MOTOR.

The discharge valves are placed toward the centre, and the suction valves toward the outside of the head. The discharge pipe goes straight out from the valve head to the main reservoir, there being no necessity for attaching elbows. The suction has two openings, one at each side of the valve head. Either or both can be used. They are provided with straining screens, and the air can either be taken straight into the cylinder or piped from the inside of the car or from the car roof. The suction and discharge valves are interchangeable and are of solid cold-drawn tubular steel, being seated by gravity aided by air pressure, and no springs nor auxiliary devices are required.

The gear and pinion are a standard herring-bone pattern with fine teeth. The gear is of open-hearth cast steel, and the pinion of high carbon steel. They are made in two halves and riveted together.

The lower half of the motor magnet frame is a steel casting, which also carries the bearings and forms a cover for the upper half of the gear. The diameters of the shaft and bearing at the pinion end have been increased. An oil-thrower has been attached just inside of the pinion end so as to prevent the oil from the gear and pinion working into the armature bearing and flooding the motor.

The motor is of the company's standard four-pole, consequent-pole type, with series-wound armatures. Two field coils are arranged in a horizontal plane to reduce the overall height of the motor compressor. The field coils can be quickly removed, the one by merely taking off the top half of the motor, and the other by taking off the top half of the motor and removing the armature.

Particular attention has been paid to the designing of the brush gear, notably in regard to the insulation. Compressor motors operating under a street car are liable to get covered with oil and dust, and unless the insulators have ample margin they will not last. In the new type of brush-holder the insulation has been liberally designed. The external leakage surface is about one and one-quarter inches. An insulating shield has also been provided between the bearing and commutator to prevent any chance of a flash-over at that point. The brush-holders have been provided with an improved patented spring tension which is constant over a wide range and is capable of being easily and accurately adjusted.

The motor is completely encased to protect it from the weather and do away with the necessity of enclosing the motor in a suspension box. Inspection doors are provided on the side of the motor casing, and a hand hole on the top of the motor casing for examination of the commutator and brushes.

The arrangement of oil-filling and oil-drain holes is such as to be convenient and sightly. The vent holes for the crank chamber are cast in the side of this chamber, being suitably protected to prevent any danger of oil splashing out, and are of sufficient area to do away with any tendency to force the oil vapor and oil from the crank chamber into the motor bearing and armature.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

CABLE TO ICELAND—The Great Northern Telegraph Company has completed the laying of its cable connecting Iceland with many far-away points, and the line has been opened for public service. The cable that will connect Iceland with the Danish capital will be opened October 1.

TO DEVELOP BIG BEND WATER POWER—R. Cross, of Spokane, president of the Big Bend Water Power Company, recently incorporated for $1,500,000, to develop power on the Spokane river, twenty-eight miles from Spokane, announces that Spokane and eastern capital is interested in the project and that a largely increased force will soon be at work on the dams and spillways. It is purposed to build a sixty-foot dam, a modern power-house and develop 16,000 horse-power. Mr. Cross says this can be done at a cost of $21.90 the horse-power.

KENTUCKY ELECTRIC COMPANY INCORPORATED—The Kentucky Electric Company, with a capital stock of $500,000 has filed articles of incorporation at Louisville. The incorporators are Lawrence Jones, Saunders P. Jones and Donald McDonald. The new company is organized for the purpose of taking up the Atherton-Jones ordinance, giving the parties named the lighting contract of the city. Peter Lee Atherton is the heaviest stockholder. This lighting franchise was sold at public auction on August 20 to Lawrence Jones, the highest bidder, for $100,150.

COST OF IMPROVEMENTS AND REBUILDING OF THE UNITED RAILWAYS AND ELECTRIC COMPANY—The effort being made by the United Railways and Electric Company to better its power facilities directs attention to the work done by the company since the fire. Not only has it provided new cars for most of its lines, but practically all of its track has been reconstructed. In addition, much special work has been accomplished. The expenditures might be summarized about as follows: cars, $2,250,000; tracks (including special work, $1,400,000); improvements to power plant, $1,000,000.

ADDITIONAL ELECTRIC POWER FOR BUFFALO—By October 1 the Cataract Power and Conduit Company expects to bring to Buffalo from the Canadian side 24,000 additional electrical horse-power, thus making its daily supply at least 75,000 horse-power. The extra energy will be brought over a transmission line 210 feet over the Niagara river, strung between two towers now being erected. From the towers, one on each side, the line will drop into a transformer station which the power company is erecting adjacent to the old Niagara street-car barns. The power will come from the power-house of the Canadian Niagara Power Company at Niagara Falls.

POSSIBLE MONOPOLY OF PEND D'OREILLE POWER—It is stated that rights to every pound of power in the waters of the Pend d'Oreille river between Big Falls, northeast of Spokane, and the international boundary, has been cornered by the Pend d'Oreille Development Company, of which David T. Ham, of Spokane, is president, and George S. Canfield, who has just completed an investigation and preliminary survey, estimated that at least 100,000 horse-power can be developed, with the cost at a minimum compared with other powers. The natural fall of the river through "Z" canyon is from sixty to eighty feet, and there is a possible fall of approximately 250 feet for power. The concern, which is backed by Spokane capital, purposes building a large plant and transmit power as far north as the boundary.

NEW EQUIPMENT FOR GUADALAJARA, MEXICO—La Electra, S. A., the Spanish light, power and street railway company, has placed orders for equipment and supplies for the electric street-railway system of this city that aggregate in value more than $500,000. The order for cars for the new street-railway system goes to the McGuire-Cummings Manufacturing Company, of Chicago. This concern will build forty cars at an approximate cost of $6,000 each. The cars will be thirty feet long and will weigh more than eight tons each. The United States Steel Products Company will supply the iron trolley poles and copper wire for the new system. Poles to the number of 1,800 have been ordered. The necessary copper wire will cost about $200,000. The dynamos, switchboards and other electrical equipment required for the operation of the street-car lines will be purchased from the General Electric Company. There will be three dynamos of 600 horse-power each, and two dynamos of 200 horse-power each.

COLORADO LIGHTING PLANT CHANGES OWNERSHIP—The Standard Light and Power Company has bought the plant of the Durango Light and Power Company, which is said to be worth $300,000. The Standard is a new company which recently obtained a franchise and intends erecting a new plant to be run by water power, obtained from a reservoir, the water for which will be taken from Junction and Hermosa creeks. The new plant will cost $250,000. The new company will operate the old plant until the new one is finished. By the terms of the franchise, the Standard company has six months in which to commence work and twenty months to finish. The present plant is operated by steam and will be kept in readiness to start whenever there is a breakdown. The Standard people say they will hold their franchise, and by doing so must make a reduction in light and power rates of about thirty-three and one-third per cent by the provisions of the franchise. The Durango Light and Power Company has furnished light for Durango for twenty years.

DAMAGES FOR McCALL COMPANY IN CONDEMNATION PROCEEDINGS—The jury in the condemnation proceedings instituted by the Susquehanna Electric Company against the McCall Ferry Power Company to value a strip of land along the river has concluded the matter by awarding the McCall company $56,000 damages, the railroad company $500 and each tenant in the houses who will be compelled to vacate $50. The Susquehanna company is a Maryland corporation which owns the old paper mill property and is the successor to the Susquehanna Water Power Company. The Harford company needed the land of the McCall company for the purpose of backing water from its proposed dam, which is contemplated to develop 25,000 horse-power to furnish electricity to Baltimore, Havre de Grace and Wilmington. The Susquehanna Power Company proposes to build its plant in Maryland, south of that of the McCall Ferry company, which is near the Mason and Dixon line. This company is a corporation separate from the Susquehanna Electric Power Company. The latter company owns property below that of the Susquehanna Power Company, and as yet has made no move toward erecting a plant.

NEW TRANSMISSION LINE FOR THE UTICA GAS AND ELECTRIC COMPANY—An electric power transmission line, which the Utica Gas and Electric Company has had under construction for a couple of months, has been completed. The company has started to transmit power eastward, through Frankfort to Ilion, Mohawk, Herkimer and Little Falls. About 1,000 horse-power has been supplied without interruption, and this will be increased by degrees. With this line completed, there have been connected the Trenton Falls power station of the Utica Gas and Electric Company and the Dolgeville water-power station of the Herkimer County Light and Power Company at Little Falls. But very little work is to be done to connect the Little Falls company with the transmission lines of the East Creek Electric Light and Power Company, thus forming a continuous transmission line from Trenton Falls to Canajoharie, a distance of about fifty miles. The electric plants in this territory are being materially increased, and eventually the combined plants will have an aggregate capacity of upwards of 35,000 horse-power. Later, a station on Fish creek, near Rome, will supply an additional 7,000 horse-power. The general plant of the transmission line contemplates extending as far west as Oneida, taking in Rome and intervening villages, and as far east as Amsterdam and Schenectady.

Digitized by Google

OBITUARY NOTES.

MR. CHARLES R. FABEN, manager of the Toledo (Ohio) Gas, Electric and Heating Company, died suddenly at Toledo on August 28, of heart trouble.

MR. E. T. HANNAM, inventor of the "Atlas" water-tube boiler, died at Chicago, Ill., at four P. M., Saturday, August 18. Mr. Hannam was about to enter a train with Mr. J. P. Johnston, of the Atlas Engine Works, to go to the latter's home at Evanston. His death was due to heart disease. Mr. Hannam had been connected with the Atlas company for the past three years, and had grown steadily in the esteem of his associates, being recently promoted to assistant manager of sales of the water-tube boiler department. He was just entering upon his new duties when he was stricken. His death is a distinct loss to the company, and will be regretted also by a host of friends and admirers.

LEGAL NOTES.

LIABILITY OF COMPANY IN AFFORDING PROTECTION TO A STRANGER—A corporation engaged in the generation of electricity is held, in Ryan *vs.* St. Louis Transit Company (Mo.). 2 L.R.A. (N.S.) 777, to be bound, upon contracting with a stranger for the performance of work within its buildings, to keep its wires so protected and insulated as to be safe for the latter's workmen.

DOBROWOLSKY PATENT SUIT—The United States Circuit Court of Appeals for the Seventh Circuit has handed down a decision affirming the lower court in the case of the General Electric Company *versus* the Kuhlman Electric Company. The suit refers to the alleged infringement of the Dobrowolsky patent No. 422,746, owned by the General Electric Company. The Kuhlman company was manufacturing polyphase transformers, in which the cores of the different elements were combined in an integral structure. The patent was sustained by the United States Circuit Court, and the Kuhlman structure held to be an infringement thereof.

NEW MANUFACTURING COMPANIES.

CAMDEN, N. J.—The Flasher Sign Company has been incorporated to manufacture and deal in electrical signs. The capital is $50,000, and the incorporators are: R. E. Thompson, Jr., L. A. Wilkins and Wilfred B. Wolcott.

NIAGARA FALLS, N. Y.—The Kirkwood Electrical Company, of Niagara Falls, has been incorporated at Albany with a capital stock of $10,000. The concern intends to do general contracting and electrical work of all kinds. The directors of the company for the first year are: William C. Winchester and Robert L. Laven, of Niagara Falls, and Nathan H. Jewett, of Buffalo.

ELECTRICAL SECURITIES.

A monetary stringency effectually checked the bull campaign which has been swinging along without abatement for several weeks. Along with this stringency a significant feature was the decrease in outside public interest in the market. At present it appears as if the stock market's development will be mainly guided by monetary conditions. It is unfortunate that this has come on the eve of the marketing of what promise to be the largest crops on record, and matters are further complicated by the understanding that general trade and commerce is in a remarkably strong position. There are, however, many well-founded hopes that a large gold import movement and relief from the United States treasury will improve the situation. Railroad earnings continue very favorable. Activity in the iron and steel trade is reported to be of great proportions.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 1.

New York:	*Closing.*
Allis-Chalmers common	19
Allis-Chalmers preferred	46
Brooklyn Rapid Transit	76¾
Consolidated Gas	139½
General Electric	167
Interborough-Metropolitan common	37¾
Interborough-Metropolitan preferred	78
Kings County Electric	160
Mackay Companies (Postal Telegraph and Cables) common	73
Mackay Companies (Postal Telegraph and Cables) preferred	71
Manhattan Elevated	148
Metropolitan Street Railway	106
New York & New Jersey Telephone	125
Western Union	91½
Westinghouse Manufacturing Company	153

The directors of the General Electric Company have declared the regular quarterly dividend of 2 per cent, payable October 15 to stockholders of record September 15.

A regular quarterly dividend of 1 per cent on the preferred shares and a regular quarterly dividend of 1 per cent on the common shares of the Mackay Companies will be paid on October 1 to shareholders of record as they appear at the close of business September 15. The transfer books will be closed from September 17 to September 29, inclusive.

The Kings County Electric Light and Power Company has made application to the state commission of gas and electricity for consent to increase its capital from $8,200,000 to $10,000,000. The commission meets September 10 to consider the application.

Boston:	*Closing.*
American Telephone and Telegraph	133
Edison Electric Illuminating	239
Massachusetts Electric	69¾
New England Telephone	129
Western Telephone and Telegraph preferred	86

The annual report of the Edison Company, of Boston, for the year ended June 30 last showed 11.2 per cent earned on the $11,488,100 stock, against 9.4 per cent the previous year. The operations for the past fiscal year were by far the best in the history of the company. Two factors were responsible for the good statement for the year, namely the remarkable increase in new business and reduction in operating costs. Of the increase in gross earnings for the past fiscal year, amounting to $439,990, or 13 per cent larger than the previous year, there was saved for net earnings $174,678, making net figures 15 per cent larger than for the previous year. From the proceeds of the proposed 10 per cent increase in capital the company will be able to clean up its present large floating debt. The directors, however, are not expected to take action on the new stock issue for a couple of months.

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	72
Electric Storage Battery preferred	72
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	28¾
United Gas Improvement	86⅜

United Gas Improvement, the company most directly affected by the failure of the gas lease extension and the consequent political upheaval in Philadelphia a year ago last spring, is almost the only company whose shares have recovered to any extent from the shock received at that time. Allowing for the value of the stock allotment, which United Gas Improvement stockholders have since received, the present price around 87¾ is equivalent to the former price above 96, rights on, at which it sold earlier this year. Immediately after the failure of the gas lease proposition the prices went below 90. Union Traction also has moved to a somewhat higher plane. The guarantee is now 5 per cent as against 4 per cent per annum the past two years and the quotation is further affected by the approach of a still higher rate of dividend.

Chicago:	*Closing.*
Chicago Telephone	119
Chicago Edison Light	140
Metropolitan Elevated	66½
National Carbon common	85
National Carbon preferred	119
Union Traction common	5
Union Traction preferred	18

South Side Elevated's daily passenger traffic for August was 93,084, an increase of 7,796.

The Metropolitan Elevated's daily average of passengers carried for August was 123,512, an increase of 7,117.

Northwestern Elevated during August showed a daily average of 68,938 passengers, an increase of 4,238 daily.

Digitized by Google

PERSONAL MENTION.

MR. J. F. DAVIS, formerly connected with the Pittsburg organization of the Atlas Engine Works, Indianapolis, Ind., has been transferred to the company's offices at Chicago.

MR. C. V. MILLS, formerly general manager of the Chester Traction Company, has accepted a similar position with the Union Electric Construction Company, of Philadelphia.

MR. R. K. MICKEY, president of the Novelty Incandescent Lamp Company, St. Marys, Pa., and his wife, were visitors to Chicago during Monday, Tuesday and Wednesday of last week.

MR. NORMAN MARSHALL, president of the Marshall Electric Manufacturing Company, Boston, Mass., is spending his vacation on an automobile trip through the White Mountains and the Adirondacks.

MR. DONALD McDONALD, president of the Kentucky Heating Company, has been elected president of the Kentucky Electric Company. This company has secured the franchise for lighting the city of Louisville, Ky.

MR. J. N. COX has been appointed superintendent of the Nashville division of the Cumberland Telephone Company. Mr. Cox was general manager of the Gainsboro Telephone Company at Sparta, Tenn., for ten years and joined forces with the Cumberland Telephone Company last April.

MR. J. ALLEN HAINES, of Chicago, has been spending a few weeks in New York. Mr. Haines will hereafter represent the Stanley & Patterson Company, of New York, in the West, with headquarters at 324 Dearborn street.

MR. J. P. JOHNSTON, for several years past general sales manager for the Weber Steel Concrete Chimney Company, Chicago, Ill., has resigned to become sales manager of the water-tube boiler department of the Atlas Engine Works, Indianapolis, Ind., making his headquarters at Indianapolis.

MR. THOMAS L. PHILLIPS, who for some time has been employed by the Ontario Power Company, of Niagara Falls, Ontario, has been engaged as superintendent by the Genesee County Electric Light, Power and Gas Company, of Batavia, which is to distribute Niagara Power in this county.

MR. J. LESTER WOODBRIDGE, formerly engineer of the sales department of the Electric Storage Battery Company, Philadelphia, Pa., has been appointed chief engineer of that company, succeeding J. B. Entz, who has resigned to accept the position of vice-president of the Electric Vehicle Company, of Hartford, Ct.

MR. S. M. KENNEDY, general agent of the Edison Electric Company, Los Angeles, Cal., has been ill at his home at Alhambra, Cal., for several weeks as the result of a railway accident. His many friends in the field will be glad to learn that he is now convalescing and expects to return to his duties at Los Angeles in a short time.

MR. JOSEPH G. RAY has been elected a director of the Woonsocket Electric Machine and Power Company. He succeeds his father, the late Edgar K. Ray. The new director is a man under thirty years of age, yet he is vice-president of one of the Woonsocket banks and the general manager of four large street-railway companies—namely, the Providence & Burrillville, the Columbian, the Woonsocket, and the Milford, Attleboro & Woonsocket—all of which are part of the Ray system, so-called, of street railways.

MR. W. H. WHITESIDE, president of the Allis-Chalmers Company, Milwaukee, returned on August 22 from a two months' combined business and pleasure tour of England, France, Germany and Switzerland. Mr. Whiteside inspected various large manufacturing industries of England and on the Continent. Among them he visited the plants of the leading English steam turbine builders whose American rights for building Parsons steam turbines for marine and land use are enjoyed by the Allis-Chalmers Company.

MR. CHARLES LAMBERT KINSLOE, of Lock Haven, Pa., has been elected assistant in the electrical engineering department of the Western University of Pennsylvania. Mr. Kinsloe graduated from the electrical engineering department of State College in 1903, with the degree of bachelor of science. He was employed by the Westinghouse Electric and Manufacturing Company at their works at Wilmerding for some time after graduating from college, and for the past two years has been engaged in experimental laboratory work in the engineering department of the Philadelphia Electric Company.

NEW INCORPORATIONS.

FLINT, MICH.—Oak Park Power Company. $60,000.

CLOVERDALE, ORE.—The Cloverdale Telephone Company. $2,000. Incorporators: Charles Ray, Charles P. Nelson and Merl Nelson.

INDIANAPOLIS, IND.—The Williams Telephone Company, Parke county. $200. Directors: James A. Taylor and James H. Adams.

SALEM, ORE.—Madras & Eastern Railway Company. Principal office, Prineville, Ore. $10,000. Incorporators: John W. Collins, L. B. Lafollett and Walter O'Neil.

HARRISBURG, PA.—Merchants and Farmers' Telephone Company, Cochranton; $5,000. Philadelphia, Pittsburg & Erie Telephone Company, Harrisburg; $10,000.

COLUMBUS, OHIO—The Dayton Street Railway Company, Dayton. $10,000. Incorporators: Dennis Dwyer, Albert Emmanuel, Charles Bosler, Samuel A. Price and Edward A. Fay.

COLUMBUS, OHIO—The Navarre Electric Light Company, Navarre, Stark county. $10,000. Incorporators: John W. Zinsmaster, George A. Myer, David A. Fisher, Peter Zinsmaster and Charles Fetters.

ALBANY, N. Y.—The Cooperstown & Northern Railway Company. To operate in Otsego county between Cooperstown, Springfield and East Springfield. $240,000. Directors: Sheldon A. Young, of East Springfield; Fred J. Maxted and Charles A. Stannard, of Springfield Centre.

PORTLAND, ME.—Salem Light, Heat and Power Company. Organized at Portland for the purpose of carrying on the business of generating and supplying electricity for various purposes. $100,000. Officers: president, W. DuBois Palver, of Salem Depot, N. H.; treasurer, Wallace W. Cole, of Salem Depot, N. H.

ATLANTA, GA.—Atlanta, Griffin & Macon Electric Railroad Company. To build and operate an interurban trolley line between Atlanta and Macon, Ga., passing through several populous towns. $100,000. Incorporators: N. P. Pratt, W. A. Wimbish, Clifford L. Anderson, Edwin P. Ansley, of Atlanta; W. J. Massee, J. T. Moore, Minter Wimberly, W. J. Kincaid, James M. Brawner, Seaton Grantland, of Macon; N. B. Drewery, of Griffin.

NEW PUBLICATIONS.

ACTUAL STATE OF THE ELECTRICAL INDUSTRIES—During the past two years a number of discussions have taken place before the Société d'Encouragement pour L'Industrie Nationale and the Société Française de Physique, upon the actual state of the electrical industries. These have been brought together and issued in pamphlet form by Gauthier-Villars, Paris.

A STUDY OF RESONANCE IN ANTENNÆ SYSTEMS FOR WIRELESS TELEGRAPHY—M. Camille Tissot has issued, in pamphlet form, his study of resonance in antennæ systems used in wireless telegraphy. This paper was originally printed in *Annales de Chimie et de Physique*, March and April, 1906.

REPORT OF THE COMMISSIONER OF EDUCATION— Vol. ii of the report of the commissioner of education for the year 1904 has been issued by the Department of the Interior, Washington, D. C. This volume describes the exhibits made during the World's Fair at St. Louis by the various colleges and universities in this country. It also gives statistics dealing with city school systems, universities, colleges and technical schools, agricultural and mechanical schools, professional education, normal schools, business schools, schools for nurses, etc. One chapter is given over to statistics of foreign universities and institutions of higher education.

Digitized by Google

TELEPHONE AND TELEGRAPH.

SPRINGFIELD, MASS.—The American Telephone and Telegraph Company has received a franchise to operate in Morningside.

CONWAY, MASS.—The Heath Telephone Company is extending its line to Whately. It will then connect with the Northampton line.

SCHENECTADY, N. Y.—The Hudson River Telephone Company has been extending its line from Schenectady along the Sacandaga road, a distance of nine miles.

OMAHA, NEB.—The Home Telephone Company, now known as the Gate City Telephone Company, has agreed to accept a thirty-five-year franchise from the city of Omaha.

SAN ANTONIO, TEX.—A new telephone system is being installed at Fort Sam, Houston. Instead of the old style of telephones, the automatic system will be put into use.

DELMONT, S. D.—A farmers' telephone company is erecting a line running twelve miles northwest of Delmont and connecting with the exchange there. A third line is contemplated, running northeast toward Parkston and Hillsdale.

NIAGARA FALLS, ONTARIO—The Stark Telephone, Light and Power Company, of Toronto, is asking the right to operate in Niagara Falls. It offers a free fire-alarm service, ten city telephones free, a house rate of $18 and an office rate of $36 per year. The company will put in an automatic system, have no party lines, and desires to use the city poles when practicable.

ST. JOSEPH, MO.—The Missouri & Kansas Telephone Company is extending its system of underground conduit, with a view of improving the service and removing poles from the streets. About 150 men are employed in this work, and the extensions are about one-third finished. Telephone poles are removed from the streets as rapidly as the underground conduits are laid. The size of the conduits varies from two inches to fourteen inches. There are about 400 pairs of wires in each cable.

IOLA, KAN.—The Missouri & Kansas Telephone Company has decided to accept the terms of the recent ordinance passed by the city council, fixing the telephone rates at $2 per month for business telephones and $1.50 per month for residence telephones. The Missouri & Kansas Telephone Company at the time the ordinance was passed by the council made a strong effort to have the rate for business telephones increased to $2.50 per month, claiming that in view of the service furnished such a rate was not exorbitant. The city council, however, held out firmly for the $2 rate for business telephones, and passed the ordinance at that figure.

JOPLINE, MO.—At the last meeting of the Quaker Valley Mutual Telephone Company, L. K. Moeller addressed the company and stated that the business men of Galena and many of the private citizens were strongly in favor of having a mutual telephone service in the city that would give them the benefit of the farmers' mutual lines which at present surround the city. The Quaker Valley local was assured that if it would extend its line to Galena that there would be a mutual company organized in the city in the next few weeks. After some discussion the matter of moving to Galena was put to a vote which resulted in favor of the proposition.

ALBANY, N. Y.—Articles of incorporation of a new telephone company to operate in the southern part of Rensselaer county have been filed in the county clerk's office. It is called The Upper Hudson Telephone Company and has a capital stock of $10,000. According to the articles of incorporation Castleton is the home office of the company. Three routes are described. One is south from Castleton to Schodack Landing, Poelsburg and Muitzeskill, connecting with the Valatie line at Elm Grove. The second is east from Castleton to East Schodack, East Greenbush, Schodack Centre, Nassau Lake, Miller's Corners, Averill Park, West Sand Lake, Snyder's Corners, Alps and other small places intervening. The third runs between Coxsackie, Four-Mile Point and New Baltimore. The directors are: Andrew A. Gardenier, of Schodack Landing; Harvie McK. Curtis, of Coxsackie; Clifford C. Hastings, of West Sand Lake; Wakely Best, of Coxsackie; Philip S. Parks, of Muitzeskill; Alberti Baker, of Coxsackie, and Martin A. Springstead, of Castleton.

ELECTRIC LIGHTING.

SALT LAKE CITY, UTAH—The Shoshone Power Company is now erecting its poles in Davis county, preparatory to stringing its wires.

MILO, ME.—Fred W. Bolster has been awarded the contract to build the new power station for the Milo Electric Light and Power Company.

KUTZTOWN, PA.—At a recent special election it was decided to secure a $10,000 loan, to be used to increase the capacity of the municipal electric light plant.

ROME, N. Y.—The Rome municipal council has approved of the municipalization of the electric light plants and the establishment of a special plant owned by the city.

TERRELL, TEX.—The city of Terrell has voted nearly three to one in favor of the municipal ownership of the electric light plant, and bonds are to be issued to construct one.

NAPOLEONVILLE, LA.—At a meeting of the Napoleonville town council a committee was appointed by the mayor to look into the probable cost of an electric light plant for the town.

ELGIN, ILL.—An ordinance has been passed granting to the Elgin Merchants' Light Company a franchise for twenty years to operate a system for furnishing electric light, heat and power to local consumers.

DENVER, COL.—The receipts of the Ephrata electric light plant for July of the current year were $414.02, and the expenditures incurred in operating the plant during the same time were $106.21, leaving a net gain of $307.81.

CLAREMORE, I. T.—The Claremore council has taken over the electric light plant. The consideration was $28,000. This is the first move toward installing the $85,000 waterworks system recently voted, the bonds for which were sold to an Iowa corporation.

WILMINGTON, DEL.—It is announced that the Commercial Light, Heat and Power Company, which recently received a franchise in Wilmington, has been financed and will permanently organize and proceed to engage in business. The new company will transact an electric and gas lighting business.

DANIELSON, CT.—The borough of Danielson has entered into a contract with the People's Light and Power Company for twenty-two arc lights, at a price of $72 per lamp; and not less than sixty-four twenty-five-candle-power incandescent lamps, at $15 per lamp. The contract is to run for five years from September 1.

ONEIDA, N. Y.—The board of public works has awarded the contract for lighting Oneida to the Hudson Power and Electric Company for a period of five years. The new company will light the streets of Oneida for just about one-half of what the city has been paying, the new contract price being $37.50 per arc lamp per year.

COAL CREEK, TENN.—Preparations are being made and ground has been purchased for building an electric light plant at Coal Creek. W. M. Banks and D. C. Taylor, two of Coal Creek's most prominent business men, are the promoters. The boiler and dynamo will be purchased at an early date and will be installed as soon as they arrive.

CATSKILL, N. Y.—The new electric light station between Tannersville and Hunter burned to the ground on August 17. The plant furnished light to Tannersville, Hunter and Haines Falls, and its destruction leaves these towns in darkness. The cause of the fire is unknown. The plant was owned by New Yorkers and was partly insured.

IRON MOUNTAIN, MICH.—At the annual meeting of the stockholders of the Iron Mountain Electric Light and Power Company O. C. Davidson, John T. Jones, E. F. Brown, A. C. Cook, James H. Cundy, L. T. Sterling and George Irving were elected directors. The reports of the several officers were read and were of a very satisfactory nature.

SEATTLE, WASH.—L. S. Robe, mining engineer, and Wilson & Stackpole, Dawson lawyers, have applied for 60,000 inches of Twelve-Mile river water, a mile from the Yukon, for the purpose

Digitized by Google

of generating electricity for Alaska and Yukon territory. They promise to spend $100,000 this year and have their plant in operation two years after the grant is confirmed.

BERGEN, N. Y.—The Genesee Power Company has made a proposition to the Business Men's Association, of Bergen, to tap the Niagara, Lockport & Ontario Power Company's line at the West Shore, a mile north, and erect a $10,000 station and transformer, for the purpose of furnishing the village with power and light, provided that the company be guaranteed business to the amount of $5,000 a year.

DENVER, COL.—In accordance with the vote at the last election an ordinance was presented to the Denver board of supervisors authorizing a contract between the Denver Gas and Electric Company and the city of Denver, for ten years, whereby the city is to be furnished with arc lamps at the rate of $60 per lamp. Councilmen estimate that the new contract means a saving of over $36,000 a year to the city.

SPOKANE, WASH.—Active work has been commenced on the new Inland Empire power plant below Nine-Mile bridge. An immense coffer dam will be placed across the river at this point. The contract for the building of the plant, which is planned eventually to develop 20,000 horse-power, has been let to Sanderson & Porter, and the cost is estimated at about $850,000. All the material for construction has been delivered.

VERSAILLES, MO.—An election was held to determine whether or not the city should set aside its present electric light system and buy current from a company to be organized and furnish light through a cable from the Gravois, a stream ten miles distant, and the proposition carried by 218 to 12. The present electric light system has been in use two years, but it is proposed to furnish the city with cheaper lights from the water power.

FREMONT, NEB.—An effort will be made to complete the new $50,000 municipal light station this year. The city council at its last meeting decided to push the work. A committee was appointed to secure options on sites and the clerk and mayor were ordered to advertise for bids for bonds. The plant will be located between F street and Military avenue, close to the railroad tracks. One of the objects in moving instead of remodeling the present plant is to get close to the railroads so the cost of hauling machinery and coal will be saved.

COVINGTON, KY.—Two resolutions, looking to the building of a municipal electric light plant, have been passed by the board of council. They were offered by Mr. Nordmeyer, and on his motion they were passed under a suspension of the rules. One directs the city clerk to advertise for bids for erecting an electric light plant as provided for in the plans and specifications prepared by Owen Ford, of St. Louis, Mo. The other directed the city clerk to advertise for proposals for superintending the erection of the plant and for estimating the cost of operating and maintaining the plant.

VANCOUVER, B. C.—The plans of the Stave Lake Power Company, now building a dam on the Stave river for the conservation of the waters of that stream for use in the generation of electrical energy, have been amplified so that instead of having a maximum of 30,000 horse-power there will be available 40,000 during the driest season. The total area to be flooded will be about sixty square miles. Survey parties are now at Stave river and Stave lake determining the exact area which will be flooded. The company has determined to proceed with dam construction during the coming winter.

NOBLESVILLE, IND.—T. C. McReynolds, of Kokomo, manager of the Noblesville Heat, Light and Power Company, reports that work will begin immediately on the company's new power-house. It will be located immediately west of the waterworks power-house on the company's own ground and will be a one-story building, 100 by 75 feet. The foundation will be of concrete and cement and the remainder of the structure brick and stone. The estimated cost of the building ranges from $5,000 to $8,000. When it is equipped with all the new machinery which the company has ordered the plant will represent an investment of $25,000.

BELLEVUE, PA.—The Bellevue, Allegheny county, borough council voted a five-year lighting contract to the Ohio Valley Light Company, over the veto of Burgess Edward S. Means, Sr. The company now has a contract which does not expire until December, 1907, but to forestall efforts to bring competition for light into the borough the old company made a reduction in its old contract on condition that it be given a new one. The Pennsylvania Light, Heat and Power Company had offered to make a contract at a price $5 less a year for each lamp. Petitions are to be circulated asking Burgess Means to refuse to execute this new contract, so that if the present company wishes to enforce the resolution overriding the veto it may be necessary to take the matter into court on mandamus proceedings.

ST. LOUIS, MO.—Two lighting contracts for the illumination of city buildings were let at a meeting of the St. Louis board of public improvements. The Union Electric Light and Power Company got the contract for lighting south of Washington avenue, and the Laclede Power Company secured the lighting contract north of Washington avenue. Neither of the companies had competition, and despite this fact the Union Electric Light and Power Company put in a bid lower than the one of last year. This year's contract will save the city $1,100. The bid of the Union Electric Light and Power Company for the district south of Washington avenue was four and one-half cents per kilowatt-hour. Last year's bid was five cents. The bid of the Laclede Power Company was five and one-half cents per kilowatt-hour, this bid being the same as last year's.

CLINTON, MASS.—Papers have been signed conveying eight acres of land belonging to H. W. Atherton, of Still River, to the Boston Light, Heat and Power Company. Mr. Atherton and F. L. Fullam, the latter superintendent of the gas and electric light plants owned by the company in Clinton, signed the deeds. The transfer of the land in Still River is a big step in the plans of the Boston Light, Heat and Power Company for the gas and electric plants which the corporation intends to establish in Still River for furnishing light to Leominster, Groton, Harvard and, eventually, Lancaster and Clinton. The corporation, within the past two months, has acquired the farm of Royal Cheney and also land owned by the Boston Paving Company. The acquisition of Still River real estate gives the corporation about all the land needed for carrying out the plans which have been made to date.

BALTIMORE, MD.—The Consolidated Gas, Electric Light and Power Company has awarded a contract for the building of an engine room as an addition to the plant at Westport. The construction will be of ferro-concrete, similar to that of the plant. The building was originally designed to include this boiler house, when the necessities of the company required it. The first installation arranged was for five generators of 2,000 kilowatts each. Four were installed and partly operated, when it was found the company needed more power. The fifth generator, instead of having a capacity of 2,000 kilowatts, was contracted for on the basis of supplying 5,000 kilowatts. The new boiler room, which will be built on the north side of the structure, and of which it will become a part, will contain an engine of 7,500 horse-power. The building will be made sufficiently large to take care of any future expansion in the boiler capacity of the company.

ALEXANDRIA, VA.—The state corporation commission of Virginia, at Richmond, has granted a charter to the Alexandria Electric Light Company, which is to construct and operate a plant in the city of Alexandria to furnish electricity for light, heat and power in Alexandria, Alexandria county, and Fairfax county. The capital stock is $100,000, and C. C. Carlin is the local attorney. The officers are: W. L. Mathues, of Media, Pa., president; J. L. Rigby, of Media, Pa., vice-president, and E. E. Mandeville, of Philadelphia, secretary and treasurer. The officers and H. J. Makiver and F. L. Blest, both of Philadelphia, compose the board of directors. Mayor Fred J. Paff, of Alexandria, signed the contract with the Alexandria Electric Light Company for the lease of the electric light franchise for a term of thirty years. Agents of the company have examined several proposed sites for the location of the plant and have expressed themselves as greatly pleased with the conditions in the city. Although no location has been definitely decided upon, the company has several under advisement, and it is thought that they will shortly decide upon the site. The work of constructing the plant, which will cost about $75,000, will soon be commenced.

Digitized by Google

INDUSTRIAL ITEMS.

THE LOCKE INSULATOR MANUFACTURING COMPANY, Victor, N. Y., in engineering sheet No. 6 describes and illustrates storm tests of insulators. This is an interesting dissertation which will be read with profit by any one interested in this subject.

THE GOODWIN & KINTZ COMPANY, Winsted, Ct., makers of fine metal goods, has ready a new line of gas and electric portables and will send its handsome catalogue illustrating and describing the devices upon request. This catalogue shows a wide range of choice and is replete with examples of high grade and artistic fixtures.

THE NORTHERN ELECTRIC AND MACHINE COMPANY, 22 Brooklyn avenue, Brooklyn, N. Y., announces its facilities for effecting prompt shipments of line construction material, creosoted and plain cross-arms, locust pins, etc. Where delivery, quality and price are concerned, R. B. Fernhead, buyer for the company, announces that he is in a position to assure excellent facilities.

THE ATLAS ENGINE WORKS, Indianapolis, Ind., whose Chicago sales offices have for several years been in the Fisher Building, will, upon the completion of the new Fisher Building in November, increase its present quarters by the addition of several larger offices. Mr. Frank H. Baker, connected with the Atlas company for over twenty years, will continue at the head of its Chicago organizations.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is sending out a circular on "D. & W." enclosed fuses, for which the company is the general western agent. This circular contains an illustration of the D. & W. Fuse Company's new office and factories, which are said to be the most complete and largest enclosed fuse factories in the world. The circular will be sent to any one interested upon request.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburgh, Pa., is in receipt of a letter from the Greene Electric Light, Power and Manufacturing Company, Ashburnham, Mass., containing the following: "I am very much pleased with the performance of the 100-light transformer. It carried 150 lights four hours a day for four months. I examined it frequently with a full load of 150 lights, but could detect no rise in temperature above normal. It did not get warm to the hand. I have one 400-lighter which has 600 lights on it at times and shows no signs of heating."

THE EXCELLO ARC LAMP COMPANY, New York city, announces that an order for eighty-one lamps has recently been placed with the British representative of the company for lighting Oxford street, London. This order was the outcome of elaborate trials with the best makes of lamps. The British office of the company has also, among others, the following municipal street-lighting contracts at hand: Borough of Islington, 250 additional lamps; Southport, seventy-one lamps on constant current, 2,000 volts (this is in addition to the first installation of thirty lamps); Stepney, sixty lamps; Greenock, fifty-three lamps. The Excello arc lamp is also used in many prominent installations throughout Great Britain and in municipal street-lighting systems in Melbourne and Sydney, Australia; Johannesburg, South Africa; Buenos Aires, South America; Yokohama, Japan, and several other important European cities.

THE PHOENIX GLASS COMPANY, New York city, is in receipt of many commendations upon the stability of the Phoenix inner globes. Quite recently the Valley Electric Company, New Brighton, Pa., in commenting on its results with inner and outer arc lamp globes, stated that with one installation of fifty-one Fort Wayne form "C" direct-current series arc lamps at Bedford, Pa., the lights had been burning from dark to daylight from July, 1905, until May, 1906, with but three outer and five inner globe renewals. One outer and three inner globes were broken maliciously through the lamps being unhooked and dropped into the street, and the carbon setter was responsible for the breaking of two of the inner globes. The Valley company also states that it is now on its second thousand box of carbons, showing that there is a very small consumption of carbon, due to the globes fitting the gas cap perfectly.

THE MARINE ENGINE AND MACHINE COMPANY, 126 Liberty street, New York city, through its elevator department, announces the following list of recent contracts: Oliver Estate, Pittsburg, Pa.; Russell House, Detroit, Mich.; Brown Shoe Company, St. Louis, Mo.; Seligman Building, New York city; Brooklyn Eye and Ear Hospital, Brooklyn, N. Y.; Brunswick Site Building, New York city; Flatbush terminal, Long Island Railroad, Brooklyn, N. Y.; Bemis Brothers Bag Company, Manitoba; Alpha Delta Phi Club, New York city; Western Electric Company, New York city; B. T. Babbitt Company, New York city; Brooklyn Rapid Transit Company, Brooklyn, N. Y.; Hartford Building, New York city; Automobile Club of America, New York city; Gulf Bag Company, New Orleans, La., Brown Building, Toronto, Ontario; Blackstone Building, St. Louis, Mo. The elevator sales department has been augmented by the opening of a Chicago office in the Marquette Building and a St. Louis office in the Chemical Building.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has published a handsome booklet entitled "Through Frisco's Furnace." This booklet gives a series of reproductions of buildings taken after the earthquake and fire which recently devastated the larger portion of the business and residential section of San Francisco, Cal. The remarkable resistance of the steel and granite structures to both the earthquake and fire demonstrates the correctness of the views of the American engineers and architects who had pinned their faith on the durability of these structures. The company has made an examination of the protective action of Dixon's silica graphite paint wherever it was used on the steelwork of high buildings in San Francisco. The manner in which this silica graphite paint preserved the maximum strength of the steelwork of high buildings in San Francisco is well shown in the reports and photographs exhibited in this booklet. This exhibition is really remarkable and should be studied by every one interested in the protection of steel structures by artificial coatings in the form of paint.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the Second Issue of Each Month.)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Ct.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Sadtler, 59 South Tenth street, Philadelphia. Next meeting, New York city, October 8 and 9, 1906.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty street, New York. Meetings, fourth Friday of each month.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnston, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Professor Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 12 West Thirty-first street, New York.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting, Birmingham, Ala., October 2-5, 1906.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, 60 Wall street, New York. Annual meeting, Columbus, Ohio, October 15-20, 1906.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, S. W. Mower, 12 Woodward

Digitized by Google

avenue, Detroit, Mich. Annual meeting, Columbus, Ohio, October 15-19.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, George R. Stetson, New Bedford, Mass. Annual meeting, Hotel Frontenac, St. Lawrence River, held this week.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Annual meeting, Atlantic City, N. J., June 19, 1907.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington street, Newton, Mass. Annual meetings held in Boston on third Wednesday in March.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Ontario.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col. Next meeting, Denver, Col., September 18, 19 and 20, 1906.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Ct. Annual meeting in November, 1906.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt street, New York.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water street, Ossining, N. Y.

ELECTRIC CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine street, St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary-Treasurer, George H. Erich, 401 Monadnock Block, Chicago. Next annual meeting, Chicago, January, 1907.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO—Secretary, Frederic P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 1, 1906.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada. Next annual meeting, January 14, 1907.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliot, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall street, New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, Rolland A. Davidson, 58 William street, New York city, N. Y. Annual meeting, New York city, October 12, 1906.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill. Next meeting, Springfield, Ill., September 19 and 20.

ILLUMINATING ENGINEERING SOCIETY. Secretary. Dr. Arthur H. Elliot, 4 Irving place, New York. Meetings in New York, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.; assistant secretary, J. A. Harney, Electric Building, Cleveland, Ohio.

IOWA ELECTRICAL ASSOCIATION. Secretary, L. B. Spinney, Iowa State College, Ames, Iowa.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Iowa.

KANSAS GAS, WATER AND ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Lawrence, Kan., October, 1906.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, October 16, 1906.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James F. Barnett.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton. 94 Genesee street, Utica, N. Y. Next meeting, New York city, 1907.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, 136 Liberty street, New York city.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty street, New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. S. Lane, 536 Ellicott square, Buffalo, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, B. C. Adams, Madison, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Bullard, Cleveland, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Washington, D. C., October 9, 10 and 11, 1906.

ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, H. S. Balliet, 337 Madison avenue, New York. Next meeting, Chicago, September 11. Annual meeting, Washington, D. C., October 16, 17 and 18.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Secretary, T. H. Stuart, Waco, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. B. Fairchild, Jr., 114 Liberty street, New York.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electrical Light Company, Middlebury, Vt.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

DATES AHEAD.

American Electrochemical Society. New York city, October 8 or 9.

American Institute of Electrical Engineers. New York city, September 28.

American Society of Municipal Improvements. Birmingham, Ala., October 2-5.

American Street and Interurban Railway Engineering Association; American Street and Interurban Railway Association, Columbus, Ohio, October 15-19.

Colorado Electric Light, Power and Railway Association, Denver, Col., September 18, 19 and 20.

Empire State Gas and Electrical Association. New York city, October 12.

Old Time Telegraphers and Historical Society. Washington, D. C., October 9, 10 and 11.

Order of the Rejuvenated Sons of Jove. Niagara Falls, N. Y., September 11-14. Boston, Mass., September 20.

Railway Signal Association. Next meeting, Chicago, Great Northern Hotel, September 11. Annual meeting, Washington, D. C., New Willard, October 16, 17 and 18.

Digitized by Google

Record of Electrical Patents.

Week of August 28.

829,381. ELECTRIC BELL. Sidney A. Beyland, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. Filed April 22, 1904. The gongs are provided with supports, allowing a continuous path of adjustment.

829,390. TROLLEY HARP. Benjamin L. Dresser, Uxbridge, Mass. Filed September 14, 1905. Adjustable fastenings permit easy removal of the axle and spring catches for attaching the harp to the pole.

829,403. FINGER-CONTACT FOR ELECTRIC CONTROLLERS. Francis E. Imeson, Thornaby-on-Tees, England. Filed April 3, 1906. A contact tipped with an adjustable roller.

829,410. TELEPHONE DESK STAND. Ray H. Manson, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. Filed February 28, 1905. A detachable support is mounted within the standard.

829,416. THIRD-RAIL INSULATOR. John J. McGill, Chicago, Ill., assignor of one-half to Frank J. Guernsey, Chicago, Ill. Filed December 14, 1905. An insulating pedestal, fitted base and clamping cap.

829,419. TELEPHONE EXCHANGE. Nils E. Norstrom, Chicago, Ill., assignor, by direct and mesne assignments, of one-half to John Anderson, Salina, Kan., and one-sixth to Globe Automatic Telephone Company, Chicago, Ill. Original application filed May 31, 1900. Divided and this application filed November 14, 1903. A selecting device for automatic telephones, the selection being made by the movement of a slider over a series of contacts.

829,421. ELECTRIC RELEASE MECHANISM. Jack Ochs, Texarkana, Tex. Filed February 27, 1906. An electromagnetic releasing gear.

829,429. SELECTIVE SYSTEM. Sylvanus A. Reed, New York, N. Y. Filed March 13, 1903. A number of parallel circuits are arranged so that each one may be actuated by a definite current strength.

829,447. METHOD OF PRODUCING AND UTILIZING UNDAMPED OR SUSTAINED ELECTRICAL OSCILLATIONS. Frederick K. Vreeland, Montclair, N. J., assignor to Wireless Telegraph Exploitation Company, New York, N. Y. Filed February 28, 1905. A discharge within a vapor-containing vessel is made oscillating by means of an alternating-current magnet.

829,469. PARLOR AND SLEEPING CAR HAVING ELECTRICALLY CONTROLLED BERTHS. Louie J. Harris, New York, N. Y. Filed May 23, 1906. The berths are concealed below the floor and raised into position by a motor.

829,511. ELECTROMAGNETIC MECHANISM FOR MUSICAL INSTRUMENTS. George H. Davis, New York, N. Y. Filed November 16, 1900. A solenoid having two windings, one of which throws a plunger, the other comes into action to withdraw it at the end of the stroke.

829,535. TELEPHONE WALL SET. Ray H. Manson, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. Filed February 28, 1905. The set comprises a hollow base and cover hinged thereto, the necessary parts being placed within the base.

829,539. FINISHING ELECTRIC LAMP BULBS. George P. McDonnell. St. Louis, Mo., assignor to American Electric Company, East Orange, N. J. Filed September 1, 1905. The lamp is caused to rotate while a flame heats the sealed tip, which is allowed to sink within the lines of the bulb.

829,545. SPARKING PLUG. Charles E. Ross, Crafton, Pa. Filed July 9, 1904. A hollow conducting-casing, containing a core of non-conducting material through which passes an adjustable electrode.

829,557. MOTOR SUSPENSION. John E. Webster, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed January 3, 1906. The motor, mounted pivotally upon the axle, has a projection by means of which a compressed spring exerts a downward pressure upon it.

829,568. INCANDESCENT LAMP FILAMENT AND METHOD OF MAKING THE SAME. Jean M. Canello, Paris, France. Filed August 30, 1904. The filament consists of a rare earth oxide core, a continuous conducting coating of the metal ruthenium and an outer coating of thorium oxide.

829,570. MAGNETIC DOLLY BAR. Edward G. Caughey, Huntington, W. Va. Filed November 20, 1905. An electromagnet, the poles of which are brought close together so as to hold the head of a rivet.

829,572. TRANSFORMER. Frank Conrad, Edgewood Park, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed January 20, 1904. A transformer core is provided with two magnetic circuits of different dimensions, one of which is unsaturated and of high reluctance, the other saturated and of low reluctance. Coils are placed upon the two cores.

829,578. ANCHOR FOR GUY WIRES. Claude D. Enochs, La Crosse, Wis. Filed July 17, 1905. A shaft is provided with wings which are forced out at an angle when it has rotated after being driven into the ground.

829,606. RAILWAY SIGNAL. Robert J. Sheehy, New York, N. Y. Filed May 5, 1903. Renewed January 22, 1906. An electromagnet is placed at each end of a track block, which, by means of local signal loops, produces a signal on the train.

829,628. SELF-RESTORING SIGNALING DEVICE. Henry P. Clausen, Chicago, Ill., assignor to American Electric Telephone Company. Filed April 1, 1906. A pair of electromagnets placed so that one operates the signal, the other restores it to its normal position.

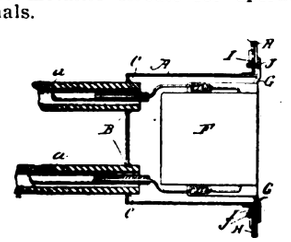
829,641. TROLLEY HARP. David J. Etly, Pittsburg, Pa. Filed December 13, 1905. Circular guard-plates are placed on each side of the wheel, projecting beyond its periphery. The plates are movable in respect to the harp.

829,643. STORAGE BATTERY. George A. Ford, Cleveland, Ohio, assignor to Harriet S. Ford, Cleveland, Ohio. Filed December 22, 1905. The units consist of trays made of infrangible absorbent material with upturned marginal edges and an inclined bottom.

829,644. WALL OR SWITCH BOX. Benjamin H. Glover, Buffalo, N. Y., assignor to Chicago Fuse Wire and Manufacturing Company, Chicago, Ill. Filed August 28, 1903. A box provided with ears for engaging the conduits and holding them in place.

829,646. INSULATOR. Walter T. Goddard, Victor, N. Y., assignor to Locke Insulator Manufacturing Company, Victor, N. Y. Filed January 7, 1905. A cap is provided for the insulators which attaches to its top and has a separate conductor seat.

829,724. TELEPHONE EXCHANGE APPARATUS. Frank R. McBerty, Evanston, Ill., assignor to Western Electric Company, Chicago, Ill. Filed August 2, 1902. A magnet is provided in each side of the metallic circuit for operating at will either one or two signals.



829,644. WALL OR SWITCH BOX.

829,726. TARGET-ILLUMINATING DEVICE FOR FIREARMS. Douglass McIntosh, New Glasgow, Canada, assignor to Frederick Johnson, Montreal, Canada. Filed September 1, 1905. A small lamp attached below the barrel lights a moment before firing, and is automatically extinguished immediately after.

829,736. INTERCOMMUNICATING TELEPHONE APPARATUS. Fred J. Ravlin and John Lofgren, Chicago, Ill., assignors of one-fourth to Arthur T. Averill and one-fourth to Glenn M. Averill, Cedar Rapids, Iowa. Filed January 15, 1906. Two members are provided, one rotatable by hand, which movement causes the other to follow and make a series of contacts.

829,774. TIME SWITCH. Henry Geisenhöner, Schenectady, N. Y., assignor to General Electric Company. Filed August 24, 1905. A receptacle held in normally one position by a spring contains mercury, which, when rotated against the spring, completes an electric circuit and is held in this position electrically. It returns to its normal position after the circuit is broken.

829,780. TRANSFORMER. Walter A. Hall, Lynn, Mass., assignor to General Electric Company. Filed May 12, 1904. A hollow rectangular iron core providing a single magnetic circuit, arranged so as to provide greater space between the coils on one side of the leg than on the other.

829,783. BLOCK SIGNAL SYSTEM. Max R. Hanna, Schenectady, N. Y., assignor to General Electric Company. Filed March 10, 1905. A signal system for alternating-current railways which employ the rails as return conductors; relays operating signals are actuated by direct currents.

829,785. ELECTRIC SWITCH. Edward M. Hewlett and Theodore E. Button, Schenectady, N. Y., assignors to General Electric Company. Filed February 7, 1902. A group of switches closed one at a time, through a number of electric clutches, by an electric motor.

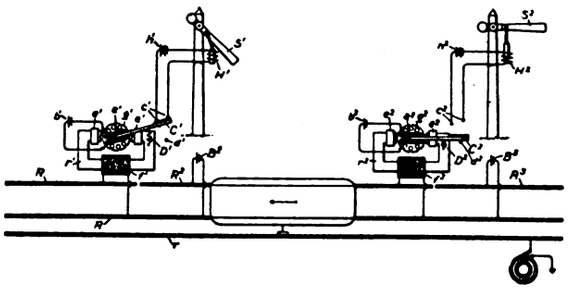
829,787. SPACE TELEGRAPHY. William S. Hogg, Washington, D. C., assignor to Overland and Marine Telegraph Company, New York, N. Y. Filed November 26, 1904. Two circuits are connected with the aerial, one attuned to the frequency to which the receiver responds, the other attuned for interfering waves.

Digitized by Google

829,790. APPARATUS FOR OZONIZING ATMOSPHERIC AIR. Edward L. Joseph, London, England. Filed December 12, 1905. An electric discharge takes place between electrodes separated by dielectrics, while air is circulated through the device.

829,794. CONTROLLER. Hermann Lemp, Lynn, Mass., assignor to General Electric Company. Filed December 18, 1905. Two braking positions are provided, one for forward and the other for reverse braking. A movable stop brings the contact member to rest in one or the other braking position.

829,799. COLLECTOR RING. Jakob E. Noeggerath, Schenectady, N. Y., assignor to General Electric Company. Filed September 22, 1905. The collector consists of parallel rings engaging one in the other, but separated by air spaces.



829,783. BLOCK SIGNAL SYSTEM.

829,806. FIXTURE SWITCH. Howard R. Sargent, Schenectady, N. Y., assignor to General Electric Company. Filed December 1, 1902. A rotatable switch which, by means of an M-shaped cam, causes quick opening or closing of the circuit.

829,808. ELECTRICAL WATER HEATER. Frederic F. Shipp, St. Louis, Mo., assignor to Electrical Heating and Manufacturing Company, St. Louis, Mo. Filed September 12, 1904. A non-conducting radiating body is pierced with parallel ducts through which the conducting heating body is threaded.

829,810. TEMPERATURE CONTROLLING APPARATUS. John H. Swan, Chicago, Ill. Filed January 20, 1904. A valve controlled by means of pressure set up in fluid heated electrically, the heating circuit being controlled by the thermostat.

829,812. TELEPHONE DISINFECTOR. Nelson J. Tubbs, Louisville, Ky., assignor of one-fourth to Hardin Collings, one-eighth to Frank C. Carpenter, and one-eighth to Walter F. Jones, Louisville, Ky. Filed May 8, 1905. The disinfector is in the shape of a cup within which the receiver is placed when idle.

829,822. TRACKLESS TROLLEY. Montraville M. Wood, Schenectady, N. Y., assignor to General Electric Company. Filed February 23, 1905. The running trolley which is carried on two parallel conductors is easily detached from the car to facilitate the exchange of trolleys when the two cars meet.

829,826. VOLTAGE REGULATOR. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. Filed March 10, 1905. A series transformer is connected in the circuit of an alternating-current motor of low power-factor. The secondary winding of the transformer is connected in shunt with the motor, lamps being placed in this circuit. An adjustable air-gap is provided in the magnetic circuit of the transformer.

829,827. POWER-TRANSMITTING MECHANISM. Edward H. Anderson, Schenectady, N. Y., assignor to General Electric Company. Filed April 9, 1904. A prime mover drives two dynamo-electric machines, mechanically connected, and provided with means for varying their electrical connections.

829,828. REVERSE-CURRENT CUTOUT. Leonard Andrews, Manchester, England, assignor to Stanley-G. I. Electric Manufacturing Company. Filed June 19, 1905. Two coils are provided, one series and one shunt, carried on different portions of one core. A magnetic shunt is provided for each portion of the core.

829,832. RAILWAY SWITCH LOCK. Robert A. Becker, Schenectady, N. Y., assignor to General Electric Company. Filed January 16, 1906. An electromagnet controlled from a distance holds the lock.

829,841. SWITCH-OPERATING MECHANISM. Theodore E. Button, Schenectady, N. Y., assignor to General Electric Company. Filed October 1, 1904. Energy for operating a switch a number of times is stored up in a spring by means of a motor.

829,842. KINETIC SOLENOID. Benjamin F. Carpenter, Roselle Park, N. J. Filed May 12, 1904. Renewed December 30, 1905. Two coils for setting up a reciprocating motion.

829,845. FLUID-PRESSURE SYSTEM. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. Filed February 2, 1903. A system for operating a motor-controlling switch by means of fluid pressure.

829,849. TELEPHONE OR LIKE TRANSMITTER. Hahnemann A. Cutmore, London, England. Filed September 28, 1905. The mouthpiece of the receiver is perforated with a series of holes, and is provided with a conical chamber in which a perforated diaphragm supporting a cone is placed in front of the diaphragm proper.

829,850. LAMP SOCKET. John C. Dallam, Schenectady, N. Y., assignor to General Electric Company. Filed August 12, 1905. A method of constructing a lamp socket, the parts of which are securely held together by a rotation of one in reference to another.

829,860. MEANS FOR CONTROLLING ALTERNATING-CURRENT MOTORS. Friedrich Eichberg, Berlin, Germany, assignor to General Electric Company. Filed January 11, 1905. A system of controlling alternating-current commutating motors in which connections are provided for supplying current to brushes placed at right angles to the normal brushes.

829,864. SAFETY INDICATOR FOR ELEVATORS AND TRACTION CARS. Robert H. Gaylord, Pasadena, Cal. Filed September 29, 1905. An electrically operated indicator actuated by the car controller.

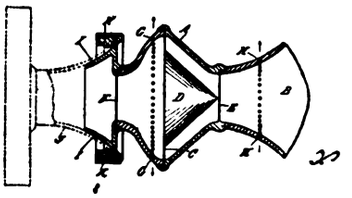
829,869. ADJUSTABLE ELECTROLIER. Alton Hopkins, Denver, Col. Filed May 15, 1905. A spring-actuated drum with suitable contacts which allows the height of the electrolier to be varied.

829,872. METHOD OF EFFECTING CHEMICAL ACTION IN GASES. Dimmitt R. Lovejoy, Niagara Falls, N. Y., assignor, by mesne assignments, to Atmospheric Products Company, Niagara Falls, N. Y. Filed March 22, 1901. A chemical combination is caused to take place by charging electrostatically molecules of different gases.

829,873. APPARATUS FOR SUBJECTING GASES TO HIGH-TENSION DISCHARGES. Dimmitt R. Lovejoy, Niagara Falls, N. Y., assignor to Atmospheric Products Company, Niagara Falls, N. Y. Filed May 29, 1902. Electric arcs are set up and broken by means of a rotating set of electrodes placed within a gas chamber.

829,874. METHOD OF EFFECTING THE COMBINATION OF GASES. Dimmitt R. Lovejoy, Niagara Falls, N. Y., assignor to Atmospheric Products Company, Niagara Falls, N. Y. Filed June 24, 1902. Renewed July 5, 1906. An electric arc is produced in air enriched with oxygen.

829,875. APPARATUS FOR EFFECTING CHEMICAL ACTION IN GASES. Dimmitt R. Lovejoy, Niagara Falls, N. Y., assignor to Atmospheric Products Company, Niagara Falls, N. Y. Filed July 19, 1902. Renewed July 5, 1906. Apparatus for carrying out the above process.



829,849. TELEPHONE OR LIKE TRANSMITTER.

829,876. PROCESS FOR EFFECTING CHEMICAL ACTION IN GASES. Dimmitt R. Lovejoy, Niagara Falls N. Y., assignor to Atmospheric Products Company, Niagara Falls, N. Y. Filed January 27, 1903. Renewed July 5, 1906.

829,877. APPARATUS FOR EFFECTING CHEMICAL ACTION IN GASES. Dimmitt R. Lovejoy, Niagara Falls, N. Y., assignor to Atmospheric Products Company, Niagara Falls, N. Y. Original application filed May 29, 1902. Divided and this application filed January 28, 1903. Renewed July 5, 1906. A combination of gases brought about by charging them electrostatically and subjecting them to action of the electric arc.

829,883. BINDING-POST. Chester Moody, Ellisville, Miss. Filed November 6, 1905. A perforated post over which is slipped a spring clip which holds firmly in contact the wire inserted through the post.

829,902. ILLUMINATED ADVERTISING SIGN. Frank H. Urry, London, England. Filed May 31, 1906. The sign screen is combined with a color screen and a dissolver having translucent and opaque portions.

829,905. ELECTRICAL RELAY. Harry M. Abernethy, Cleveland, Ohio, assignor to the American Railway Signal Company, Cleveland, Ohio. Filed July 8, 1905. A relay provided with a series of reversible carbon and platinum points and actuating electromagnets.

829,909. ELECTRIC BELL. Edward B. Craft, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. Filed October 21, 1904. A method of construction in which the core and return-plate pieces are punched out.

829,917. SWITCH. Francis K. Fassett, St. Louis, Mo., assignor, by mesne assignments, to William Maxwell Scott, Philadelphia, Pa. Filed April 27, 1904. A set of laminated contacts of an unequal length submerged in an insulation fluid, bridge across terminal blocks.

829,934. APPARATUS FOR THE PRODUCTION AND UTILIZATION OF UNDAMPED OR SUSTAINED ELECTRICAL OSCILLATIONS. Frederick K. Vreeland, Montclair, N. J., assignor to Wireless Telegraph Exploitation Company, New York, N. Y. Original application filed February 28, 1905. Divided and this application filed November 14, 1905. A vapor tube in which an electrical discharge takes place and is acted upon by an alternating magnetic field, so as to commutate the current within the tube.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 11. NEW YORK, SATURDAY, SEPTEMBER 15, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON
NEW ENGLAND OFFICE, M. W. BARBER, Mgr., DELTA BLDG., 10 Post Office Sq.

LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE
TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single copy, 10 cents. Back numbers, beyond one month, each . .	.25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
- The Cadmium Cell 405
- Coal Values 405
- The Magnetic Indicator for Hardening Steel 406
- High-Speed and Flying Connections 407
- An Anticipation for the Telephone 407

Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw 408
BOOK REVIEWS 410
Some Characteristics of Coal as Affecting Performance with Steam Boilers, by W. L. Abbott 411
High-Efficiency Lighting Units in Ohio 416
The International Independent Telephone Association of America 416
The Frankfort Central Station, by B. F. Hirschauer 417
Applications of Electricity 420
Liberty and Organization, by F. A. Pattison 420
Electrical Night at the Coliseum, Chicago 422
Recent Advances in Our Knowledge of Radiation Phenomena and Their Bearing on Radiation Pyrometry, by J. B. Henderson 422
Electrical Equipment of a Lumber Mill 424
An Electrical Spectacle at Connellsville, Pa 426
Niagara Falls Meeting of Electrical Jobbers 426
The Cincinnati Fall Festival 427
Osram Lamps 427
Colorado Electric Light, Power and Railway Association 427
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 428
Detroit River Tunnel Contract Awarded 429
METHODS OF GETTING NEW BUSINESS 430
INDUSTRIAL SECTION:
- HCK Instantaneous Electric Water-Heater 432
- A Large Electric Flasher 433
- New Navy Department Test Set 434
- Results Obtained by the General Electric Company's Automatic Feeder Regulator 435
- New Design of Push-Button Switch 436
- The "Young" System of Signaling for the Philadelphia & Western Railway 436
- The Lincoln Variable-Speed Motor 436
- An Apprenticeship Course as a Preparation for Engineering Activity 437

CURRENT ELECTRICAL NEWS 438
Record of Electrical Patents 445

Copyright, 1906, by Electrical Review Publishing Co.

THE CADMIUM CELL.

The advantages of the cadmium cell as a primary standard of electromotive force are now well recognized. Its temperature coefficient is small, compared with the Clark cell, and the electromotive force is near unity in value. Until recently we had every reason to believe that its permanence was at least equal to that of the Clark cell, and it was no more difficult to set up. It was with these ideas in mind that the substitution of the cadmium cell has been urged to replace the Clark cell, which has heretofore been the recognized standard; in fact, this substitution has been recommended by a number of scientific bodies, and at the recent meeting of the British Association for the Advancement of Science a report was made by the committee on practical standards of electrical measurement in which the change is recommended.

Unfortunately, as we have already noted, more recent work with the cadmium cell has thrown some doubt upon its permanence, and it is a coincidence that at the same time that the report of the British Association's meeting comes to hand an article appears in the *Physical Review* for August, contributed by Professor George A. Hulett, on this subject. Professor Hulett's work with the Clark cell is well known, and he here gives some of his most recent results. They bear out the opinion expressed somewhat earlier in the year—that is to say, that, as at present constructed, the cadmium cell can hardly supplant the Clark cell as a primary standard of electromotive force. Until the cause of the trouble has been located or avoided, it would seem well not to make any change in our standard. This criticism should be applied to the cadmium cell merely as it is now constructed. The inference is not that the cadmium cell will not eventually supplant the Clark cell; in fact, we have good reason to hope that the change may be made with confidence before long. It will be remembered that just such difficulties were encountered in bringing the Clark cell up to its present highly developed condition. But until there is no question as to the reliability of the cadmium cell there should be no change made in our standard.

COAL VALUES.

That method of producing coal in which the price paid depends upon the amount of useful combustible is coming into use, though slowly. It is a rather remarkable fact that though a few power companies adopted this method about ten years ago, but little or no thought was given to the matter by the managers of the greater number of power stations. No expense whose object was to increase the efficiency of the boiler house or to decrease the cost of generating steam was grudged, but few went back of this, and all accepted whatever coal was sent

Digitized by Google

to them, for which they paid the stipulated price. That this was poor policy is now generally believed, and coal is purchased now, by many important stations, at least, according to the amount of combustible in it. A reduction in price is made for the amount of ash and for the amount of moisture which must be evaporated, and which thus causes a loss of heat.

The question has been raised, whether the ash acts merely as a diluent or whether it is not detrimental in other ways. Moreover, it seems likely that the size of the coal will have some effect upon the performance of the furnace, either as respects its efficiency or the rate at which fuel may be burned. An exceedingly interesting and valuable paper dealing with these problems was read at the recent meeting of the Western Society of Engineers by Mr. W. L. Abbott. Mr. Abbott has conducted a long series of experiments, made to determine the effect upon furnace efficiency and performance, of the size of the coal, of the thickness of the fire, and of the amount of ash. His paper appears on another page of this issue, and it should be read by all who have to do with steam generation. Although the ground has not yet been fully and satisfactorily covered, the results already obtained are significant and important. As regards the effect of ash, it was found that besides acting as a diluent of the combustible, ash is detrimental in other ways. If a coal contain a high percentage of ash it then not only has a correspondingly less amount of combustible, but such coal can not be burned as effectively in the furnace. There is less combustible on the grate for a given thickness of fire, and to burn it completely requires an excessive amount of air. Thus the efficiency of the furnace is lowered, since the temperature is lowered; and, what is equally important, in most cases, the capacity of the boiler is reduced—that is to say, less steam can be produced. The penalty for ash should therefore not be simply proportional to the amount of ash, but should involve some power of this factor. For instance, it was found by Mr. Abbott that the efficiency of his furnace, and therefore the capacity of his boilers, was reduced to zero when about forty per cent of ash was present in the coal. Therefore, coal containing sixty per cent of combustible has no value as a fuel under the conditions of the test.

Next in importance to the amount of ash is probably the size of the fuel. This seems to have an irregular action—that is to say, taking the coal that is passed by screens of different sizes, it was found that the efficiency first increases with the size of the screen, then decreases and then again increases. The best results are obtained when the coal is fairly uniform in size. These results show that, given two coals, each having the same percentage of ash and of moisture, that which runs most uniform in size should be given the higher value, and in the purchase of coal this factor should be given some weight. To determine the way in which the penalty should be brought in, a large number of experiments were conducted and from them a table constructed which assigns values to the coals, according to the size of the screen through which they have passed. Probably, dealers in coal will object to such discrimination, holding that the value of a coal depends upon the amount of combustible it contains; but from the central station's point of view the availability of the heat generated is as important as its amount, and therefore that coal which may be burned most efficiently or which will produce the greatest amount of steam in a given boiler is the most valuable.

Another feature studied by Mr. Abbott, and mentioned above, was the effect of the thickness of the fire. This, of course, has nothing to do with the price to be paid for the coal, but for each kind of coal there is, undoubtedly, a particular thickness which gives the best results. An interesting fact shown by the experiments was that the efficiency of the furnace is practically independent of the thickness of the fire; but a thick fire, due to the deficiency of air, gives incomplete combustion and therefore produces smoke. The thin fire may be smokeless. Although the efficiency of the furnace is unaffected, the capacity of the boiler is. It was found that with small-sized fuels the greatest amount of steam was secured when a large amount of smoke was produced. We have heard so much of late regarding the inefficiency of smoky furnaces, but the results just mentioned seem to indicate that a large amount of smoke does not mean necessarily that the furnace is being badly managed. It may mean simply that it is doing a large amount of work, and it is an important advantage to the central station if two boilers may be made to do the work of three. It does not follow from these results that the furnace in question might not be improved and the same amount of steam generated without the smoke by introducing certain improvements in it. But the fact that a smoky chimney does not prove that the furnace is being managed badly is a point well worth bearing in mind. We hope that the experiments will be carried further, for the work has not yet been completed, and any light thrown upon problems of burning and of purchasing fuel is most acceptable.

THE MAGNETIC INDICATOR FOR HARDENING STEEL.

Unusual applications of peculiar electric or magnetic phenomena are always interesting, but particularly so when the phenomena in question have not been made use of. A case of this kind is that described by Mr. William Taylor before the British Association at its recent meeting at York, England. After having contended some time with the difficulties of getting the proper temperature for hardening tool steel, Mr. Taylor tried a thermo-junction pyrometer, thinking that in this way he would get accurate temperature indications and thus be able to control his furnace. Unfortunately, the pyrometer was not satisfactory, for while it gave accurate temperature indications, it did not show when the critical temperature of the sample being tested was reached, and it thus became necessary to obtain a cooling curve for each lot of steel.

It occurred to Mr. Taylor that, since the critical temperature for tempering is also a critical temperature magnetically, he might avail himself of the magnetic change in order to guide his tempering work. His attempts to do this were most successful. The method by which he experimentally demonstrated that the idea could be utilized in practice consisted in arranging a

Digitized by Google

circuit containing two coils and a telephone receiver. Through a third coil, placed between these two coils, was sent an alternating current, and the positions of the coils were adjusted until no sound was heard in the receiver. Then, interposing between either of the outer coils and the central one a piece of iron or steel, a sound was immediately heard in the receiver; but when the sample of metal was heated to its critical point it lost its magnetic properties and the sound ceased. It was then quenched. Using this test, he found that there was no difficulty whatever in tempering his tools, and that, in consequence of it, warping and changes of size were avoided. It was found that if the sample was allowed to cool below the critical points, so that sound was again heard in the telephone, the tempering was imperfect. As the apparatus described is hardly suitable for factory work, a modified instrument was made. This consisted of a permanent horseshoe magnet having extended soft-iron poles. One of these poles was arranged so as to rock back under normal conditions. By placing the sample of steel to be tempered at the tips of the two soft-iron poles, both were held down by magnetic attraction; but when the sample was heated until it lost its magnetic properties the rocking pole was at once released, and, flying back, gave the signal for quenching. This device was found to be of great practical service in making the work of miscellaneous hardening safe and certain in its results. By means of it tempering is carried out at temperatures less than that used by a skilled workman, and in this way overheating, resulting in brittleness, cracking and warping, is avoided.

This is a very ingenious use of a peculiar property of iron, and, so far as can be recalled, it is the only one making use of it. Many years ago an endeavor was made to utilize this property for generating electric currents, but it was unsuccessful, the efficiency being too low and the output of the apparatus comparatively small.

HIGH-SPEED AND FLYING CONNECTIONS.

Among the advantages which may be secured by means of electric traction, should the necessity arise, will be higher speeds and the safeguards which must go with them. An interesting suggestion in this direction was made in a recent discussion of the advantages of electric traction by Mr. C. F. Jenkin before the British Association. Mr. Jenkin believes that if high speed be introduced every station on the road will demand express service, and he suggests that the difficulty of giving it might be overcome by introducing what he calls slip cars—that is to say, each train has attached to it a number of cars which may be detached as it proceeds at full speed. Passengers for a certain station or group of stations will be gathered together in the last car, and as this approaches their destinations the car will be separated from the train and follow it under its own power. To give a corresponding service in the opposite sense it would be necessary for the cars to start from the stations as the train approaches and to attach themselves to it while running at full speed. The plan seems rather visionary at present, though some such method of operation may become necessary.

AN ANTICIPATION FOR THE TELEPHONE.

The extension of the telephone system has been so rapid as to make its use general in the smaller towns and villages and even in sparsely settled country districts, and now the natural anticipations are toward its universal use. Arguments as to its utility are trite, the demand exists, and the limitation is that of cost.

It is puerile to demand that the price of telephone service must be reduced merely because it brings a profit, which is true likewise of the price for anything else which is bought; and yet the whole of the technical and administrative skill of the telephone companies are concentrating their abilities upon the reduction of costs, and bestow the benefits of such reductions upon their patrons. Step by step the rates are being lowered, and what is of vastly more importance the service is being segregated into different classes suited to the needs of various patrons and the prices made in accordance with the measure of the service which is sold.

The expense of the rural telephone service is already reduced to a minimum under existing conditions, and yet the line and pole expense increase with longer distances into sparsely settled districts, and the growing price of poles, with every prospect of an increased price of copper, will add to the cost of all such lines in the future.

How is the skilled inventor to meet this problem? Selective ringing instruments are in abundance, and those types which are successfully operative under conditions of practical usage are of value in affording improvements to the service, although such devices would deprive the other nineteen inquisitives on a rural line of the opportunities to reenforce their knowledge of their neighbor's affairs by their wonted custom of removing the telephone and listening in whenever the bell rings.

This is not the solution of the problem, as selective ringing would add to the cost as well as improve the character of the service.

The line of improvement must be in adding to the traffic capacity of telephone lines. This has been done in the telegraph, and the telephone has improved in the same direction by the phantom circuit by which two metallic circuits may be made to serve as three circuits, and another instance is that which permits the simultaneous use of telegraph and telephone service over the same line. And in somewhat more than an experimental manner telephones have been used upon lines which simultaneously carry electric lighting or power currents.

Will some one amplify this usefulness of a single telephone circuit by extending its functions to simultaneous transmissions of speech, and make the invention practical by allowing such transmissions to divide to other circuits at the switchboard, and thence each on its own course as may be needed?

The difficult portion of this problem, like that of the present use of the telephone and the operation of the electric railway car, is that it must be capable of use without skill by the patron at the telephone.

The power of doubling the service over a telephone would be of great value, and who can deny that it is not within reason to expect that this may not be done with the telephone as it has been done in greater measure with the telegraph?

Digitized by Google

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW.

I—NATURAL AND ARTIFICIAL FUELS: THEIR ORIGIN, COMPOSITION AND METHODS OF SAMPLING.—*Concluded.*

Semi-Anthracite or Steam Coal—Fuels which when heated yield from ten to twenty per cent of volatile matter, are known as semi-anthracite or steam coals. They are very largely used for steam-raising purposes in the Royal navy and by factories located in cities where smoke prosecutions are frequent. Approximate analysis of typical semi-anthracites are given below:

No.	Ash.	Volatile Matter.	Coke.	Calculated Calorific Value in Centigrade Units.
	Per Cent.	Per Cent.	Per Cent.	
1....	14.95	10.00	90.00	7,405
2....	15.25	11.80	88.20	7,398
3....	10.00	12.50	87.50	7,855
4....	10.75	13.60	86.40	7,783
5....	8.85	15.50	84.50	7,950

Fuels of this type can be burned without smoke production in most types of boiler furnaces, and they do not require large combustion chambers or very skilled management in order to obtain perfect combustion. As shown by the approximate analyses, the greater portion of the fuel remains as an incandescent mass of coke after the preliminary heating upon the firebars of the furnace, and radiation transfers the heat from this mass of glowing fuel to the water in the boiler.

Anthracite—Anthracite is the nearest approach to coke in chemical constitution which is found naturally, but it differs from coke in its physical properties, being very dense and of shining appearance. Anthracite gives off only from three to ten per cent of volatile matter when heated, and consists chiefly of fixed carbon, with little oxygen or hydrogen.

The following is an approximate analysis of a typical South Wales anthracite fuel:

sh.	Volatile Matter.	Coke.	Calorific Value.
Per Cent.	Per Cent.	Per Cent.	
1.70	3.64	96.36	8,305

Anthracites are difficult to ignite, owing to their density and low percentage of volatile matter; but under proper conditions this type of fuel can be burned completely and yields a very intense but localized heat. Anthracite is chiefly used in metallurgical operations, and is not employed to any great extent for steam-raising purposes; but when so employed no combustion chamber is required, and the boiler surface may be placed close to the mass of burning fuel.

Petroleum and Its By-Products—Although liquid fuels have little application in the United Kingdom, owing to the limited supply available for industrial purposes, in Russia and the United States they are largely used for heating and steam-raising purposes. Crude petroleum contains a large number of liquid hydro-carbons of the general formula $C_n H_{2n+2}$, and it is the crude oil or the residues obtained in refining it that is used for steam-raising purposes. In Russia, especially, the residue from the first distillation of the crude oil, called "astatki," is utilized also most entirely in this way.

The following tests[1] show the difference in composition and heating value of the Russian and American oils.

	Per Cent Carbon.	Per Cent Hydrogen.	Per Cent Oxygen.	Calorific Value.
Russian crude light..	86.3	13.60	0.10	22,628
" " heavy.	86.5	12.3	1.1	19,440
" astatki.....	87.1	11.7	1.2	19,260
Pennsylvania crude..	84.9	13.7	1.4	19,224
West Virginia crude..	86.6	12.9	0.5	21,240

When burnt in suitable furnaces with proper provision for the supply of the oil in the form of a spray, petroleum is superior to ordinary coal as a fuel, and has thirty-three per cent higher evaporative value than anthracite. Actual tests have given an evaporation of 20.8 pounds of water per pound of petroleum. Liquid fuel is easily transported and stored; yields no ashes on combustion, and were the supply of crude oil sufficient there is little doubt that it would be very largely used for steam-raising purposes in this and other countries. Under present conditions, however, the price of petroleum is too high to enable it to compete with coal as a fuel.

ARTIFICIAL FUELS.

Gas-Coke and Coke-Oven Coke—These two forms of fuel are obtained by submitting bituminous fuels to dry distillation—that is, by heating in closed retorts or ovens in the absence of air. The moisture and volatile constituents of the coal are driven off, and only the carbon, ash and impurities remain—as a solid residue in the retorts or ovens. Gas-coke is the residue obtained in the manufacture of coal-gas, and here the quality of coke is of secondary importance to that of the gas. The coke produced from coke ovens, on the other hand, is the chief product of the coking process, being designed for use in the iron smelting industry, and in many cases the gases from coke ovens are allowed to escape into the atmosphere.

The use of coke for steam-raising purposes is very limited, since its price is comparatively high; but it is sometimes purchased and mixed with bituminous fuel, to lessen the trouble from smoke in very heavily worked boiler plants. Coke can be burned completely without any combustion chamber.

The following is an approximate analysis of a typical coke:

Ash.	Volatile Matter.	Coke.	Calorific Value.
Per Cent.	Per Cent.	Per Cent.	
18.85	1.90	98.10	6,972

Owing to the loss of the volatile constituents of the fuel, the percentage of ash in coke is always higher than that of the original fuel.

Coke contains, as a rule, from 2.0 per cent up to 6.0 per cent of moisture, owing to its absorbent properties and to the fact that on drawing from the retorts or ovens it is often quenched with water.

Coke contains also a large portion of the sulphur impurity of the original fuel, and it is not, therefore, a very suitable fuel for use in towns or cities for the reasons already given under Bituminous Fuel.

Peat-Coke—This artificial fuel is obtained by the dry distillation of peat in retorts of special design, after a large portion of the original water contents of the peat have been removed by mechanical methods. The following is an analysis of a peat-coke prepared by an electrical method:

	Per Cent.	
Moisture	17.50	
Ash	18.00	on the dried sample.
Volatile matter.....	57.60	
Coke	42.40	
Fixed carbon.....	24.40	

This test must not be taken as representative of peat-coke generally, however, as it is possible by scientific methods to obtain a much lower percentage of moisture, and of volatile matter in the finished product. The ash test in this case has also been increased by the unwise addition of chemicals to promote electrical conductivity.

A sample of peat-coke from Argyleshire contained only 6.50 per cent moisture and 2.70 ash; while Norwegian peat-coke contains 4.82 per cent moisture and 3.0 per cent ash.

Although peat-coke has not so far been manufactured upon a large scale, it is now being produced at several small works in Norway, Canada, Ireland, Germany and other peat-producing countries. When the coal fields of Europe and America are exhausted, peat-coke is likely to play an

[1]All rights of reproduction and translation reserved. Copyright, 1906, by John B. C. Kershaw.

[1] "The Calorific Power of Fuels," H. Poole.

Digitized by Google

important rôle—in the maintenance of the world's industries. Owing to its percentage of volatile matter and freedom from sulphur—peat-coke is a far more perfect fuel for household and industrial use than ordinary coal.

Briquette Fuels—Briquette fuels are made chiefly from semi-anthracite and anthracite coal by mixing the dust and fine coal obtained in the course of mining and screening with tar or other binding materials and by moulding the mixture into bricks in specially designed presses. The resulting briquettes burn slowly with evolution of little smoke, and find a large use in Germany and other European countries for domestic purposes. The following shows the composition of such a briquette fuel made from German peat:

	Per Cent.	
Moisture	10.78	
Ash	7.35	on dry sample.
Coke	36.50	
Volatile matter	63.50	
Fixed carbon	29.15	

As the cost of briquette fuel delivered in manufacturing districts is higher than that of coal, it is little used for industrial and steam-raising purposes.

Gaseous Fuel—There are many engineers who believe that the power and heat required by our industries in the future will be obtained from gaseous fuel. Some of the advantages of this form of fuel have already been mentioned. Others are that with slight modifications in the gas-producing apparatus the gas obtained can be used either for heating or for power purposes. Large gas engines driven by producer-gas (obtained from ordinary bituminous slack costing only 6s. per ton d/d) have now been running satisfactorily for some years in Germany, in America and in the United Kingdom; and as one horse-power can be obtained from one pound of coal by this method, the advantage over the present methods of power generation are undoubted. Even with the existing power plants—consisting of steam boilers and reciprocating or turbine engines—there is much to be said for heating by gas, and in many works the installation of a large gas-producer plant would lead to fuel economy, and incidentally also solve the smoke problem.

Producer-gas varies in composition with the type of producer used, the method of working and with the composition of the fuel consumed. When steam is used in the working of producers, a mixture of ordinary producer-gas and water-gas is obtained. Carbon monoxide and hydrogen are the essential heating constituents of producer-gas and upon the percentage of these constituents present in the gas its thermal value depends.

The earlier forms of gas-producers could only be worked satisfactorily with semi-anthracite and anthracite fuel. Modern producers and methods of working permit the cheapest forms of bituminous slack to be employed with satisfactory results. The ammonia recovered in the form of sulphate as a by-product is also of considerable value. The following is the composition of gas from a typical Mond gas plant, using cheap fuel:

		No. 1. Per Cent.	No. 2. Per Cent.
CO_2	(Carbon dioxide)	16.3	16.0
CO	(Carbon monoxide)	10.2	11.0
CH_4	(Methane)	2.5	2.0
H	(Hydrogen)	26.4	29.0
N	(Nitrogen)	44.6	42.0
		100.0	100.0

No. 2 gas has a heating value of 140 British thermal units per cubic feet, and contains eighty-four per cent of the thermal value of the original fuel. In the writer's opinion the transition from steam

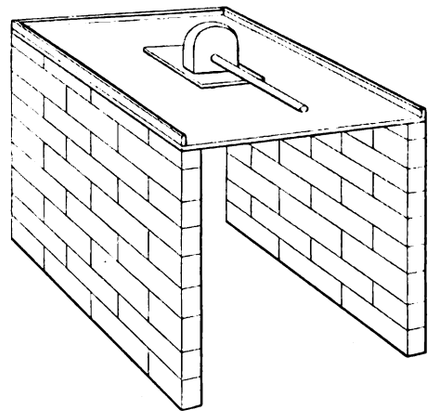


FIG. 1.—SAMPLING PLATE AND HAMMER.

engines to gas engines for power generation will be marked by an intermediate stage in which gaseous fuel will be employed for steam-raising purposes.

Sampling Fuels—The sampling of fuel has not in the past received from engineers the attention it requires. It is perfectly useless having elaborate chemical and calorific tests made of fuel, if the sample be a non-representative one. In the majority of instances, in which engineers have submitted fuel samples to the writer for analysis or report, they have evidently given little thought or attention to the problem of sampling the fuel. The sampling operation is in fact one demanding as much care and attention as the later chemical examinations; and the idea, that a few pounds of coal selected haphazard from any part of a wagon-load or heap of fuel, can form a representative sample is utterly absurd.

The sampling of slack and small fuel is simpler than the sampling of mixed large and small coal, but in each case a truly representative sample of coal can only be obtained by strict adherence to the rules for sampling given below. The sampling of liquid fuels is simplest of all, since here the contents of a barrel or tank can be well mixed by blowing air through or, in the case of tar, by using a plunger for a few minutes before taking the sample. The only difficulty then is the selection of the number of barrels from which to take samples, and the usual proportion in sampling work is every third or fifth—excepting when the total number is small—when every barrel may be sampled with little extra expenditure of time.

The sampling of peat and briquette fuels is best carried out by taking borings out of a large number of selected blocks, and reducing these to powder by rubbing between serrated iron plates. A proper sampling-plate and suitable hammer (Fig. 1) are required for the preparation of fuel samples when this work is often carried out, and in large works where fuel sampling is a regular portion of the scientific management of the plant a small mortar mill or large crushing and grinding mill is essential for the speedy performance of the work.

The ordinary type of coffee mill is useful for crushing samples of fuel in the final stage of their preparation for laboratory examination.

RULES FOR SAMPLING FUEL.

As each barrow-load of fresh portion of fuel is taken from the pile or store heap a count is kept of the number used, and the whole contents of each tenth or twentieth barrow or portion are placed on one side, in a cool place, under cover. Care must be taken that the barrow or portion selected for the sample does not contain an unfair proportion of lumps or smalls.

At the end of the day, or period for which the sampling is to be carried on, the heap of fuel obtained for sampling purposes, as described above, is transferred to a sampling-plate, and the larger lumps are all crushed down to walnut size. Should no sampling-plate be available, four of the iron plates used for covering manholes and boiler flues may be utilized to obtain a hard clean surface on the floor of the boiler house, and the crushing down of the sample may be carried out on these plates with any heavy and flat lump of iron at hand. The heap of fuel, after this first crushing, is thoroughly mixed by turning over and over with a spade. The heap is then flattened

Digitized by Google

down, two lines are made across it at right angles with the edge of the spade, and two of the four opposite sections are selected to form the reduced sample. The lumps in this are again crushed, the sample is again mixed, and the quartering operation repeated until about eight or ten pounds of fuel only remain, with no lumps that will not pass through a quarter-inch sieve. Two one-pound tins, with ordinary or patent lids, are filled from this remaining heap of fuel, after thoroughly mixing the same with the hands or with a small shovel. One of these tins is to be sent per parcels post to the fuel expert for analysis; the other is to be kept for reference in case of dispute.

(To be continued.)

BOOK REVIEWS.

"The American Steel Worker." Second edition. E. R. Markham. New York. The Derry-Collard Company. Cloth. 366 pages. 5¾ by 8 inches. 163 illustrations. Supplied by the ELECTRICAL REVIEW at $2.50.

The experience of twenty-five years' working with steel and in the selection, annealing, hardening and tempering of various kinds and grades is brought together in book form for the benefit of those who have to do with such operations. The work is eminently practical, as it not only states clearly the end sought, but gives detailed instructions in each case for obtaining it. There is an excellent index to the book.

"Designs for Small Dynamos and Motors." Cecil P. Poole. New York. McGraw Publishing Company. Cloth. 186 pages. 6½ by 9½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $2.

This book has been compiled by bringing together twenty-two designs of small dynamos and motors which originally appeared in the *American Electrician*. The designs have been prepared with a view to obtaining a machine as simple as possible and one easily constructed by means of the facilities ordinarily obtainable by amateurs. The machines considered vary from motors rated at one-sixth to three horse-power, to a 400-ampere electroplating dynamo, a four-kilowatt combined alternating and direct-current generator, and a single-phase rectifier.

"A Graphical Treatment of the Induction Motor." Alexander Heyland. New York. McGraw Publishing Company. Cloth. 48 pages. 5¾ by 8¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.

This well-known and widely discussed graphical treatment of the induction motor, which is really a special application of the general transformer diagram, was published first in 1894. It is based on two simple and quickly performed experiments. The value of such methods, both to the student and to the constructing engineer, is well known. In this volume the translators have put in convenient form the original discussion of the method by Heyland. Heretofore imperfect treatments of the subject only have been available in text books, and those who wished to go into the subject further have been forced to follow it up through the various technical periodicals. The present translation will therefore be very acceptable to all who are not at home in the language of the original.

"Handbook of Mathematics." J. Claudel. New York. McGraw Publishing Company. Cloth. 708 pages. 6½ by 9½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $3.50.

This is a translation of the seventh edition of Claudel's handbook of mathematics. It is intended for engineers as well as for engineering students—in fact, it would seem to be more suitable for the latter class of users, for it covers practically the entire field of mathematics involved in ordinary engineering computations, and the engineering student usually has covered a considerable part of this ground before he takes up the special branches employed in his profession. For engineers, however, it gives in convenient and easily referred to shape the essential parts of the various branches of mathematics, including arithmetic, algebra, geometry, trigonometry, analytical geometry and calculus. In these branches it gives not only the fundamental principles, but those abbreviated processes which are such time-savers. The value of the book is considerably added to by the numerous examples presented, although these are of a rather general character. For the engineer who is occasionally forced to brush up his mathematics this book will be very acceptable.

"Stray Currents from Electric Railways." Dr. Carl Michalke. Translated and edited by Otis Allen Kenyon. New York. McGraw Publishing Company. Cloth. 90 pages. 6 by 8¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.50.

In this book are brought together the results of many careful investigations made in Europe to determine the actual conditions existing regarding stray currents from electric railways. The author has made a painstaking study of the reports, and gives his conclusions here. He does not, however, offer any general method of preventing electrolytic troubles, since there are too many factors depending upon local conditions which enter into the problem. His deductions are not at all startling, and, in fact, are in good agreement with the opinions held by the best-informed engineers. It is, of course, impossible to prevent leakage of current from the rails when they are employed as the return circuit. It is also impossible to prevent entirely current from entering underground piping systems when they are not perfectly insulated from the ground. It is possible, however, when bad conditions exist, to find means of alleviating them considerably. At the ninety German cities where investigations were made there were only two or three cases where there had been any serious trouble from leakage currents.

"Illustrated Technical Dictionary in Six Languages." Vol. I. Compiled by K. Deinhardt and A. Schlomann. New York. McGraw Publishing Company. Cloth. 404 pages. 4½ by 7½ inches. Supplied by the ELECTRICAL REVIEW at $2.

A novel plan has been adopted in this dictionary. Instead of employing the ordinary alphabetical arrangement, certain words are grouped together, each group dealing with some particular division of engineering. This particular volume is a dictionary of the elements of machinery and the tools most frequently employed in metal and woodworking. It is in six languages—English, German, French, Russian, Italian and Spanish—and all six terms are given together, accompanied, where possible, by a drawing illustrative of the apparatus referred to. With such an arrangement it is impossible at once to find the word sought, so that an auxiliary section becomes necessary in which all the words are arranged alphabetically. To use this dictionary it is necessary, therefore, first to look in the index for the word sought, and then to turn to the page and section there indicated in order to find it and its foreign equivalents. While there may be occasions in which the grouping together of words in this way is advantageous, it would seem that the double work required in order to find the meaning of the word sought would more than offset the compactness aimed at. When using a dictionary one always wishes to do so with the least amount of trouble and distraction, and the double search required would seem to be a decided disadvantage. Moreover, the necessity of adding to the dictionary proper an index containing all of the words in the dictionary prevents the full realization of a compact book which is sought by the peculiar plan adopted. An engineer does not usually carry his technical dictionary with him, as he may his handbook. It is usually employed as an instrument to facilitate his work at the office, and for this purpose one enabling him to turn at once to the word sought is by far the best.

Digitized by Google

SOME CHARACTERISTICS OF COAL AS AFFECTING PERFORMANCE WITH STEAM BOILERS.[1]

BY W. L. ABBOTT.

The capacity and efficiency obtained with a steam boiler is the result of many influences more or less variable in character, and for the purpose of studying some of these influences certain experiments were conducted in which coal screenings were used, the results of which are presented in this paper.

The apparatus employed in the researches to be considered consisted of two Babcock & Wilcox boilers, one being fourteen tubes high and eighteen wide, of approximately 5,000 square feet of heating surface, fitted with a chain-grate stoker seventy-five square feet in area, which discharged the gases of the fire from under an ignition arch five feet long, immediately among the tubes of the boiler; this boiler was also fitted with a Babcock & Wilcox superheater having an approximate area of 1,000 square feet. The other apparatus employed in one of the series of tests differed only in sizes; its boiler was twelve tubes high and sixteen wide, contained 4,000 square feet of heating surface, provided with a superheater and served with a chain-grate stoker sixty-six square feet in area.

The experiments were for the purpose of studying the following features and their influence with the particular apparatus used, and are presented in the following order:

Effect on capacity and efficiency due to coal of different sizes.

Influence of ash in coal on capacity and efficiency.

Effect of variation in size of coal screenings.

Results of different thicknesses of fire.

The experiments illustrated by the diagram (Fig. 1) consisted in the use of coal separated into various sizes by means of screens having the following square openings: 0.25, 0.50, 0.75, 1.0 and 1.25 inches. The coal was all from one lot, so that the different portions resulting from the screening process where necessarily the "same kind of coal," except that some portions were uniformly larger and others smaller, and that the smallest, on account of its size, was higher in ash. As shown by the curves of efficiency and capacity in the diagram, five tests were made, each with a different size of coal. In all other respects, however, everything was equal; thus influencing conditions, except that due to size of coal, were constant. In this way relative values for the feature studied were obtained as shown by the diagram.

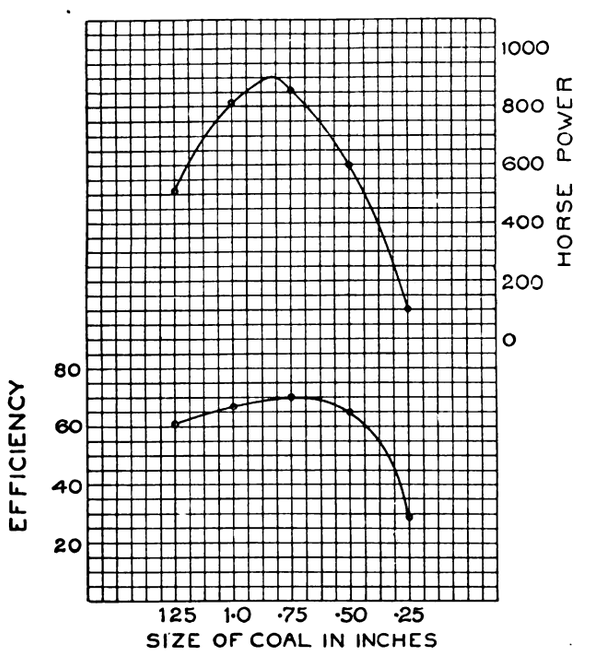


FIG. 1.—EFFECT ON CAPACITY AND EFFICIENCY DUE TO COAL OF DIFFERENT SIZES.

It is well in this connection to give the percentage of ash in the dry coal of the various sizes.

	Square Screens. Through.	Over.	Ash in Dry Coal.
Size of coal in inches..	1.25	1.00	13.7
" " " " " ..	1.00	0.75	14.0
" " " " " ..	0.75	0.50	15.6
" " " " " ..	0.50	0.25	20.8
" " " " " ..	0.25	0.00	30.8

The high per cent in the smallest size is not due to ash in the coal itself, but to the fact that all of the fine-sized foreign matter separated from larger coal, or which comes from roof or floor of the mine, naturally finds its way into this smaller coal.

INFLUENCE OF ASH IN COAL ON CAPACITY AND EFFICIENCY.

This diagram (Fig. 2) gives results of eighteen tests made to determine the effect of varying quantities of ash associated with coal. One result of its presence is to reduce the heating power, owing to displacement of combustible matter. Therefore, in this connection, ash may be considered as a dilutant, and if this was the only result of its presence, it would have no effect on heat efficiency secured through a boiler. A proportionately less amount of water would be evaporated by a pound of such mixture of ash and coal, of course, but efficiency would not be affected. If, however, ash acts in some other way as well, such as an obstruction to the combustion process, the effect of its presence is doubly harmful.

To ensure that the result would not be affected by any influence other than that of the ash, special coal was used which came from the No. 7 seam, north of Marion, in Williamson county, Ill. It was prepared in a Stewart washer and is known to the trade as No. 4 washed coal, a size made by passing over a screen having one-quarter-inch round openings, and through one having similar one-half-inch openings. Its composition is represented by the following:

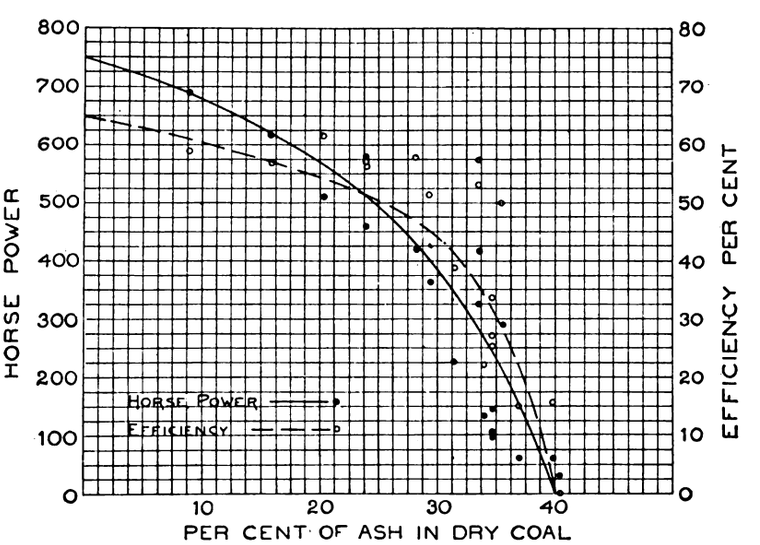


FIG. 2.—INFLUENCE OF ASH IN COAL ON CAPACITY AND EFFICIENCY.

Moist coal:	
Moisture	7.48
Ash	8.23
British thermal units	12,191
Dry coal:	
Ash	8.90
British thermal units	13,176
Pure coal:	
British thermal units	14,463

The test indicated by the two points showing highest efficiency and capacity

[1] Paper read before the Western Society of Engineers September 5.

Digitized by Google

was made with coal just as it arrived, or in other words, was of the composition shown by the analysis. Beginning with the test of the second day a quantity of refuse from the stoker ash pits was added to the coal to be used. This refuse was first weighed and the large pieces broken up, after which it was thoroughly mixed with the coal in the required proportion and increasing amounts were added in each test which followed. This fuel composition was, of course, weighed as used and a sample of it selected for analysis in the regular manner.

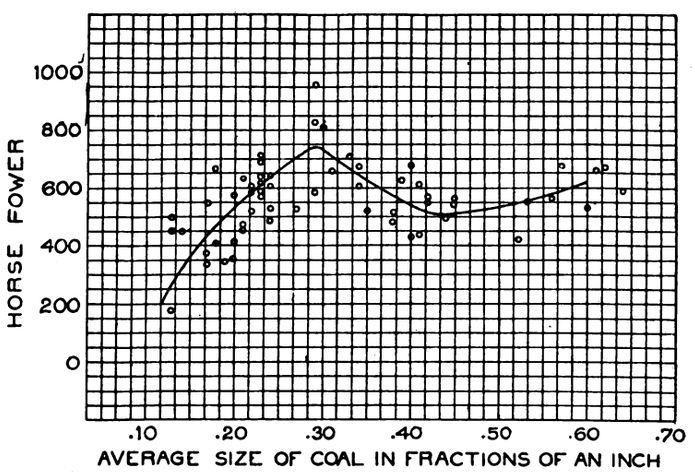


FIG. 3.—EFFECT OF VARIATION IN SIZE OF COAL SCREENINGS.

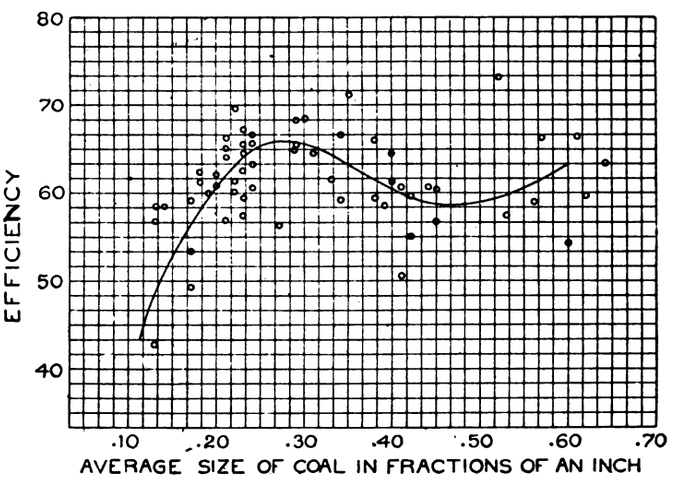


FIG. 4.—EFFECT ON EFFICIENCY OF COAL OF DIFFERENT SIZES.

It appears from the diagram that useful effect from the fuel drops to zero with forty per cent of ash, notwithstanding the fact that the other sixty per cent of the composition was pure coal. The fact should be emphasized, that although over half of the composition fed to the fire was fuel, it burned without producing any useful effect, for which there are two reasons; one, that on account of obstructed air supply through the fuel bed, incomplete combustion and escaping hydrocarbons carried away a portion of the heat, because the gases passed immediately among the tubes of the boiler. The other is, that owing to the presence of an excess of ash, the percentage of fuel on the rear portion of the grate is greatly reduced. On this account a larger proportion of the air passing through the fuel bed does not combine with the fuel, but enters the furnace as free air. As the prime function of a furnace is to heat the gases passing through it, any increase in the amount of air entering the furnace without a corresponding increase in the amount of fuel burned must result in a lowering of the furnace temperature.

This lowering of temperature, besides making a long, smoky flame which reaches up among the boiler tubes and is there chilled to below the burning point, also reacts on the fuel bed, reducing the rate of combustion and still further increasing the adulteration of the furnace gases with free air. When the temperature of the furnace has been thus reduced to about 600 degrees Fahrenheit the boiler is unable to absorb any more heat than is necessary to make up for radiation losses.

It will be observed that the points on the diagram do not fall in symmetrical order. This is particularly true of ash percentages of about thirty-four, which may be explained by the refuse used in these tests being probably of a more fusible character than with others. These tests with the ash composition were made with the smaller boiler above mentioned.

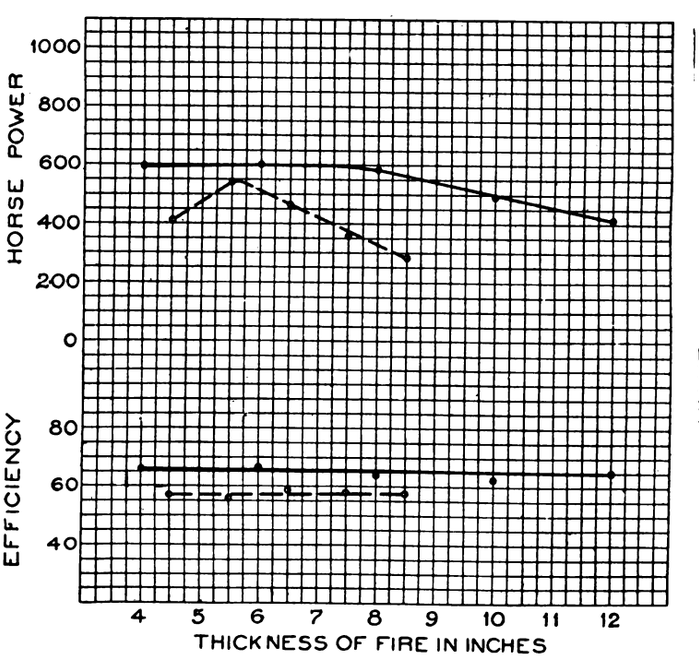


FIG. 5.—RESULT OF DIFFERENT THICKNESSES OF FIRE.

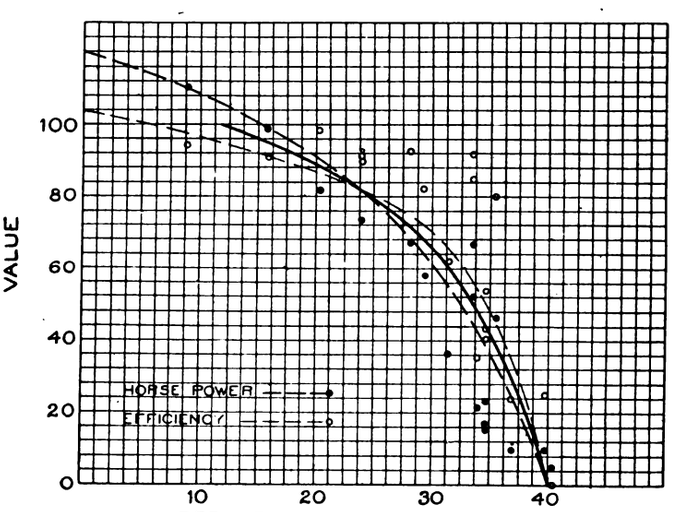


FIG. 6.—EFFECT OF PERCENTAGE OF ASH IN DRY COAL.

EFFECTS OF VARIATION IN SIZE OF COAL SCREENINGS..

In Illinois and Indiana coal not sold as mine run is separated largely as lump and screenings, and such screenings furnish

Digitized by Google

about ninety per cent of the stoker fuel used in Illinois.

The diagrams (Figs. 3 and 4) illustrate the result of sixty-two tests. With each the size of coal as measured by screens with square openings ranging in dimensions from 0.25 to 1.50 inches, advancing by 0.25 inch, and the average sizes of coal as shown at the base of the diagrams, were calculated from sizing tests made with these screens and represent the dimension in fractions of an inch of openings in a screen which would allow one-half of the coal to pass through and the other half to go over the screen, and it is this that is designated as its average size.

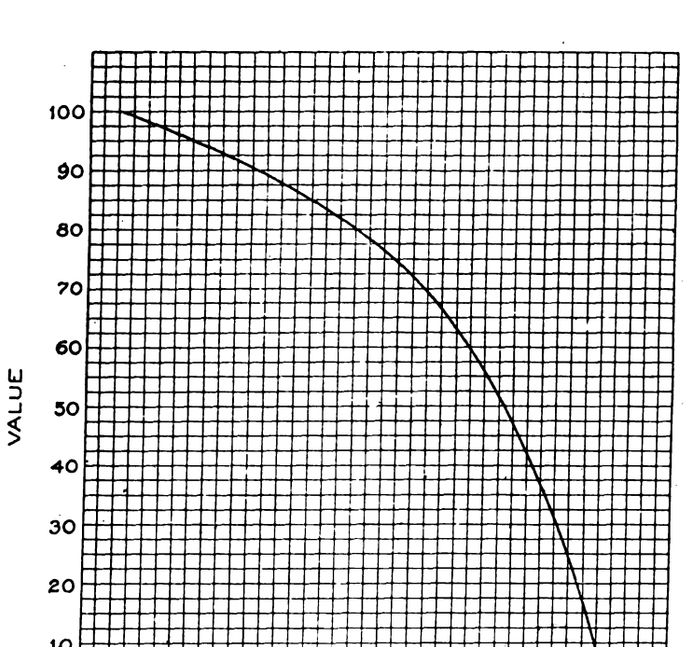


FIG. 7.—VALUE OF FUEL WITH REFERENCE TO PERCENTAGE OF ASH.

In diagrams, Fig. 3 shows the effect produced on horse-power output owing to this variation in size of the coal, and Fig. 4 illustrates the resulting efficiency from the same cause and for the same tests.

The curves for both efficiency and capacity drop midway between the tests with both small and large coal. This is a peculiarity which may be explained as follows: Performance becomes better as the size of coal increases, until a point is reached when the quantity of large pieces becomes so great that there is not enough fine material to properly close the interstices between, with the result that performance drops off, due to excess of air, until a condition is reached when all of the pieces of fuel approach uniformity, when owing to greater agreement in size, they fit together better, and in a measure produce a homogeneous mass similar to that secured by the fine dust filling the spaces in the fuel bed in the first case.

The presence of fine dust in excess is a great and important source of trouble. Referring to Fig. 1, coal through a 0.25 inch square screen produced only 108 horse-power, yet a size of fuel known in Illinois as No. 5 washed coal, which will pass through a 0.25-inch round hole (a smaller aperture than the square opening) will produce as high as 600 horse-power under the same boiler. It is true that the lower ash content of the washed coal has a considerable influence, but this is offset by the larger size of the square screen as against the round one.

To arrive at a better understanding of the physical make-up of these two characters of fuel, tests were made of the dust of each, using that quantity which would pass through a twenty-mesh screen, with the results shown in table A.

TABLE A.

QUANTITY AND SIZE OF COAL DUST BELOW TWENTY-MESH SCREEN.

Per Cent of Different Sizes.

Dust Sample.	Through 20 and over 40.	Through 40 and over 60	Through 60 and over 80.	Through 80 and over 100.	Through 100.
No. 5 washed	63.36	16.78	6.51	2.93	10.42
Duff through one-quarter-inch square screen	46.10	13.87	8.18	3.84	28.01
Average of five tests from ordinary screenings	48.50	13.78	7.57	4.38	25.74

The quantity of the extremely fine dust through the 100-mesh screen is shown to be almost three times as much in the unwashed as with the washed coal. The third line of the table is an average from five tests taken from different lots of screenings, and it shows an approximate agreement with the quantities from the dust through the one-quarter-inch square screen, from which it follows that the presence of the fine dust has an enormous influence on the burning of the fuel.

RESULT OF DIFFERENT THICKNESS OF FIRE.

An excess of air accompanies a thin fire, and because of it, efficiency produced through the boiler is affected. On the other hand, a thick fire reduces the excess of air, but increases the volume of hydrocarbon gases which leaves the surface, or in other words, makes more smoke. If a furnace is located between the boiler and stoker, these gases will be burned, otherwise they will largely escape among the tubes of the boiler as they did in this case. Therefore, under these conditions, a thin fire increases the loss due to excess of air, but decreases that due to smoke and incomplete combustion. On the other hand, a thick fire reduces the excess of air, but increases the smoke and escaping combustible gas, and so the best thickness of fire may be a matter of importance. With this type of boiler of a height of nine tubes when served with chain-grate stokers discharging immediately among the tubes, it is always most economical to produce as large a volume of smoke as possible with the coal being used. With boilers of fourteen tubes in height, the conditions are different, because such boilers are more efficient.

With an ideal boiler the final temperature would be the same as the atmosphere, therefore an unlimited excess of air could be used without causing heat loss. No practical boiler can, of course, be an ideal one, but the Babcock & Wilcox type of fourteen tubes high approaches much nearer to it than does one of nine high, and for that reason is more efficient, and in this connection is quite unique, as Fig. 5 will show.

The curves of efficiency in this diagram illustrate a constant heat efficiency produced through the boiler for a full working range in thickness of fire, insuring not only maximum excess of air, but incomplete combustion loss as well, yet the efficiency remained uniform, and the only

Digitized by Google

opportunity for the "skillful' and "intelligent" fireman is in selecting that thickness best suited to capacity requirements.

The coal used in these two series of tests was very uniform in size and ash content, and for these reasons was well suited to the purpose of experiments. In the series with thickness of fire, from 4.5 to 8.5 inches, what is known as No. 5 washed coal was used, a size which passes through a screen having round openings 0.25 inch in diameter. With the other series and a larger range in thickness, washed screenings were employed.

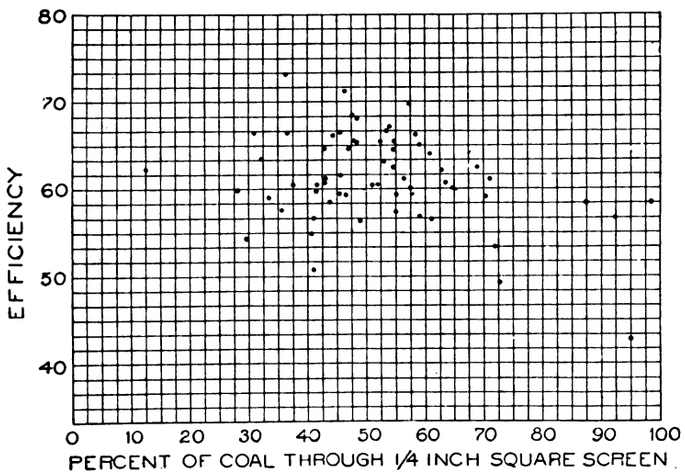


FIG. 8.—EFFECT ON EFFICIENCY OF SCREENED COAL.

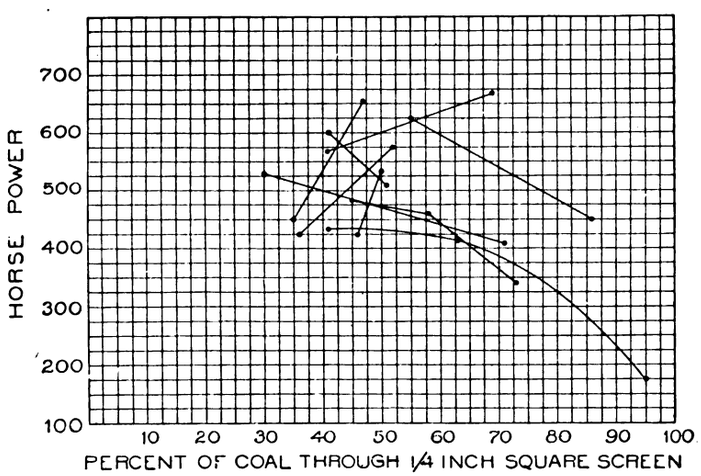


FIG. 9—EFFECT ON HORSE-POWER OF SCREENED COAL.

TABLE SHOWING VALUE OF SCREENINGS.

Table B gives values in one figure for screenings containing different percentages of ash, and of variation in size as measured by that portion passing through a 0.25-inch round screen. The following detailed statement explains how this table was prepared:

The value of coal screenings is affected by four variables, which are heating power, moisture, ash and size of the pieces of coal. Heating power in Illinois and Indiana of the pure coal—in other words, free from ash and moisture, the real coal—ranges from 13,800 as the minimum to a maximum of 14,500 British thermal units per pound, and moisture from about nine to fourteen per cent. These two characteristics, however, are of minimum importance, as either can affect the result by only a comparatively small amount. With the other two features, amount of ash and size of the pieces, each may exert an influence of such moment that they cause the fuel to be valueless. Thus, in fuel inspection service it may be necessary to test only the latter characteristics, therefore table B is based on variation in per cent of ash and on size of the coal, moisture and heating power being assumed as constant.

The fuel in service under a boiler produces two results, one of efficiency and the other of capacity, and capacity, or in other words, quantity of steam produced, is a matter of great importance. Therefore, if these two effects may be averaged and treated as a single value, the problem is much simplified.

Inspection of diagrams Figs. 3 and 4 shows that resulting capacity and efficiency are approximately the same, and that the condition of fuel which results in a high efficiency also produces large capacity. This makes it possible to assign two values to the fuel, one applying to ash content, the other to its size, each of these values embracing efficiency and capacity as a unit.

In placing the effect due to ash in shape for use in preparation of table B, diagram Fig. 6, which is a reproduction of Fig. 2, has a heavy curve drawn midway between those of efficiency and capacity. This average curve represents the value of the fuel as far as ash is concerned, which appears to be 100 per cent, with twelve per cent of ash in the dry screenings, and according to this, value could be greater than 100 per cent, but twelve per cent represents an average minimum ash content for coal screenings in Illinois and Indiana at the present time, therefore

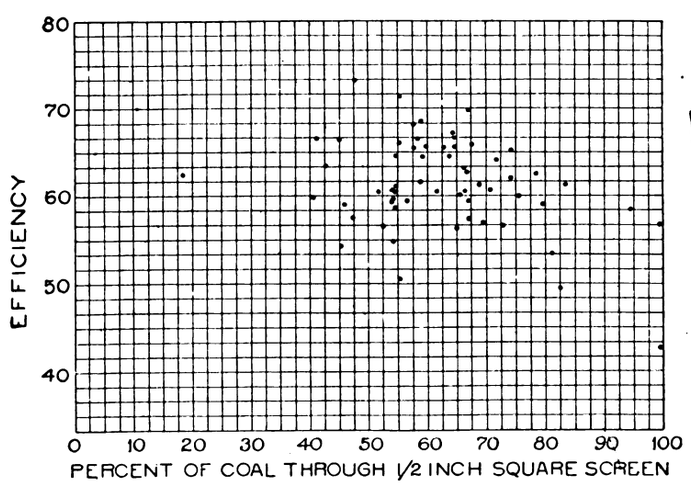


FIG. 10.—EFFECT ON EFFICIENCY OF SCREENED COAL.

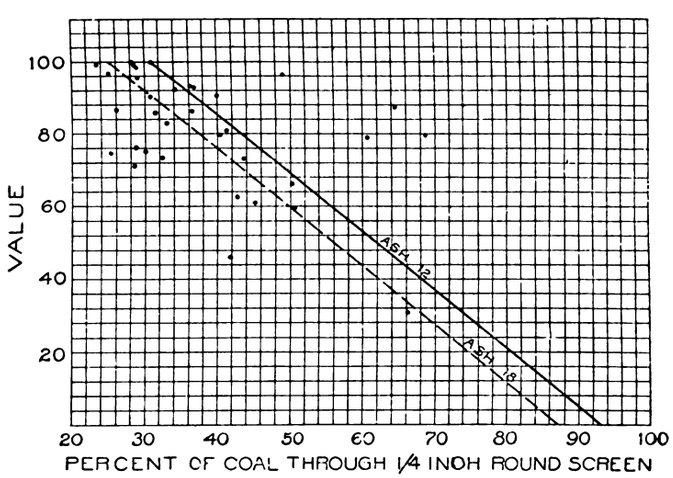


FIG. 11.—EFFECT ON VALUE OF SCREENED COAL.

Digitized by Google

such fuel is the best obtainable, and for this reason may have a value of 100 per cent assigned to it.

Thus Fig. 7 contains a curve showing value taken from Fig. 6, and without the complication of curves and points in the latter, and ash values were taken directly from it for use in the compilation of table B.

PERCENT OF ASH IN DRY COAL

PERCENTAGE OF COAL THROUGH 1/4-INCH ROUND SCREEN

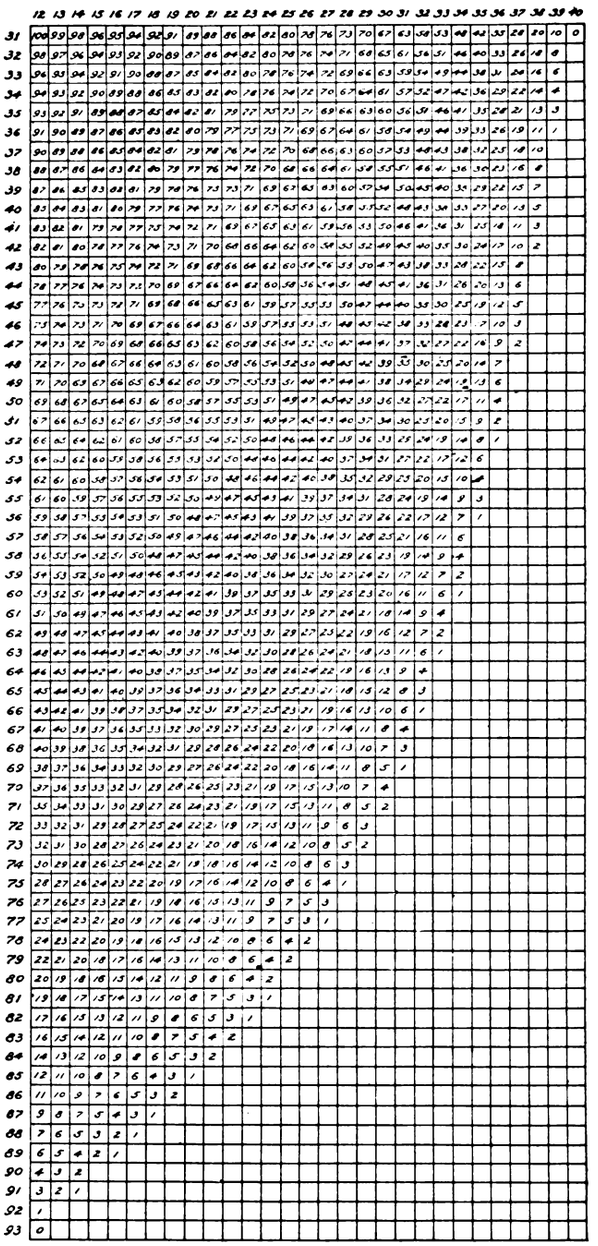


TABLE B.—COAL VALUES FOR SCREENINGS.

The feature of size is a more difficult problem than that of ash, as the following will show. After the tests represented in diagrams Figs. 3 and 4 (sixty-two in number) were finished, Fig. 8 was plotted, using percentages of coal through a 0.25-inch square screen. The diagram for efficiency only is shown, because that for capacity gave no different result. It is apparent that the arrangement of points fails to show any harmful effect due to presence of excessive quantity of fine dust. The fuel used in these sixty-two tests was ordinary screenings, containing varying amounts of ash, and to ascertain if this variable ash content could be the cause of the failure of Fig. 8 to show harmful effect of fine dust, individual tests were used in the plotting of Fig. 9, the ash content for the tests shown by any one of the curves being constant, while the size as represented by the percentage through the 0.25-inch square screen varied. The result of this analysis made it appear that the presence of finer sizes was sometimes harmful, and in other cases beneficial. The scheme of average size was then adopted and employed, with the result shown by diagrams Figs. 3 and 4, described in the first division of this paper, and as a check on the conclusions of these two diagrams, Fig. 10 was plotted, based on percentages through a 0.5-inch screen. With 1.25-inch screenings, this size is nearer to the general average than that of 0.25-inch, and it is apparent that a curve may be drawn through the points which will show a falling off in efficiency or capacity with increase in quantity of fuel through the 0.5-inch screen, which helps to corroborate the conclusions of Figs. 3 and 4.

In coal inspection service, it is quite essential that the tests be simple and few in number, but determination of the average size requires that several screens be employed, involving a large amount of work, as well as difficult calculation, and for this reason there is great advantage in using but one screen. The 0.25-inch size having received more of less favorable consideration in working out a scheme for its use in connection with table B, all of the tests which showed a capacity below 575 horse-power were taken. With these data Fig. 11 was prepared. The average ash in the dry coal for these tests was eighteen per cent. A curve representing values for this ash content, and also for standard ash of twelve per cent being drawn, the latter curve gave values for use in table B. The quantities of coal were transposed from that through the 0.25-inch square to a 0.25-inch round screen. Thus the final result for ash shown by diagram Fig. 7 and that for size by diagram Fig. 11, furnished data used for calculating the final combined values in table B, from which it appears that screenings having twelve per cent of ash or less, and of a size that no more than thirty-one per cent will pass a 0.25-inch round screen, may be considered of 100 per cent value, or in other words, sufficiently good for the purpose.

Basing conclusions on the measurement given by any one screen is arbitrary, as four points in diagram Fig. 11 indicate; therefore, while table B may be depended on to identify all of the coal containing an excess amount of fine sizes, it will, in a few cases, condemn satisfactory fuel.

This paper does not presume to lay down the ultimate laws by which fine coals may be graded in value, but rather to point out the fact that such laws, although at present obscure, do exist, and

Digitized by Google

that our conclusions drawn from numerous tests are as herein indicated.

During the year 1905 there was produced in Illinois and Indiana about 50,000,000 tons of coal, forty-eight per cent of which was one and one-quarter-inch screenings, and although it was not in every case separated from the lump, we can truthfully say that this forty-eight per cent, or 20,000,000 tons of screenings, was sold at the mine at an average price not to exceed two-thirds of its cost of production, and this same fine coal was used for making steam at an average efficiency of less than fifty per cent.

These two facts are sufficient warrant for further investigation of this little-known subject.

High-Efficiency Lighting Units in Ohio.

One of the most interesting subjects of discussion at the recent convention of the Ohio Electric Light Association, at Put-in-Bay, was the progress made in introducing the newer forms of electrical illuminating units in Ohio. In a paper entitled "High-Efficiency Lighting Units in Ohio," C. C. Collins, of the Columbus Railway and Light Company, presents an analysis of the situation.

While referring *en passant* to the flaming arc and the Nernst lamps as among recent improvements, he treats more especially of the Gem-filament incandescent lamp. He thinks the improvements in the incandescent field are more welcome than in other units, since the incandescent constitutes the greater portion of the central station load and source of revenue. The writer deplores the timid policy of clinging to the older types of lamps for fear that sufficient revenue may not be secured by the introduction of a better lamp, and believes that to be governed by such a policy is to invite discontent, competition and perhaps legislation. On the other hand, the adoption of a liberal policy will cause the consumer to increase his lighting and outshine his neighbor, who in turn will retaliate and thus the sum total of consumption be largely increased. The writer doubts if any community has been worked so hard that it will be impossible to further increase its lighting demands. It is also possible in many cases to substitute in existing installations a lamp of higher candle-power but consuming the same amount of energy, thus making friends for the central station in satisfied customers. No improvement is too good for your customer if you would retain him when reverses set in in the way of competition with other as well as with electrical illuminants. The writer mentions with commendation the new factory markings of the Gem lamp, explaining that this method of marking is intended to measure the degree of useful light rather than the candle-power, technically speaking, about which the average consumer knows very little, accurately speaking. A direct comparison of illuminants is probably the best method of convincing the public of the merits of one illuminant over another. This can be done either on customer's premises, or in a display room owned by the central station. By this method all the effects of reflectors, globes for filtering out objectionable colors, general diffusing properties, etc., can be taken into full account. The customer sees that he is buying light, not candle-power nor kilowatts, and can see for himself what he is going to get. Such a display room can be made invaluable. Great care should be taken in the selection of reflectors. The high-efficiency Gem lamp and its shade must be used together as a unit. It is generally used with one of two shades, the concentrating and diffusing, which are so designed that they give an even distribution of light over a specified area. The source of light is distributed over a much larger area than with the arc lamp, the Nernst lamp and the flaming arc, when used at their maximum efficiency, that is, without dense globes. The Gem large size, although not equal to the arc in efficiency, is far better suited where ceilings are low; and in every case where clusters are now used. The writer then makes a comparison illustrating this position. A strong point is that the customer is able to increase his lighting with no additional wiring, as the Gem can be taken on without any change in existing installations. A number of companies are at present making fixtures suitable for the Gem lamp and at very reasonable prices. All incandescent lamps should be used with shades, and their selection is a matter of considerable importance, and should have an eye to giving proper distribution always. A wide difference will be found in shades with respect to their evenly distributing the light and their absorption. An arc lamp, preferably the direct current, should be used where it is essential to show the daylight color of an article; but where color is of little consequence, or white light is not so effective as a light rich in red or yellow rays, the Gem can be used to great advantage. Articles sold should be so far as possible displayed under light similar to that with which they will be used; for example a rug or piece of carpet. In lighting large stores or halls a combination of arc and Gem lamps gives very good results, and is probably the most efficient method. Where the ceilings have a height of less than ten feet, in rooms too small for an arc lamp, in show-windows, offices, stores with hangings, porches, etc., the Gem lamp with its proper shades will be found entirely feasible. The Gem lamp is recommended to all lighting companies as being in sizes of 250 watts or less the best lamp obtainable at the present time. It may at first be put out as a specialty until it has proved its feasibility to the customer, and then be adopted as standard. There is no reason why the fifty-watt, twenty-candle-power size should not be used to displace all carbon-filament sixteen-candle-power lamps. For lighting companies whose regulation will not permit the use of 3.1 watt carbon-filament lamps the Gem can be used at either its middle or bottom voltage, and still give an efficiency of 2.65 or 2.8 watts per candle. The writer, in summing up, expresses his belief that the tantalum lamp is not yet in a commercial form, owing to its high initial cost, and further should be used only on direct current. On account of the method of suspending the filament the lamp can only be burned in a vertical position, on account of the danger of rupturing the filament.

The International Independent Telephone Association of America.

The general offices of the International Independent Telephone Association of America have been moved from the rooms formerly occupied to 422 and 423 Electric Building, Cleveland, Ohio.

The following committees have been appointed by the president:

Executive committee—Senator C. W. Kline, Hazleton, Pa.; Frank L. Beam, Columbus, Ohio; A. C. Lindemuth, Richmond, Ind.; M. B. Overly, Louisville, Ky. The constitution provides that the president shall be an *ex officio* member and chairman of this committee.

Committee on litigation and legislation—J. B. Earle, Waco, Tex.; F. H. Woods, Lincoln, Neb.; E. R. Conklin, Aurora, Ill.; E. B. Fisher, Grand Rapids, Mich.; Richard Valentine, Janesville, Wis.

Digitized by Google

The Frankfort Central Station.

A Large German Municipal Power Plant.

By B. F. Hirschauer.

AMONG the municipal plants which are in successful operation on the Continent may be mentioned the large station which has been erected within a recent period at Frankfort. It ranks among the best-equipped of the German plants. Most of the equipment consists of alternator groups using horizontal engines, but a late addition to the station is a large steam turbine and alternator unit of the Brown-Boveri-Parsons type. All the alternators are operated on the single-phase system, and the feeders which leave the station for use throughout the city, carry the standard tension of 3,000 volts at forty-five cycles, coming direct from the alternators. The present equipment of the plant consists of four direct-coupled units made up of tandem-compound engines driving 1,030-kilowatt Brown-Boveri alternators, and four smaller units of the same general design, rated at 530 kilowatts, besides the steam turbine group, which has a capacity of 3,000 kilowatts. The alternators deliver the same voltage in all cases, and are operated in parallel when desired, including the machine belonging to the steam turbine group.

The general disposition of the buildings will be observed in the accompanying plan, which shows the main dynamo hall, the boiler room and the coal bunkers. The dynamo room is about 300 feet long and ninety feet wide, and contains nine direct-coupled engine and dynamo groups of different sizes and construction. Lying next the dynamo hall is a large and well-equipped boiler room, which is somewhat longer than the first portion of the building. At each end of the boiler room is mounted a battery of six boilers of German make, and besides these two, there has been mounted a battery of three boilers, making fifteen boilers for the whole outfit. The remaining space is occupied by feed-water heaters, superheaters, pumps and other apparatus. Facing the boilers is the building occupied by the coal bunkers, which is thirty-six feet in width. As the station building lies not far from the river, the coal can be easily brought into the premises from the barges. This is carried out by a well-designed set of conveyors combined with cranes for unloading the coal from the boats, so that the coal is taken directly into the bunkers. At each end of the boiler house is a smoke-stack of 170 feet height.

As regards the boiler plant of the Frankfort station, it is made up of fifteen boilers in all, mounted as we have seen in two separate batteries of six boilers each, and one battery containing three boilers. Six boilers of the Simonis and Lanz pattern make up the first battery, and these units have a heating surface of 380 square yards each and a fire-grate surface of about 5.5 square yards. The second battery is formed of six Cornwall boilers of the G. Kuhn type, constructed by the Steinmüller firm. Each of these units has some 100 square yards heating surface. The third battery is made up of boilers of a large size, also of the G. Kuhn type. They have a heating surface of 480 square yards. Mechanical stoking apparatus of the Leach system is used in the boiler plant. In general running, the batteries of boilers just mentioned are called upon to furnish some 70,000 pounds of steam, superheated at 300 degrees centigrade.

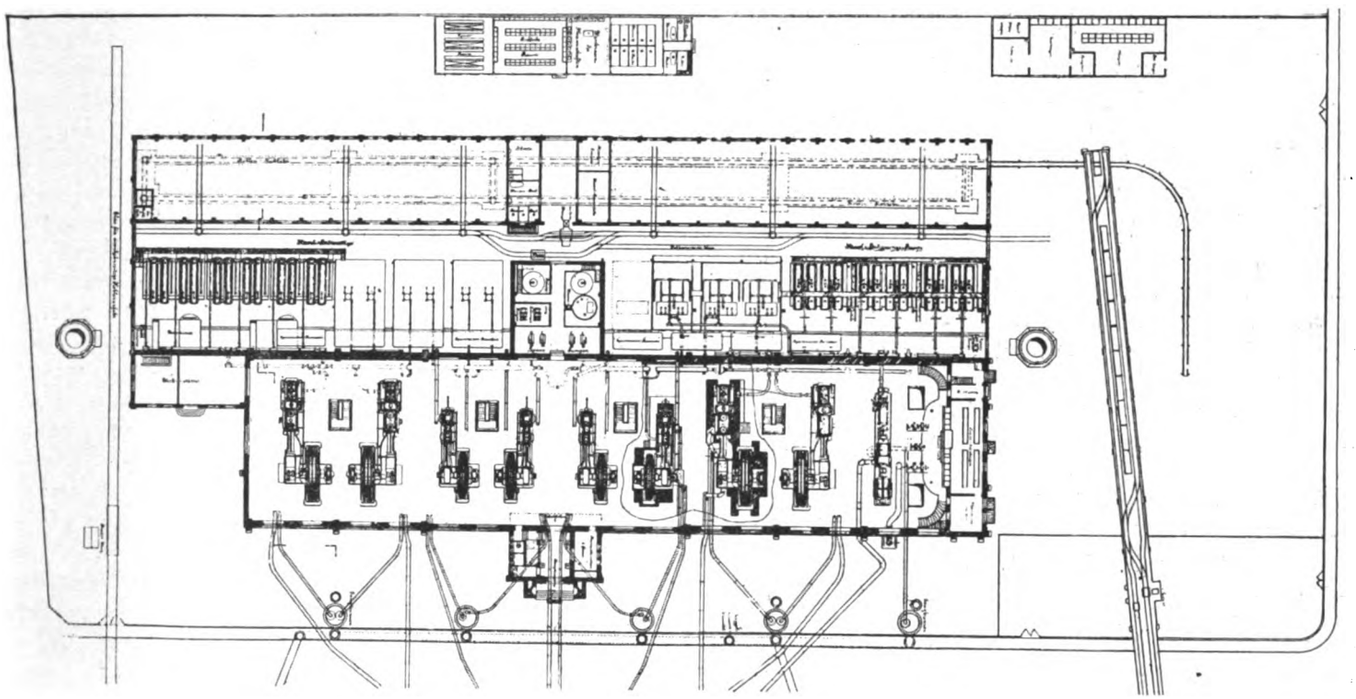


FIG. 1.—PLAN OF FRANKFORT CENTRAL STATION.

In connection with the boiler outfit just mentioned, the plant is equipped with two superheaters of the Steinmüller pattern, which are mounted overhead. Each of the superheaters contains a set of 220 horizontal heating tubes and has a total heating surface of 350 square yards.

The main dynamo room contains nine direct-coupled units in all. These are made up of eight engine-and-dynamo

Digitized by Google

groups and one steam turbine group. For the former units, two different sizes of machines are used. The four larger groups are made up of 1,030-kilowatt alternators driven by horizontal engines, while in the central part of the building we find four groups of smaller size. The latter consist of 530-kilowatt alternators, also driven by engines of the horizontal type. Engines of two different makes are used in the station. For the smaller groups we find a 570-horse-power engine of the G. Kuhn pattern in use. It is one of the best-known types of German compound engines, and can be run as high as 750 horse-power on a maximum load. The engine is tandem compound. A governor is mounted upon the high-pressure cylinder, while the low-pressure system is invariable. The high-pressure cylinder has a bore of twenty-five inches, and the low-pressure cylinder thirty-eight inches. Both cylinders are steam-jacketed. The piston stroke is forty-eight inches. The condenser pump, which is placed in the basement underneath the engine, is driven by a transmission from the outer end of the engine shaft. Three bearings are used to support the latter.

Upon the engine shaft is mounted a heavy flywheel, which serves at the same time as the support for the field magnets of the alternator. A slotted ring, built up of laminated iron, surrounds the field in the usual way. The alternators have been constructed by the well-known Swiss firm, Brown, Boveri and Company, at their Baden factory, and they are designed to furnish single-phase current at 3,000 volts when running at the normal engine speed of eighty-five revolutions per minute. Around the periphery of the flywheel are mounted sixty-four pole-pieces of solid iron. These pole-pieces are fixed to the wheel rim in such manner that they can be easily removed. On the pole-pieces is laid a winding of flat and thin copper strip, with the layers separated by paper insulation. As to the weight of the flywheel proper, it is about thirty tons, and has a diameter of sixteen feet, exclusive of the pole-pieces. Around the field which is thus formed is placed the armature ring, which is made up of a circular casting built in four parts and bolted together, and containing the armature iron proper. The latter consists of sixteen segments of laminated iron. Upon each segment is mounted a winding in the form of four lathe-wound coils which are placed in the slots in the usual way. The coils can be readily removed from the slots when desired, owing to a special method of construction which is used here. At the above-mentioned speed, the alternator is made to furnish 45.3 cycles. On the outer end of the main shaft is mounted a direct-current machine of some size, which serves as the exciter for the alternator. It is a six-pole machine and furnishes a current of eighty volts and 190 amperes. The current is taken into the alternator field by a two-ring collector mounted on the shaft. The four direct-coupled groups of 530 kilowatts form the outfit which was set up during the first period of operating the Frankfort station. As the demand for current increased, it was decided to erect four other groups of a somewhat similar character, but of a much larger size, and in fact the latter groups have nearly double the capacity of those we have just mentioned.

The new outfit is made up of four groups of 1,050-kilowatts capacity, shown in Fig. 2. In the ground plan, Fig. 1, are seen two of the large groups placed on each side of the four smaller sets in the dynamo room. The engines are also of the tandem-compound type and in this case they have been furnished by the Swiss firm of Sulzer Brothers, of Winterthür. A maximum capacity of 1,500 horse-power is given by the engines, and they use superheated steam at 250 degrees centigrade and at a pressure of nine atmospheres. A characteristic point of the engine is the arrangement of the high and low-pressure cylinders. The low-pressure cylinder is mounted next the cross-head of the piston rod, so that the latter will not become unduly heated, and the high-pressure cylinder which carries the highest heat, is separated from the former by a cast-iron connecting piece, so as to isolate it to some extent. The live steam for the engine is made to enter directly from the piping into the steam jacket before going to the cylinders. Upon each of the cylinders is mounted four valves. The inlet valves of the high-pressure cylinder are operated by means of a special form of governor. A pneumatic device connects the governor with a lever upon the switchboard, so that the machinist can vary the speed of the engine from this point.

Upon the shaft of the engine is mounted a single-phase alternator of 1,050 kilowatts maximum capacity. These machines have also been furnished by the Brown-Boveri firm, and in their construction they follow very closely the lines of the alternators which we have already described. Here the flywheel, which is mounted upon the engine shaft, weighs about sixty-five tons and has a diameter of twenty feet. Around the periphery of the flywheel is placed a set of sixty-four field poles which have a copper-strip winding. On the outer end of the shaft is mounted an eight-pole exciter. The cable from the exciter passes through the engine shaft, which is made hollow for the purpose, directly to the terminals of the field, thus dispensing with the collector rings.

As regards the steam consumption of the engines, we find that in the case of the smaller 570-horse-power engines above mentioned, the tests showed that for a normal load of 560 horse-power the engines consumed 25.9 pounds of steam per kilowatt-hour as indicated upon the switchboard. For the maximum load of 750 horse-power, the amount is 26.8 pounds per kilowatt-hour.

An interesting feature of the Frankfort station is the steam-turbine dynamo which has been installed by the Brown-Boveri company. This group will be noticed in the foreground of Fig. 2, and also in the plan view (Fig. 1). It is erected at one end of the dynamo room, beside the engine groups. The turbine is of the two-cylinder form of the Brown-Boveri-Parsons type, and is coupled direct to an ironclad alternator of 2,600 kilowatts. Superheated steam at 300 degrees centigrade is used to operate it, using a pressure of thirteen atmospheres. In this form of turbine the high and low-pressure wheels are placed in separate chambers, with the shafts coupled together in the centre by an intermediate bearing and clutch. But in the more recent forms of wheel the two turbines are built directly together without using a middle space, and having only the two bearings mounted at the ends. This makes the turbine considerably shorter. Aside from this, the present turbine contains the usual features of the Brown-Boveri system.

The high-pressure turbine contains three separate chambers of increasing diameter. The smallest of the wheels mounted on the main shaft contains eleven disks, the second has nine disks, while the largest wheel has eight disks. The second or low-pressure part of the turbine is provided with two wheel-chambers. In the first chamber, having the smaller diameter, there is one set of ten disks, while the second chamber contains a four-disk wheel. Connecting the high-pressure and low-pressure systems is a pipe of large diameter, which passes underneath the central bearing. Four bearings are used for the entire group of turbine and alternator. The bearings of the turbine proper are designed as self-oiling ball bearings, and the outer part of the bearing is cooled by a water circulation, using a water pump which de-

Digitized by Google

livers fifty gallons per minute, so as to give an efficient cooling. Between the two halves of the turbine is placed a specially designed bearing which is combined with a clutch in such a way that it is an easy matter to uncouple the shafts of the two wheels in order to separate them when desired. A good lubricating system is employed for the bearings of the present group. From an oil tank placed in the basement underneath the foundation, a turbine pump operated from the main shaft by a worm gearing takes up the oil and passes it through a cooling box and from thence it is taken to the different bearings by a set of piping. The water which has previously cooled the bearings is made to pass from thence into the oil cooler box through an appropriate piping. By means of the oil pump, the bearings are well lubricated by a constant circulation. A steam pump is provided which serves as a reserve in case of need.

In practice it is found that the steam turbine group runs at a very regular speed and on this account no trouble is experienced in running it in parallel with the other alternators of the station. This is partly due to the method which has been adopted by the Brown-Boveri company in the construction of the alternator. Here the revolving field of the machine is built upon the lines of the rotor of a non-synchronous motor. As will be noticed, the alternator is almost entirely enclosed, except for a set of ventilating holes. Current is brought into the revolving field by a set of collector rings provided with carbon brushes. The present machine is built for a capacity of 2,600 kilowatts under the regular load, in which case the power-factor is 0.8. At the maximum load the capacity rises to 3,000 kilowatts. The normal speed of the turbine is 1,360 revolutions per minute. Although the length of this group is somewhat above what we find in the turbines which do not employ the central bearing, it does not exceed reasonable limits, and is here about fifty feet over all, with a width of eight feet. The exciting current for the revolving field of the alternator is furnished at 120 volts from two rotary groups which have been installed in the dynamo room. These groups serve to convert the high-tension alternating current from the main bars into low-tension direct current. Each of the rotary groups has a capacity of fifty kilowatts. The station contains a large outfit of accumulators, which is mounted in a special room adjoining the dynamo hall. A reserve supply of current is always at hand in this case. The storage battery consists of sixty-seven large cells, and has a capacity of 920 to 1,300 ampere-hours at a three-hour discharge rate. A special group has been installed in the plant for charging the storage battery, consisting of a rotary converter rated at fifteen kilowatts.

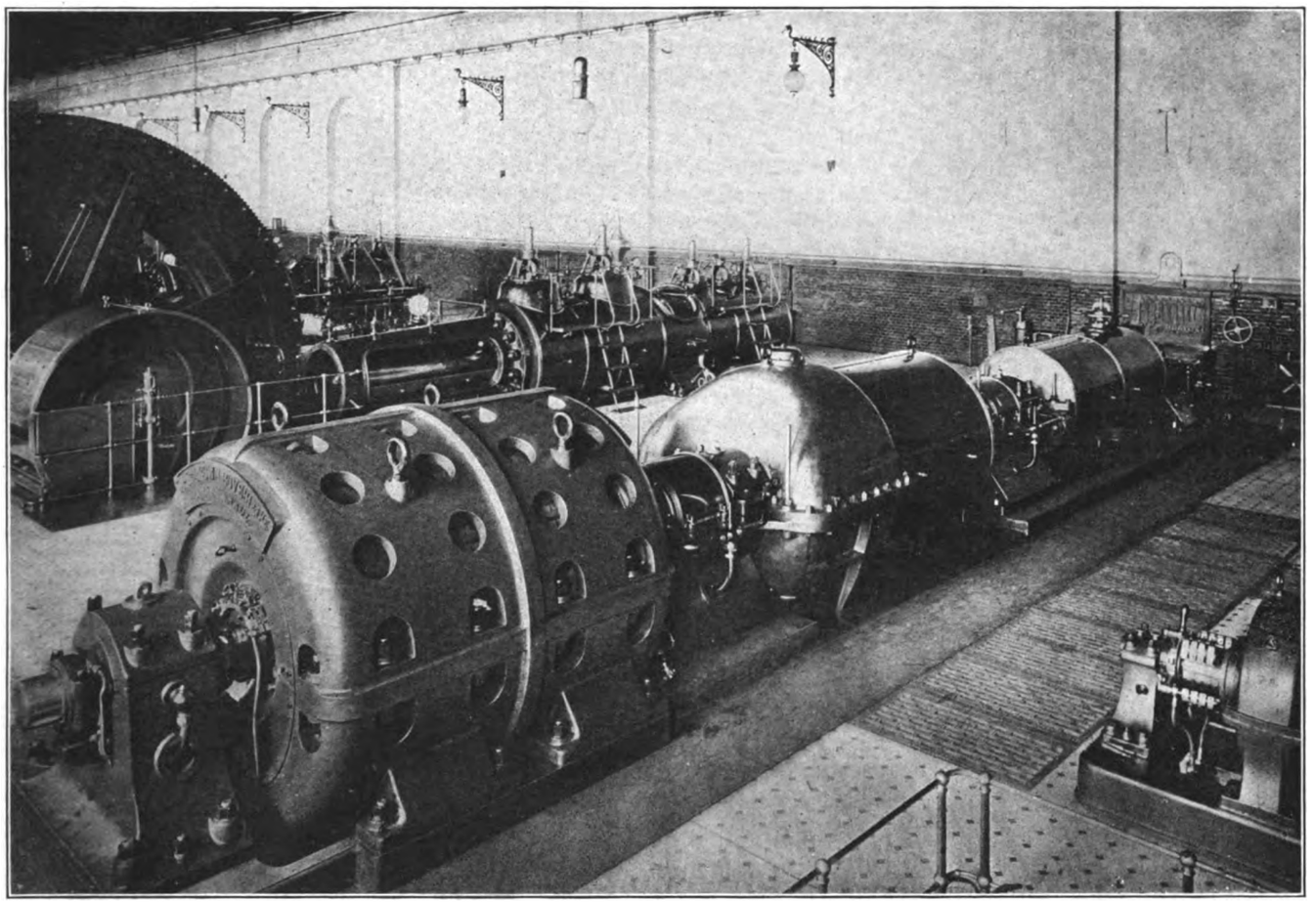


FIG. 1.—3,200 3,000-VOLT TURBO-ALTERNATOR AT THE FRANKFORT MUNICIPAL STATION.

As regards steam consumption in the present group, a few of the principal results which were obtained upon a series of tests made in the station at the time of installing the turbine are given in the accompanying table. The following table shows the general figures taken in the trials under different loads which varied from 2,000 to 3,000 kilowatts on the alternator. A water resistance was used for

Digitized by Google

the load, and this was kept constant during the tests.

TABLE 1.—STEAM CONSUMPTION OF TURBINE.

Steam pressure at the inlet in lbs. per sq. inch. ..	179.5	181.8	156
Vacuum, per cent.	93.2	91.8	90.6
Superheating, degrees C.....	298	295	312
Load on the alternator, kilowatts.....	1 945	2,518	2,995
Steam consumption per kilowatt-hour in pounds.....	15.85	15.6	14.75

In order to compare this performance with the steam consumption of the engines, take the example given above in regard to the 750-horse-power steam engines of the station. Here, as already noticed, the rate is 25.3 pounds per kilowatt-hour on normal load, or 26.2 pounds for the maximum load. For the steam turbine, as will be seen, the consumption is much less, seeing that for the normal load we have but 14.75 pounds per kilowatt-hour on the normal load and 14.3 pounds for the maximum load. For the steam turbine the steam consumption is less as the load rises, on the contrary, to what happens for the steam engine. In the Frankfort station the steam dynamo has been running continuously day and night, except for a short stop of one hour per week for overhauling and cleaning of the turbine and condenser.

Applications of Electricity.

The Cooperative Electrical Development Association, Cleveland, Ohio, has compiled a booklet entitled "Applications of Electricity." This gives a very complete list of the applications of electric current, indexed under various lines of business.

The objects of the Cooperative Electrical Development Association are:

First—The promotion of an increased and more extensive use of electricity by the public, for light, heat and power, as both an end in itself and a means to the increased demand for electrical apparatus and supplies, and the cooperative planning and execution of various means and methods effective to this end.

Second—The establishment of cooperative relations, both moral and financial, among the different electrical interests, from manufacturer to consumer, to the end that each may contribute in some measure toward bringing about the above results desired in common by all.

LIBERTY AND ORGANIZATION.[1]

BY F. A. PATTISON.

If any part of the infinite plan under which this world of ours is developing is comprehended by man it seems to be the preservation and betterment of the individual and the fact that organization means strength. Gathered as you are from all quarters of this broad country of ours, there is naturally some common motive which actuates you, and it is undoubtedly the aim and object that holds together all trade organizations as distinguished from technical societies. Perhaps, in view of this fact, it would not be amiss for us to study for a short time this question of associations from the point of view of an outsider or interested onlooker.

What, then, are the common interests that draw men together in an association which expresses to the world that they stand for all that is good in a given trade? Whenever several men or companies are bonded together for the promotion of common interests they immediately create certain relations with obligations and privileges which they are bound to regard and the treatment of which determines the standing of the trade, the association and the individual. In a trade like electrical contracting these obligations are:

1. Obligations to your association.
2. Obligations to labor.
3. Obligations to materials.
4. Obligations to your customers.

So bound together and interwoven are these several relations that it is impossible to be untrue to one without affecting some and nearly always all the others. As a rule, every one is ever ready to take advantage of and insist upon all the privileges, but few are equally alive to the obligations. It should never be forgotten that there can in all fairness never be a privilege without a corresponding and equally binding obligation.

I have designated as the first obligation that to the association. The precise and paramount objects of any single organization are naturally unknown to me, but through my acquaintance with your members in many localities throughout the country, and by your reputation, I believe one is justified in starting on the premise that your association stands for all that is best, most upright and honorable in the conduct of electrical contracting. Living under this banner it is indeed a great privilege to be a member of your organization, and each and every member is under equally great obligation not only to live up to that standard, but to see that every other member does so. This high grade of association can only be sullied in two ways, *viz.*: by the honest member who fails to live up to it because of undertaking work too large for his financial standing, or work he does not know how to perform; and by the dishonest member who deliberately does not do the best and right thing. An association should be only so large as it can be and contain only members of the first class, and should be so graded that the good name of the organization does not suffer from either of the above-mentioned weaknesses. We can not all do the same kind or the same size of job, and do ourselves justice, but we all can and should if we belong to the same association do the same grade of work; therefore, grade yourselves or those you deal with will grade you and you will have to accept the rating. This is one weakness of the labor organizations. Instead of grading they say we are all alike and must be paid alike. With graded and classified membership an association stands in such a position that any one may with perfect safety employ a member of that association and be sure of the grade of work for which the organization stands. It is self-evident that the character of an association is determined by an integration of the behavior of the individual members. There is, therefore, a binding obligation to each other and to the association in each and every act in carrying on the every-day transactions. The true test of these various and complicated relations in every move is this: "Is every one concerned getting a square deal?" If every one is able to answer this in the affirmative, there never will be any need of that weakest of all excuses that "Business is business." All are in business to make money, and an association is formed to further these ends; but when an association or its members follow this purpose without regard to the means employed, the result is sure to be disastrous. It is formed to assure the greatest good for all, not for the greatest number. Any member of an association who to further his own interests or for any other purpose does not give a fellow-member a square deal is a traitor to the association and not only injures the member and himself, but also the association, and this, too, whether any formal declaration covering the specific case exists in the constitution or by-laws. It is in accord with the unwritten law that should control the actions of any one having the title of a gentleman, and an asso-

[1] Abstract of an address delivered before the convention of the National Electric Contractors' Association, Cleveland, Ohio, July 18-20.

Digitized by Google

ciation should never be composed of any but gentlemen.

In this age there would be no need of a contractors' association if it were not for the fact that the contractors have to buy labor and materials. The most important and complex question before the American people to-day is the labor problem, and the contractors have been working for years to solve it. But there will never be any permanent solution of the problem until it is approached by both sides from the standpoint of justice, rather than that of advantage to one party or the other. Business is so based on money values or similar consideration that it will be impossible for two organizations to be on a fair basis in a business proposition until both are reliable and subject to the same forfeiture for non-performance. If an organization claims the power to make a bargain for its members it must make itself liable by bonds or other considerations, not only in order to give the organization it is making a compact with fair play, but also for the proper protection of the rights of its individual members. In this age it is necessary for both sides of any agreement to have a sufficient bond at stake to make them think before they act and to prevent being led astray by the hotheads.

One of the useful members of society is he who makes things, but from the contractor's point of view one of the most useless members of society is he who makes things and sells them and then won't stand behind them. This brings us to the contractors' relation to the material supply. There are but three essentials in this relation, *viz.*, price, grade and delivery. The question of price can be determined by the rules of barter until complications set in, and then it becomes necessary for the association to step in, and demand just treatment. It is a very unfortunate fact that there are manufactures of all grades of materials for any one given use. The instant a good device appears the market is flooded with cheap imitations or substitutes. This opens the field of gambling to the contractor. But it should not affect members of the same association, for in all fairness to his fellow-members every member should state in his bid, if not bidding on a specification, exactly what materials he proposes to use. Otherwise what protection has a member against the worst kind of cut-rate, cheap-grade work from his fellow-members as well as from the outsiders? What advantage is it to belong to an association if you know you can not have a square deal from the members? Any one is better off on the outside where he has to consider self-interest alone and catch the poor unbenighted customer with any bait he sees fit to use. Here is an opportunity for the association to be one in deed as well as in name.

Again, too often is a contract made between a supply association and a contractors' association, and the pernicious rebate system gives advantage to a selected few. Here again we fall far short of the ideal association. Any organization has to have its officers and committees to carry on its affairs, but the moment they become a ring it is time to clean house and consider the greatest good for all and not for the greatest number.

Probably no one subject has caused greater stretches of the imagination than promises of delivery. It would seem wise for associations to pay some attention to questions of grade of materials and time of delivery and see if its members can not be better protected in these two particulars rather than lay all the stress upon price. It may at first blush seem foolish, but it seems to me if a powerful association took proper care of its members there would be less black mud sold for rubber, less painted spaghetti for soft-rubber tubing, fewer rejected panel-boards and switchboards, less painted putty for porcelain, no meters or instruments that don't mete, fewer overheating dynamos, a smaller number of galloping motors, a minimum of steam-eating engines. In other words, in time perhaps, the material men would cater as strongly to good grade as they do now to price. It is a very difficult matter for a small contractor or even a large one to compel any of the large corporations to live up to delivery promises, but if he has a national association back of him he would be listened to and heeded much oftener. It is often a matter of financial loss and most always the estrangement of a customer to fail in performance on account of non-delivery. Therefore, permit me to offer as a suggestion that such matters be studied and acted upon by associations instead of individuals.

In all the industrial world the most important essential is the customer. You are in business to promote industrial progress and make money, and therefore the most important relation to the contractor is that to the source of income, namely, the customer. It seems to be the first impulse of this busy world to regard any one who suggests any attempt to try to realize the ideal as a dreamer or a charlatan, and yet I venture to assert that the relations existing between contractor and customers to-day is far from what it should be. We have tried the system of everybody for himself and the devil take the hindmost, and the results you all know if you read the papers and magazines and have a good honest talk with yourself. Can the trade associations do anything to help better the conditions? They most assuredly can and will, for if not of their own initiative they will be compelled to by the sentiment of the people.

The divines in their baccalaureate sermons to technical graduates are dwelling at length upon ethics in the engineering world, the professional societies are discussing professional ethics, corporations are investigating themselves, and throughout the industrial world better behavior is looked for, expected and insisted upon. The people are becoming politicians in the best sense of the word. All this tends to show that we are all beginning to realize that we have been following the wrong path. We are awaking to the fact that a real man must be a man at all times and under all circumstances; that dishonesty is dishonesty, no matter what high-sounding or conscience-appeasing names we may choose to give it; that one can not be a dishonest man and at the same time an honest tradesman, contractor or professional.

What then is the course for the organization to pursue to help toward the rule of fraternalism rather than individualism? This country has shown to the world many examples of contest for principle without regard for monetary gain, and thousands upon thousands of its citizens have shown themselves to be men in every sense of the word. Organizations should continue this spirit and stand for something besides money-making. Now do not make the false inference that we for one moment do not believe in money-making. It is a very necessary, honorable and noble calling. Any one and every one if they so desire should make all the money they can honestly, but beyond that the spirit of the world is changing, and instead of standing in open-mouthed wonder, admiration and praise, it is crying halt, where did you get it? We, the people, demand an explanation. First, then, an organization should stand for high-grade membership. No individual or company should be allowed to become a member until it has shown itself to be capable. This applies more forcibly to labor organizations, but is equally true of trade associations. No one should be admitted who is not perfectly honest in every detail, in all deal-

Digitized by Google

ings with fellow-contractors, material men, workmen and customers. Outside of all questions of ethics or morals, it absolutely pays to be honest.

Second, the spirit of cooperation should be predominant. Not only should this apply to your own trade but to others and also to the owner. More cooperation and fewer attempts to gain advantage would work wonders in the progress of carrying out contracts. There must be absolutely no unfair treatment of any one concerned either openly or under the guise of business custom or other puny excuse. Fair, open, man-to-man dealings is what will be insisted upon in the near future. The people want it or they would not applaud the late revelations of crooked dealings which are but the natural outcome of the business methods for years past.

Third, organizations should have graded membership. If they do not, time will bring about a large number of smaller organizations, each comprising a certain branch of each trade, and the arrival of cooperation and harmony will be again postponed. It is sufficiently difficult to have peace between the several trades, but with smaller subdivisions trouble will be too plentiful to have peace abide with us.

Fourth, establish and maintain a code of contracting ethics. Call it by any name you will, but have something in organization that corresponds to professional ethics. One man's honor should be just as high as another's, no matter what his calling. This system has had a universally good effect in all professions in spite of some awful lapses. The world will accept your trade on the plane upon which you place it, and therefore I would say place it on a high plane and not only maintain it but raise it just as much higher as possible.

Electrical Night at the Coliseum, Chicago.

On August 28 the Coliseum Company, Chicago, Ill., gave a special concert for the officers and friends of the Electrical Trades Exposition Company at the Coliseum. Among the guests were about 600 electrical men and their families. Ellery's Band, Channing Ellery, manager, prepared a special programme for the occasion, and the audience appreciated to a high degree the rendition by this band and the work of its well-known leader, Francesco Ferullo.

RECENT ADVANCES IN OUR KNOWLEDGE OF RADIATION PHENOMENA AND THEIR BEARING ON RADIATION PYROMETRY.[1]

BY J. B. HENDERSON.

In a previous paper[2] I drew the attention of engineers and physicists to the recent advances in the theory of radiation which have been made during the last decade, principally by the Berlin school of physicists—on the theoretical side by Boltzman, Planck and Wien, and on the experimental side by Lummer, Pringsheim, Rubens, Paschen and Wanner.

The laws of radiation which have been developed theoretically and confirmed ex-

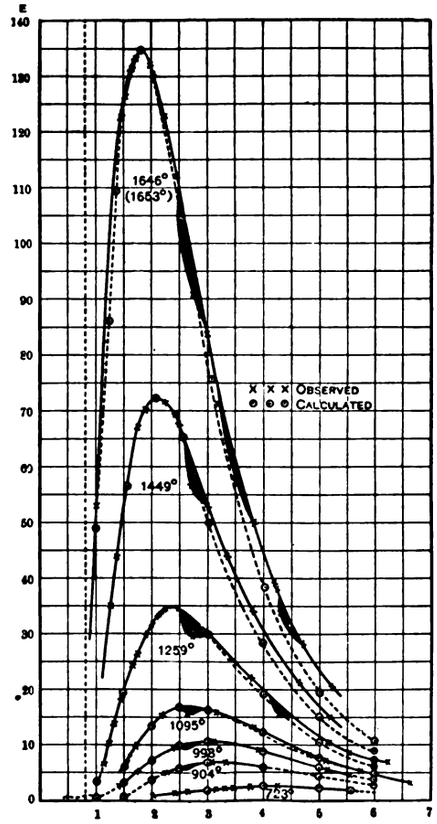


FIG 1.—COMPARATIVE DATA.

perimentally are four in number, and apply to the radiation from any ideal black body. They are

1. $\int_0^\infty E_\lambda \, d\lambda = \sigma T^4$ (σ being a constant)—Stefan-Boltzman law.
2. $\lambda_m T$ = constant } Wien's law of
3. $E_m T^{-5}$ = constant } displacement.
4. $E_\lambda = \frac{a \lambda^{-5}}{\epsilon^{\frac{b}{\lambda T}} - 1}$, ($a$ and b being constants). Planck's law of the partition of energy in the spectrum.

λ_m is the wave-length of maximum radiant energy in the spectrum, E_m the value of the maximum radiant energy, and T the absolute temperature. The expression proposed by Wien for the partition of energy in the spectrum differs from Planck's only in omitting the figure unity in the denominator, and may be interchanged with Planck's if λT is less than 3,000.

The comparison between Wien's expression and Lummer and Pringsheim's experiments is shown in Fig. 1. It will be noticed that there is considerable deviation from the experimental results at long wave-lengths, but if Planck's expression is used these deviations disappear, except such as are within the limits of experimental error.

The above laws are developed theoretically from Maxwell's electromagnetic theory and the laws of thermodynamics, as was pointed out in the former paper.

All accurate radiation thermometry is founded on these four laws; hence, wherever accuracy in radiation thermometry is required it is very important to remember the limitations of the laws—namely, that they apply only to the radiation from an ideal black body. Kirchhoff showed that the radiation inside an enclosure whose walls are at uniform temperature is the same as would be emitted by an ideal black body at the same temperature; and by using the radiation from cavities whose walls were heated electrically to uniform temperatures, the theoretical laws have been experimentally proved.

If, then, we wish to obtain accurately the temperature of any material in a furnace by means of the radiation which it emits, we must take the radiation from a cavity whose walls are at the required temperature. If the material is in liquid or pulverous form, a tube closed at one end serves the purpose if the closed end is inserted in the material and the radiation taken from the closed end. If the material is in ingot form and there is no serviceable hole in it we can use an auxiliary piece of similar material provided with a hole and placed against the ingot, so as to have practically the same temperature as the ingot. The hole or cavity may bottom against the ingot or in the auxiliary piece of material.

To use a radiation pyrometer in the tempering of armor plate on a cooling curve, it would be necessary to lay another plate with holes in it on the one to be tempered, then heat the two together in the furnace and after withdrawing them from the furnace to focus the thermometer on the bottom of one of the holes.

[1] Paper read before the British Association (Section A) at York, Wednesday, August 8.
[2] *Electrician* (London, vol. li, p. 773, August 28, 1903.

Digitized by Google

When the required temperature is indicated, the upper plate could be removed and the lower one quenched, the upper one being returned to the furnace with the next plate.

In every case where the temperature is read while in the furnace, it is necessary to shield the radiation from luminous flames after leaving the cavity. This may be done by means of tubes, and the temperature of the walls of these tubes will not affect the result, provided an image of the cavity is formed on the sensitive surface of the thermometer.

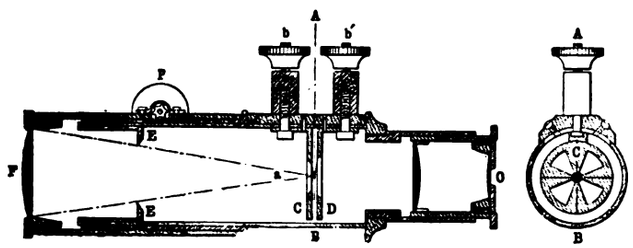


FIG. 2.—FERY'S RADIATION PYROMETER.

The principles on which the present radiation pyrometers are founded are the first and fourth laws. Those founded on the fourth law we may distinguish from the others by the term optical thermometers because only the luminous portion of the spectrum is used. Law ii does not lend itself well to temperature measurement, because the maximum radiation is not well marked, especially at low temperatures; but it has been used in the laboratory to fix limits for the temperature of our luminants, of the sun and of some fixed stars. Law iii, which measures the maximum energy in the spectrum, promises better than Law ii, but it has little advantage over Law i, and the instrument would be much more complicated.

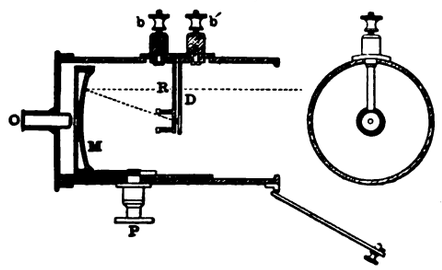


FIG. 3—SECTIONAL VIEW OF FERY'S RADIATION PYROMETER.

Pyrometers based on Law i have a black receiving surface for absorbing the radiation from the radiating body. This surface may be one of the junctions of a thermo-couple, or the wires of a bolometer or one arm of a radiometer balance, but as we are more concerned with instruments used in the industries than with those used in the laboratory, the following descriptions will be confined to the former.

Figs. 2 and 3 show two types of Féry pyrometers. In Fig. 2 the image of the radiant is formed on the receiving surface by means of a fluorite lens, although in some technical forms a particular kind of glass having low absorptive power in the infra red is used for the lens. The temperature of the receiving surface is measured by a thermo-couple and portable galvanometer. This pyrometer lacks sensitiveness at temperatures below 900 degrees centigrade, and to increase the sensitiveness Féry replaces the lens by a concave mirror, making a reflecting telescope, as shown in Fig. 3. This form can measure down to 600 degrees centigrade. The eye-piece in both instruments is for sighting purposes, as an image of the radiant must be formed on the small receiving surface of the junction. So long as this image is larger than the receiving surface the reading of the pyrometer is independent of the distance from the radiant, because both the total radiation received by the lens or mirror and the area of the image vary inversely as the square of the distance from the radiant, hence the intensity of the image is constant.

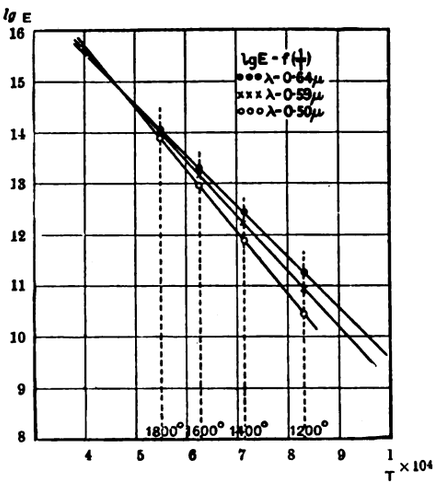


FIG 4—COMPARATIVE DATA FOR THEORETICAL AND EXPERIMENTAL RESULTS

In a perfect pyrometer of this kind the receiving surface should be ideally black, and in some researches Lummer and Pringsheim have used cavities as receiving surfaces. The error introduced in a practical instrument due to this defect is, however, not of great significance. The accuracy of the Féry instrument is within one per cent between 800 degrees centigrade and 1,600 degrees centigrade with ideal black radiation.

Law iv gives us the equation connecting the radiant energy with temperature along an isochromatic curve. This may be written.

$$\log E = c + \frac{d}{T}$$ where c and d are constants.

If, then, we confine our attention to one luminous wave-length, say the red line transmitted by red copper oxide glass, and plot log E as a function of 1/T, we get a straight line. Fig. 4 shows a comparison between theory and experiment for several isochromes. This is the scientific foundation of all optical pyrometers. It may be easier to calibrate them empirically, but it is possible to calibrate them by means of this equation.

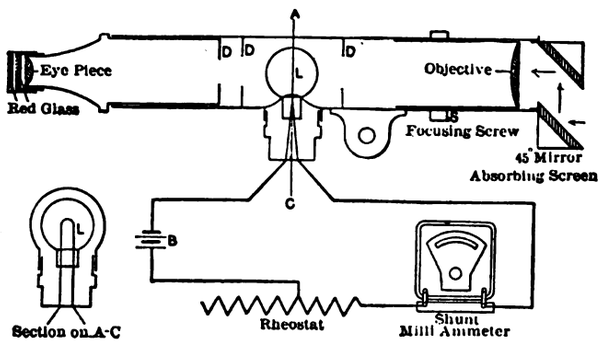


FIG. 5.—HOLBORN AND KURLBAUM'S OPTICAL PYROMETER.

Optical thermometers are simply spectro-photometers of simple form. Among the laboratory forms are le Chatelier, the Féry absorption type, the Wanner and the Lummer instruments, for a description of which the reader should consult the original memoirs or "High-Temperature Measurements," by le Chatelier, Boudouard and Burgess (Wiley & Sons).

The most practical form of optical pyrometer, however, is that due to Holborn and Kurlbaum, which is shown in Fig. 5. An image of the radiant is formed in the focal plane of a telescope, and is there superposed on the filament of a small electric lamp placed in the focal plane. The current in the filament is then varied until the filament, as viewed through the eye-piece of the telescope, can not be distinguished from the image of the radiant. The current in the filament then forms a measure of the temperature. To standardize the instrument each lamp is first of all aged and then calibrated to get the connection between the current and the temperature of the filament. In measuring very high temperatures the radiation is weakened by dark glasses or by successive reflection, the glasses or reflecting surfaces being also standardized. Red glass is used in front of the eye-piece.

The following table given by Burgess shows the accuracy of the instrument at two points on the scale:

Temperature from H. & K. Pyrometer.	Temperature from Thermo-Couple.	Temperature from H. & K. Pyrometer.	Temperature from Thermo-Couple.
1,347	1,347	632	634
1,351	1,347	634	633
1,343	1,343	633	633
1,338	1,342	633	632
1,342	1,342	...	...

Digitized by Google

Electrical Equipment of a Lumber Mill.

An Interesting Use of Belted Motors in the Eggers & Graham Lumber Company's Mill at Uniontown, Pa.

THE conditions encountered in lumber mills present, in many respects, problems in power transmission not found in other industries. The material employed and the wastes are very inflammable, and the size of the work handled and the severe power demands for starting and operating wood-working machinery of necessity require a motive power that is not only immune from fire risk, but which will withstand heavy fluctuations in load and operate the various machines with as little obstruction to the handling of the materials as possible.

In the old method of driving by means of overhead shafts and belts these conditions were but imperfectly fulfilled, and, moreover, on account of the losses in the shafting and belts the transmission system was inefficient. Numerous countershafts were required, not only occupying much valuable room, but adding to the lost power. In such installations the frictional losses were always great, the belts required constant attention, were expensive and slipped under the severe fluctuations of load necessarily thrown upon them; and, more than all, they were objectionable because of the danger to life and limb which is inherent in this type of drive and on account of the large floor space occupied. This latter inconvenience brings about an additional risk, since the sawdust and chippings necessarily accumulate in places from which they are removed with difficulty, grease and dirt are mixed with them, and a very inflammable material results, bringing an added fire risk.

These conditions have led to the demand for a method of driving which would eliminate, in the main, many of the objectionable features involved in the old system. Naturally the electric motor was the one selected. When it is adopted the mill may be divided into sections of convenient size, and each floor or each group of machines, or each individual machine supplied with its own motor, thus producing a flexibility which is of especial value when the work is light or when the mill must run overtime. Even though the belted type of motor be adopted, the overhead countershafts and belts are, to a large degree, eliminated, thus removing the objectionable and dangerous features attending their use. These considerations led the Eggers & Graham Lumber Company, of Uniontown, Pa., to adopt the electric drive in its mills, and the accompanying illustrations show, in a striking way, what may be done by the substitution of the electric motor for the old system.

The electrical system adopted is a two-phase, alternating-current system supplying induction motors operating at sixty cycles, 200 volts. Current for the motors is supplied by the West Penn Railways Company, and each machine throughout the mill is driven by its own motor. These are all of the Westinghouse CCL type, with the exception of the motor driving a mortising machine, which is of the C type.

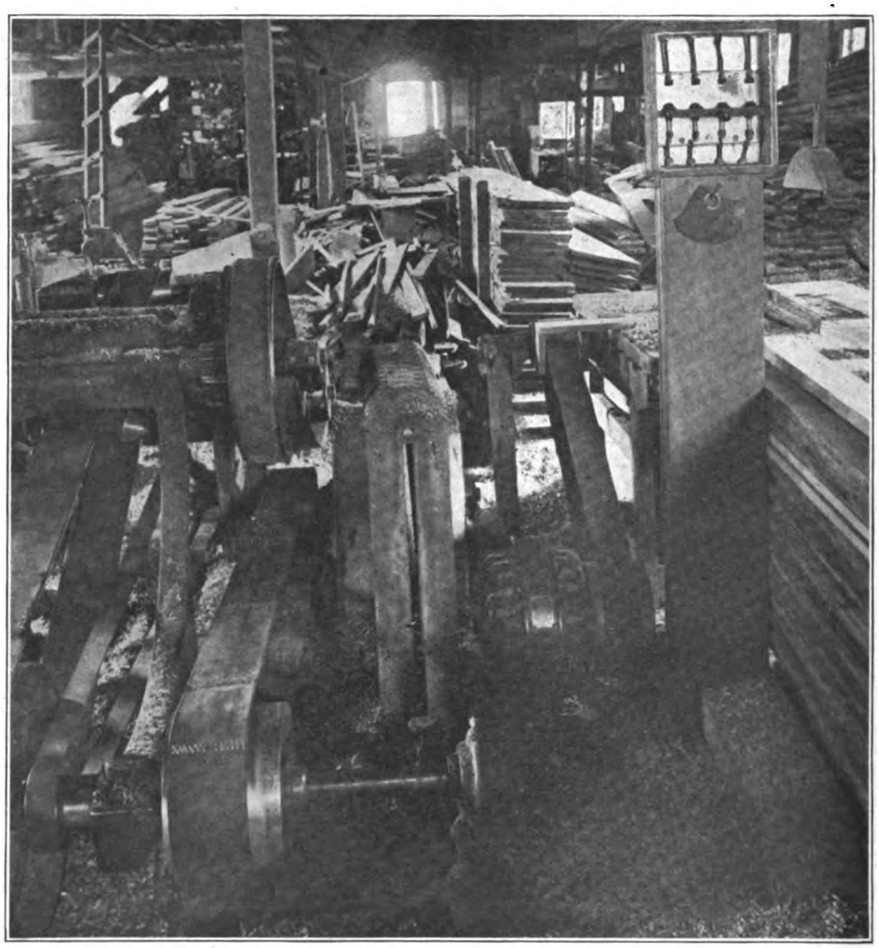


FIG. 1.—THREE-HORSE-POWER INDUCTION MOTOR DRIVING A RIP SAW.

Fig. 2 shows a fifteen-horse-power induction motor driving a moulding machine. From the arrangement it is evident that but little space is available, yet the motor and its belt are easily accessible. To the left of this machine is shown a rip saw. Another view of this saw is given in Fig. 1, where the motor (rated at three horse-power) may be seen. In Fig. 2, in the background, may be seen two small motors. These are rated at one-half horse-power each. One drives an emery grinder hidden behind the moulding machine mentioned above, and the other drives a grindstone, which may be seen. The controlling switches for these motors are placed conveniently on the side wall.

Fig. 3 is a view of a fifteen-horse-power induction motor driving a planer. From the amount of sawdust or chips shown in this view the pressure under which the work is being carried through the mill is indicated. Fig. 4 shows the type C induction motor referred to above, driving a two-horse tenoning machine.

In addition to the motors shown there are a five-horse-power motor driving a ten-inch cross-cut saw, a five-horse-power motor driving a pony planer, one rated at four horse-power driving a panel raiser, and one of one horse-power driving a shaper. A hand-feed planer is driven by a three-horse-power motor, a hand saw by

Digitized by Google

another of the same rating, and a second rip saw is driven also by a three-horse-power motor.

tration of the excellent fire risk obtained when motors of this type having no commutators or other parts at which flashing may occur are adopted. In certain positions in the mill the accumulation of refuse is so rapid and so great as to make it necessary to furnish the motors with covers, which, of course, interfere very considerably with ventilation. The installation in this mill is operating day and night, to the entire satisfaction of the owner.

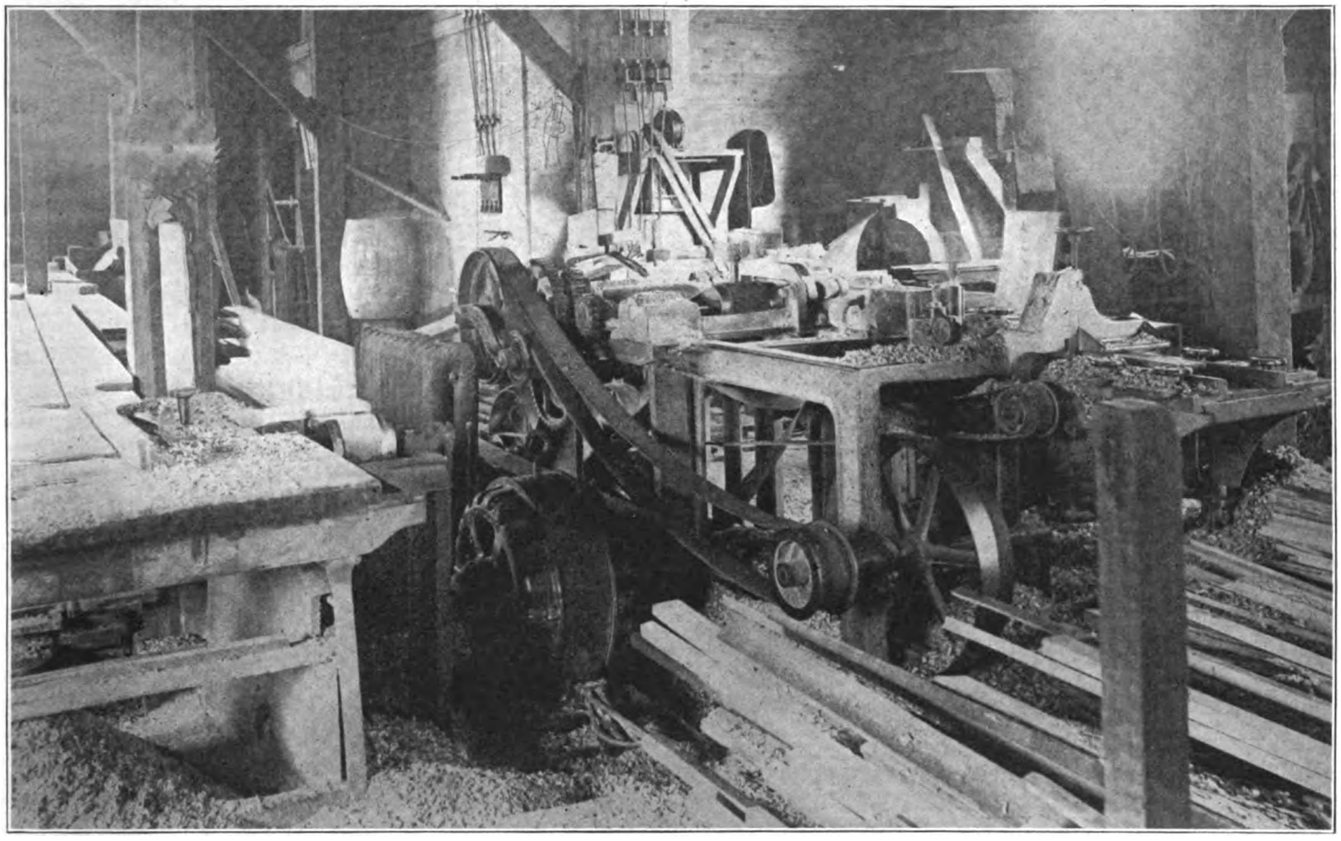


FIG. 2.—FIFTEEN-HORSE-POWER INDUCTION MOTOR DRIVING A MOULDING MACHINE.

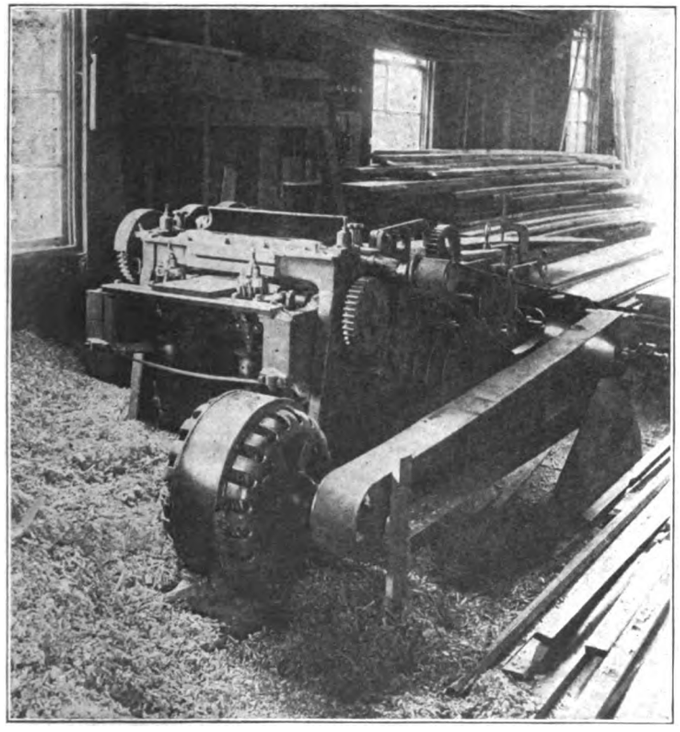


FIG. 3.—FIFTEEN-HORSE-POWER INDUCTION MOTOR DRIVING A PLANER.

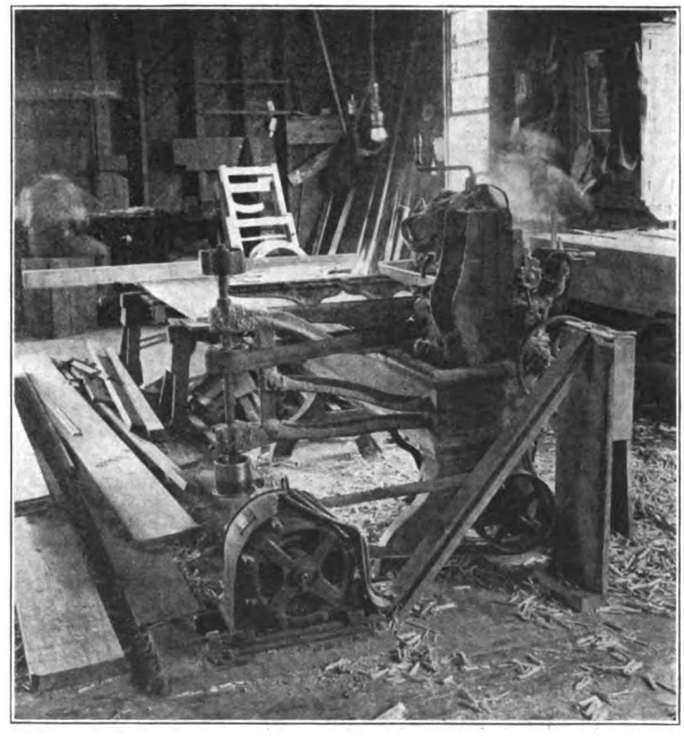


FIG. 4.—TWO-HORSE-POWER INDUCTION MOTOR DRIVING A TENONING MACHINE.

The illustrations give a striking idea of the severe conditions encountered in this type of service and furnish a forcible illus-

Digitized by Google

An Electrical Spectacle at Connellsville, Pa.

The accompanying illustrations show the electrically illuminated and decorated coal and coke arch recently installed at Connellsville, Pa., by the H. C. Frick Coke Company, commemorating the one-hundredth anniversary of the town. Connellsville is the centre of the coke-producing territory of the state of Pennsylvania, and its output is considered among the best in the world.

Thirty tons of coal and seven tons of coke were required to build this arch. The lighting required about 600 sixteen-candle-power lamps. For the other lighting decorations nearly 6,000 lamps were used; current being supplied by the West Penn Electric Company, of Connellsville, which controls the trolley and lighting interests, covering about 100 miles of territory.

We are indebted to E. T. Penrose, superintendent of the West Penn Electric Company, for the illustrations and facts.

ELECTRICAL ILLUMINATION, HUNDREDTH ANNIVERSARY OF THE TOWN OF CONNELLSVILLE, PA.

COAL AND COKE ARCH, HUNDREDTH ANNIVERSARY OF THE TOWN OF CONNELLSVILLE, PA.

Niagara Falls Meeting of Electrical Jobbers.

Nearly 300 members and guests attended the meeting of the electrical jobbers held at Niagara Falls, N. Y., September 11, 12, 13 and 14. Two sessions were held each day, in which trade matters and the relations of its members to manufacturers and consumers were discussed.

The meeting was largely given over to entertainment and sightseeing. About fifty ladies were present. The entertainment committee, headed by W. E. Robertson, of Buffalo, gave a smoker and vaudeville performance at the Cataract Hotel on Tuesday evening, and following this a rejuvenation was held of the Sons of Jove and seventy-one new members were taken into the order. H. B. Kirkland was master of ceremonies for this rejuvenation. C. B. Roulet, Mercury of the order, came from Dallas, Tex., to be present at the rejuvenation.

On Tuesday a tug of war was held on the lawn of the Cataract, which created considerable amusement, and in the evening an informal dance was held.

On Thursday a baseball game was the feature, and in the evening a banquet was given at the International for jobbers and manufacturers.

The following prominent representatives of the electrical manufacturers were among those present:

C. E. Corregan, E. J. Kulas, J. C. Fish, A. D. Page, Frank Harrington, Bailey Whipple, Walter Cary, H. B. Kirkland, R. B. Corey, Charles Munder, John W. Brooks, J. E. Way, H. B. Bliven, Albert S. De Veau, J. B. Estabrooks, Ralph A. Schoenberg, Harry Adams, J. B. Olson, A. C. Garrison, Charles I. Hills, Charles Flack, N. C. Cotabish, V. C. Gilpin, J. Wilson, A. E. Carrier, E. J. Wilson, M. H. Moffett, F. D. Masterson, Harry P. Moore, T. C. Walsh, George E. Seaving, H. O. Phillips, G. F. Brunt, A. H. Pease, F. B. Smith, H. A. Waterman, E. G. Bernard, Thos. G. Grier, William Crockett, S. H. M. Agens, Francis Raymond, H. T. Paiste, F. Overbaugh, James Wolff, W. W. Merrill, E. A. Downes, W. F. Sisson, W. C. Bryant, E. B. Dodge, J. Robert Crouse, C. O. Baker, A. B. Palmer, W. K. Patton and A. W. Spear.

Digitized by Google

The Cincinnati Fall Festival.

The Cincinnati Fall Festival, which opened on August 28 and will run until September 22, under the direction of the Cincinnati Fall Festival Association Company, has this year arranged an electrical exhibit, the main object of which is to familiarize the general public with the many ways in which electricity and electrical apparatus and appliances may be utilized in every-day life.

The Cincinnati Gas and Electrical Appliance Company, an offshoot of the Cincinnati Gas and Electric Company, now the Union Gas and Electric company, has a handsome booth, with E. A. Sarran and George A. Conway in charge, where are shown chafing dishes, curling irons, flat-irons, sewing-machine motors, batter-cake griddles, coffee percolators, heating pads, hot-water heaters of all descriptions, etc. Mr. Sarran reports many inquiries from callers respecting the cooking and heating devices, and believes the company is making progress in its efforts to introduce these appliances. At the same booth the Federal Electric Sign System, of Cincinnati, shows electric signs.

The Warner Elevator Manufacturing Company, a well-known Cincinnati concern, established before the first half of the last century had ended, has within a few years added electric elevators, and within the past year has put out its patent push-button electric-control elevators. The one shown at the festival will be shipped to New York later for installation, the building there not being ready to receive it. It is a duplicate of the one that will be placed in the Jewish Hospital, Cincinnati, shortly. Upon pushing the button the car comes automatically to the floor; upon the person entering, the elevator will not move until door is closed; the party inside then pushes an indicator indicating the floor at which he wishes to alight, and the elevator runs to that floor and stops automatically. The occupant then opens the door to that floor, and nobody can take the elevator away until the door is again closed. This exhibit is in charge of John Hitzler and C. H. M. Atkins, president of the company.

The Chicago Pneumatic Tool Company shows its enterprise in setting up an exhibit which none of its Cincinnati competitors have emulated. Messrs. Walker, Aplin and Coates are in charge. Special electrical tools and accessories, such as portable grinder and buffers, portable pressure blowers, drilling stands, and air-cooled Duntley electric drills, single-motor, two-motor and three-motor, with armored cable, are shown. The magnetic "old-man" will withstand an upward stress of 1,200 pounds, and is superior in many points to the mechanical "old-man" heretofore used.

The Bullock apparatus, shown by the Allis-Chalmers Company, is on display, and comprises several induction motor-generator sets of twenty-five kilowatts, with starters complete, and other electrical apparatus.

The Lodge & Shipley Machine Tool Company, of Cincinnati, includes in its exhibit a twenty-four inch patent head lathe, motor-driven. The system permits the use of any motor having a speed variation of not more than two to one. The motor is mounted on an extended cabinet leg at the head of the lathe, and is connected to the lathe spindle through gearing at the back of the headstock.

The J. A. Fay & Egan Company, in connection with its wood-working machinery, shows Westinghouse electric motors.

The Cincinnati & Suburban Bell Telephone Company has a handsome booth, F. L. Van Arsdale in charge. In this booth is located the Fall Festival exchange. The exchange has connection with all booths so that exhibitors may have constant communication with their down-town offices. This booth was designed by J. E. Peavey, superintendent of exchanges. An interesting feature to the general public is the radiophone, in charge of George Johnson, who uses the same radiophone apparatus which was shown at the St. Louis World's Fair. It transmits in this instance sound by light-waves a distance of 150 feet. In the balcony is located a powerful searchlight, the rays from which are received by a concave reflector in the booth. A phonograph plays into the arc light, whose rays thence transmitted to the concave reflector are focused upon selenium, the light-waves resolved into electrical energy, and this again converted into sound-waves in the ear receivers.

The Post-Glover Electrical Company, of Cincinnati, shows a great variety of fixtures and apparatus, several show cases being filled with a miscellaneous assortment of appliances. The handsome bronze electroliers, female figures one-third life-size, imported from Austria, attracted attention. This company also had some beautiful designs in art glass domes of its own make, and portable lamps. The exhibit is in charge of H. S. Kinnicutt, Frank Kindleberger and William Schlewinsky.

J. W. Weatherington, an enterprising photographer from Louisville, is picking up the dimes making very clever pictures on postal cards. Curious to learn how these effects were produced, the representative of the ELECTRICAL REVIEW found Mr. Weatherington using the Cooper Hewitt mercury vapor lamp, which he declares is unequal for his work, costing one-half as much as the arc and giving three times the actinic power; it also has great diffusive power.

Wandering further, in the Berninghaus barbers' supplies exhibit, there was shown the James Barker (Philadelphia) motor-driven vibrator for use in massage.

The special committee on electrical exhibits is as follows: Frank D. Lawrence, J. C. Hobart, Luke Lilley and J. A. Brett.

D. A. B.

Osram Lamps.

The following particulars have appeared in a number of foreign journals regarding the Osram lamp, which is being introduced by the Deutsche Gasglühlicht Aktien Gesellschaft. The lamps are rated at from thirty-two to fifty candles, and are put out for pressures from 100 to 130 volts. Their efficiency is said to be one watt per candle, and a life of 1,000 hours is claimed for them when running at the correct voltage. Tests made by the Physikalische Technische Reichsanstalt with certain of these lamps rated at thirty-two candle-power showed a decrease of about three per cent in the light after burning for 1,000 hours. With the higher-candle-power lamps a still smaller falling off was found. The lamps are said to give the same light whether used on direct or alternating-current circuits. During the Reichsanstalt life tests the circuit upon which they were running was operated under ordinary commercial conditions, and the voltage varied from two to three per cent. Little or no appreciable variation in the brilliancy of the lamps is noticeable under these variations. The accompanying diagrams have been drawn from the Reichsanstalt tests.

Colorado Electric Light, Power and Railway Association.

The convention of the Colorado Electric Light, Power and Railway Association will be held at Denver, Col., September 18, 19 and 20. A number of features have been arranged for, and the following papers have been announced: "Voltage Regulation," Leonard Wilson; "The Use of Polyphase Motors in Outlying Districts," W. A. Carter; "Profitable Commercial Cooperation," J. Robert Crouse; "The Lighting of Small Stores," J. R. Cravath; "Water-Type Lightning Arresters," A. M. Ballou; "Transformer Testing and Line Records for Transformers," E. P. Dillon; "Steam Turbines," C. C. Chappelle.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

A Self-Registering Electric Target.

A self-registering electric target designed by Colonel George A. Peters, of Toronto, Ontario, was exhibited at the Bisely rifle ranges, during recent target practice at Bisely, England. The particular apparatus shown there was to mark a four-foot target used in competition at 200 yards. The target consists of a target plate of solid one-half-inch steel. This is carried on four hinged brackets supported by a frame bolted to a foundation platform of heavy timber. The front of the main frame carries a milled steel plate one-half inch in thickness, forming a carrier for the recording hammers, which vary in number from sixty-one, in a target four feet in diameter, to 173 for a six-foot target employed for greater ranges. This plate is pierced by a series of oblong holes, through which the ends of the hammers project. The hammers are supported on pins, and, due to their weight, rest against the target plate. When thrown backward they make contact with brass plates, each thus closing a circuit through a wire, which drops a shutter on the announcing board. The distance between the hammer or supporting plate and the target plate can be varied to correspond to different service charges or different ranges. It is made so that a hammer will be thrown whenever a bullet strikes within a three-inch circle of the point of contact of the hammer with the target. There is one electrical circuit for each hammer and annunciator, and they are put up as an ordinary telephone cable. When a bullet strikes the target plate, if directly over a hammer, it throws this up and completes the circuit. If midway between two hammers, it will throw both, thus indicating the position struck; or it may throw three or more. In any event, the number thrown will, by means of the corresponding drops at the indicating board, give an accurate idea of the point struck.—*Abstracted from Engineering (London), August* 17.

Construction of Squirrel-Cage Armatures.

The types of construction of squirrel-cage armatures employed by the various large electrical manufacturing companies of the world are described here by A. G. Ellis. A number of these are very familiar. The use of the cast-iron spider in the large sizes is universal. In the smaller sizes the iron stampings are slipped directly on the shaft. The greatest variation in construction is in the method of making end connections. One company uses a solid ring drilled to fit the rotor conductors, which are inserted in the holes and then riveted up on the outside and turned smooth. Another uses a flattened ring which is slipped into slots milled in the ends of the conductors. Both of these give strong structures, and the latter a good cooling surface. The Allmana Svenska Elektriska Aktiebolaget, of Sweden, uses a peculiar construction. The ends of the rotor conductors are carried well out and then connected together by weaving a small copper wire around them. This wire is carried from conductor to conductor and is given one turn around each. The last few turns are then sweated to the conductors. This gives a strong construction with large cooling area. It has the advantage that, if desired, some of the outer turns may be taken off and thus the resistance of the connection be increased. The Alioth Company, of Switzerland, employs a ring having two series of projecting lugs upon it, leaving radial spaces between. The conductors are bent down into these spaces, and the lugs are bent alternately right and left over them. A construction used some time ago by the Svenska company consisted of a small ring in which radial slots were milled. The ends of the conductors were left long and bent down and fitted into these slots. The construction usually adopted in this country, which is a flat ring to which the conductors are bolted, is also widely employed in Europe.—*Abstracted from the Mechanical Engineer (London), August* 18.

Electrical Plant of the King Edward Bridge, Newcastle-on-Tyne, England.

On July 10 the new bridge known as the King Edward Bridge, on the North-eastern Railway at Newcastle-on-Tyne, England, was opened. On interesting feature in the construction of this bridge was the employment of electrical power throughout. Electrical derricks, an electrical conveyer, and electric power for driving the air-compressors were all used. The bridge consists of four spans and the total amount of steel work is 5,872 tons. A generating station was built and equipped with two direct-connected generators delivering each 750 amperes at 440 volts, and three smaller sets for supplying lights. Steam was supplied from locomotive boilers. The distributing system is divided into two parts, one for the caisson work, the other for the outside apparatus. Each caisson was provided with three shafts and was served by a five-ton electric derrick. The air-lock doors were heavy, and, for convenience, were operated by small electric motors. Compressed air was supplied by three compressors, each having cylinders fifteen inches in diameter and thirty-six inches stroke, running at ninety revolutions per minute. Each of these compressors was driven through gears by means of a 125-horse-power shunt motor. A cableway was erected across the river for delivering material at the piers. The span was 1,520 feet, and the carriage was served by a 100-horse-power motor. The cableway was capable of handling loads of ten tons, and, altogether, carried 40,000 tons of material. For constructing the spans a fifteen-ton gantry crane was used. This crane was fitted with shunt motors operated on the regenerative system. In addition to the machinery mentioned, the pumps, concrete mixers, mortar mills, saws and other tools were all electrically driven.—*Abstracted from the Electrical Review (London), August* 17.

The Limitations of the Ballistic Method for Magnetic Induction.

During the investigations into the magnetic properties of pure electrolytic iron which are being carried out by Professor C. F. Burgess, of the University of Wisconsin, it was found that great care is necessary in employing the ballistic method, and it became necessary to examine this method for sources of error and to see if it might not be improved. The chief error seemed to be due to magnetic viscosity, and such a source of trouble has been noted by various other writers on the magnetic properties of iron. It was found, however, that while this trouble

Digitized by Google

did exist, it was not alone responsible for the errors which crept in—errors which in some cases amounted to nearly fifty per cent. A convenient way of applying the ballistic method by the step-to-step process consists in arranging the apparatus with fixed constants and varying the current through the magnetizing coils by varying the applied potential. It was found that this method introduced an error, due to the time constant of the magnetizing circuit, and better results are obtained if a constant voltage be employed and the current be varied by varying the resistance in this circuit. In this way, when the currents are low, the resistance is high and the time constant small. In the step-by-step method errors are cumulative, and to get around this difficulty the process was changed somewhat in the following way: The magnetizing circuit was arranged so that, by closing one switch, a current would be sent through the magnetizing coil sufficient to carry the iron up to full saturation. Then, by closing a second switch and opening the first, the current was suddenly decreased from the former value to that at which a reading was desired. This method is more laborious than the other, but it gives values for the induction several per cent higher than the other, and a hysteresis area about eighteen per cent larger. The effect of the galvanometer period was also investigated, and it was found that with a period of five and one-half seconds the viscosity of the iron caused the reading for the induction to be considerably lower than when the period was fifteen seconds.—*Abstracted from the Physical Review (Lancaster), August.*

Electricity Applied to Rolling Mills.

In concluding a long communication on the application of electric power to rolling mills, M. Creplet considers first the amount of work necessary to be done in rolling ingots out into different shapes, and then examines certain methods of applying motors for this difficult service. In one of these a so-called power equalizer is employed. This consists of a booster exciter, the armature of which is connected in shunt with the series fields of the main driving motor (this motor being a compound machine), while the field-winding of the booster is connected across the main source of supply. The object of this machine is to enable the series field of the main motor to be varied either at the will of the operator or automatically, so that the speed variation of the main motor may be greater than that which would occur normally. For example, running as a cumulative compound machine, the speed of the main motor varies from 320 to 275 revolutions, with a variation in the armature current of from 200 to 800 amperes. If, however, the armature current were increased to 1,000 amperes, the speed would fall to 232 turns. By means of the booster the additional 200 amperes required through the compound winding to reduce the speed to the lower figure may be obtained. This arrangement then enables the motor to operate as a compound machine at speeds lower than it would develop normally. This feature is important, since the amount of work required in rolling different sections varies considerably. The regulator is mounted on the motor shaft, and a commutating switch is provided, enabling it to increase or decrease the current flowing through the series field. A table is given, showing the power required to roll various sections, the dimensions of which are noted. In all cases the total power required is considerably greater than that actually expended on the section. To roll a simple round bar weighing about thirty pounds to the yard requires twenty-seven and one-half kilowatt-hours per ton actual energy, 4.5 kilowatt-hours of which are useful. To roll a sheet weighing about two pounds to the yard requires an expenditure of 125 kilowatt-hours actual energy per ton, 62.5 of which are useful. The table indicates that the efficiency varies, according to the sections and to the method of handling them, from thirty-three to sixty-five per cent.—*Translated and abstracted from the Bulletin of the Association des Ingénieurs Electriciens (Liege), August 1.*

Electrical Machinery for Mines.

The use of electrical methods and apparatus in mining work has been increasing notably during the last few years. The advantages of this system are well recognized, but in its use, particularly in fiery mines, certain safeguards must be taken against fire and explosion. This phase of electrical machinery in mines is dwelt upon in this article by George Farmer. The author frankly admits the economy of the system as compared with other methods of transmitting and applying power, but contends that there is danger accompanying the use of the electric motor in mines where fire damp exists. He considers that the use of electric power transmission should be attended with the strictest care and that foresight should be exercised before putting in an electric plant. The prevention of ignition of mine gases from electrical machinery has been made the subject of exhaustive experimental investigations in Great Britain and Germany. The latter country took up the matter as long ago as 1885, and five years later a series of investigations was made by the French government. In Great Britain galleries were constructed above ground and fitted with mining apparatus. These were then filled with mixtures of explosive gases in order that the appliances should be subjected to the worst dangers apt to be found in mines. The dangers from electrical machinery underground lie principally in the possibility of sparking and consequent ignition of explosive mixtures. The most common remedy for fiery mines is a free circulation of air, but this can not always be guaranteed. It is therefore necessary to take precautions at the motor to prevent ignition. Gauze coverings of the commutator, while in most cases effective, can not be relied upon if the surrounding air provides a continuous explosive mixture at the commutator; nor can completely enclosed motors be depended upon. The following suggestions are made for securing the greatest degree of safety when installing electrical machinery in mines: All motors should be placed on a good solid foundation, so as to reduce vibration to a minimum, and thus avoid a frequent cause of sparking. For coal-cutting machinery the tracks should be laid carefully and solidly. It is very important to keep the motors scrupulously clean, free from dust and superfluous oil, and it is an excellent plan to make ample allowance all through the plant. Avoid cheap apparatus and make the machine suit the conditions of the mine, at the same time making the conditions of the mine as easy and safe as possible for the machine.—*Abstracted from Cassier's Magazine (New York), September.*

Detroit River Tunnel Contract Awarded.

The contract for the tunnel under the Detroit river, to be used by the Michigan Central Railroad, has been awarded to Butler Brothers Hoff Company, New York city. Several alternative plans were submitted by the railroad company, that selected by the contractor being the one designated as design A, though this has been modified somewhat. In this design the previous material underlying the river is to be replaced by an imperfectly watertight material of concrete placed under water, through which, without the use of shields, the tunnel proper may be constructed. The date set for the completion of the tunnel is June 1, 1909.

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

NEW BUSINESS: HOW TO GET IT AND HOW TO KEEP IT, AS APPLIED TO A LARGE CITY.[1]

BY FRANK M. TAIT, DAYTON, OHIO.

Time was when the average central station man was bending every energy to secure the lowest possible generation and distribution costs of his current and the greater problem of securing a larger volume of desirable business was not the leading question it has become the last few years.

To-day the central station man is asking how he may improve the power factor of his plant, and what are the best means of procuring the desirable new business, and when it has been obtained how he may best retain it and encourage the further use of electricity after it has been connected to the system.

These questions are ones that must be very carefully considered, and a plan of action to produce quick results must depend upon the past performances in the particular town or city considering the problem.

Assuming that the getting of new business has not been followed in a systematic manner or perhaps not at all, and the results obtained meagre or not satisfactory, it will be necessary to make a fresh start. If the company does not possess a complete card index of the town, active young men of pleasing address should be sent out to make a building to building canvas to procure the data necessary to compile a complete card index showing the style of house, location, owner of same and his business, tenant and his business, whether the house is wired or piped, if the fixtures are in, and when possible, the feeling of the tenant toward the electric light company and the use of its current. These cards should also bear the date and the name of the canvasser. When the cards are carefully taken and properly filed, they form a true guide to the whole field desired to be worked for better and for more electric business.

After the card has been obtained a complete list should then be made from same, indicating the building, etc., that seem to offer the best opportunities for business. The town or city should then be divided into sections or districts, with the list of prospects located in each district and tabulated. The next problem is to secure a proper type of canvasser to solicit the business in each district, and this part of the central station scheme is a difficult one, for it is soon learned that good solicitors are hard to obtain, and it is acknowledged that a first-class canvasser, who can close good business every day, is one of the most important personages about the whole central station system.

A satisfactory method is to employ bright, energetic, clean-cut young men of pleasing address and courteous manner and carefully train them for the position of canvassers.

The new canvasser should be placed in the several departments of the company until he obtains a good insight into the requirements of first-class electrical service and thoroughly appreciates the necessity of observing the details that go to make up the satisfactory electric current he is to sell.

When the candidate has advanced far enough in the operating and complaint departments he should be turned over to the chief canvasser or other official who has charge of the new business department, to be further coached along the line of his duties and then sent out for a few days, in company with an experienced canvasser, that he may observe the method of approaching prospective customers, arguments used, etc. He should then be given a district and started off to produce the proper amount of profitable new business required of him.

In order to keep an accurate record of what each canvasser is doing, it is very necessary to have them fill out daily an accurate report blank, and these daily blanks must be correctly kept and the results obtained by each man should be tabulated each week, showing the names of parties called upon, number of contracts closed, reason for not closing all of them, amount of new business added to old customers, expense items, etc. From these weekly sheets may be readily learned the percentage of contracts closed to calls made, the cost per call, per contract closed, per kilowatt of new business obtained, or in any particular way the data may be desired.

These weekly sheets quickly indicate the men who are producing the business, and by properly alloting the districts, no trouble will be found in producing satisfactory results all around, and the canvasser who does not put in good substantial work in his district can not escape the weekly inquiry.

Each canvasser should be paid a definite weekly salary, and at the end of stated periods, should receive an additional recompense, in the way of commission or bonus, based on the value to the lighting company of the new business he obtains. Further rewards should also be offered to the canvasser making the highest record in a given time. The districts covered by the various men will indicate the proper method of handling this feature of the new-business department.

To facilitate the efforts of the canvassers, it is desirable, if possible, that a room be especially devoted to their use. Every morning, the first hour should be given over to the discussion of the past day's trials, troubles and tribulations and a full and frank talk on the best ways and means of obtaining better results and of avoiding past difficulties, should be engaged in by the respective canvassers and the chief canvasser, superintendent or whoever is responsible for the new business of the company. These meetings are a great help and with the proper man at the head of the canvassing department will fill the men with enthusiasm for each day's work.

To afford the canvassers and other men about the plant, as well, an opportunity for studying the theoretical as well as the practicable side of the business and make them better salesmen and workmen, every company should feel able to purchase a number of the best books published on the various branches of the business and also keep on file the leading electrical magazines, journals, etc.

The men should be encouraged in their desire for more knowledge of the business they are engaged in and nothing helps promote this spirit more than to have meetings in the evenings at regular intervals at which meetings a talk may be given by the superintendent or any man in the company who is capable of affording information along any line of the business.

Pertinent questions should be solicited

[1] Paper read before the Ohio Electric Light Association, Put-in-Bay, August 22.

Digitized by Google

from the men and all should feel that their interests and the lighting company's interests are the same. Efforts spent along these lines will be liberally repaid by the higher quality of work performed by the men and the larger amount of good new business obtained by the canvassers.

The number of canvassers that may be used to advantage will depend upon the locality and in some places it is found desirable to have special men in addition to the regular canvassing force. These special men may be experts along the line of electrical signs, cooking and heating apparatus, decorative and window lighting, power, etc., while in others the chief canvasser or superintendent is usually a man capable of looking after this special work.

To further facilitate the canvassers' work it is desirable to have advertising that will keep the lighting company's product constantly before the public. This result may be partly accomplished by the local newspapers and satisfactory space should always be purchased and attractive, timely copy inserted and frequently changed. The newspapers will also be likely to be friendly to your company if this medium is used.

To enable the canvasser to get to the man who is thinking about wanting electric current, the follow-up scheme of individual letters is a good one. These letters should be written in a clean-cut style with as few words as possible and sent to the merchant, manufacturer or tenant and enclosed with each letter a stamped return postal card ready for return if they are interested. These letters should be mailed to a well-selected list compiled from the card index and should be sent at intervals close enough to keep the matter ever before the prospect until he finally decides to investigate and returns a postal card and the canvasser's opportunity arrives.

All envelopes leaving the electric lighting company's office and going to consumers or others in the territory covered by your mains should always carry a dodger or booklet, relating to some appliance for the economical use of electric current, and the leading manufacturers of these appliances are now furnishing, gratis, quantities of their booklets with the lighting company's name printed on same.

All construction work, wagons, toolboxes, etc., should be properly decorated with banners or labels calling attention to the use of your product, and no opportunity should be lost sight of in keeping your commodity in the public eye.

A convenient and very satisfactory method of keeping before the public day and night is the use of prominent bill-boards in the various districts and have a concise advertisement printed on same and by means of trough reflectors illuminate the bill-board at night.

The use of electric signs for advertising the company's business is also a good means of burning the lighting company's product into the public mind. Both of these methods indicate to other advertisers the value of electrically lighted signs and bill-boards and indicate new business in this direction.

It is this publicity and constant pounding of the word "electricity" into the minds of the public that brings a central station business. When a manufacturer's steam plant breaks down and he wonders what he can do; when a kerosene lamp explodes and the user wants safer light; when the decorator sends in a large bill for retouching walls in a residence and the owner thinks of a light that will not smoke and disfigure paperings and tapestries, then it is that the constant hammering of these advertisements, letters and canvassers' efforts has its effect and the electric current its reward.

To assist the canvassers, exploit the use of current during the daylight hours, and it is well to arrange that they may offer appliances like electric sad-irons, sewing-machine motors, vibrators, etc., on a free trial basis for two weeks or more with the understanding that the appliance will give satisfactory and economical results during the trial and allow the customer the privilege of purchasing same at the end of the trial at about cost price or return to the company without expense if they are not satisfactory and merely pay for the current consumed during the trial. It is a fact that very few trial installations ever come back on the company.

It will be well to remember in this connection that a canvasser should see to it that the trial user thoroughly understands the proper use of the appliance, and the trial should be carefully watched to this end by the canvasser concerned.

With all the advertisement and follow-up systems, dodgers, bulletins, etc., it is necessary that the canvassers follow up every possible clew to new business and present the matter in the proper light personally, for there is nothing as good as the personal interview by a clever canvasser.

When new business has been obtained and connected to the lines the central station should then make the satisfactory service of the customer its particular object of attention.

A polite letter of appreciation should always be mailed to every new customer and enclosed with his approved copy of the electric current agreement, and the anxiety of the lighting company to give absolutely satisfactory service at all times and to every one on the line should be touched upon in this letter.

The canvassers responsible for the new business should inquire of the new user after it is in use a few weeks if everything is satisfactory and as represented, and also remind the customer that the company is always waiting to do the right thing if the service requires any attention from any cause whatever.

The complaint department of every lighting company bears a vital relation to the keeping of new business and the enlarging of the old business. Those in charge of the same should be diplomatic and courteous to a high degree and fully posted on the policy of the company. Telephone calls or complaints relating to the service should always be handled intelligently, promptly and courteously.

Every complaint received should be attended to at the earliest possible moment, and it should be the aim of every person connected with the lighting company to give the customer entire satisfaction.

This may be a difficult proposition in some instances, but it is a matter of record that special effort along this line always pays the lighting company, and too much stress can not be laid upon this particular point.

While this paper may not fit the requirements of all lighting companies, the scheme noted, enlarged or curtailed, as may be needed by the size of the district covered, will be found satisfactory. Human nature is nearly the same everywhere, and the central station man who will see to it that every person in his company, from the president down, studies the interests of the customers, attends to their complaints promptly and satisfactorily, renders honest and good service, properly rewards the canvassers who bring in the business, will soon find as much new business and enough enlargement of the old business as the most active electric lighting man can take care of in a rapidly growing power plant. In addition to this, think of the possibilities for a large business in any community served by a central station that has the confidence of the entire public and the business good will of the individual citizens.

Digitized by Google

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

HCK Instantaneous Electric Water-Heater.

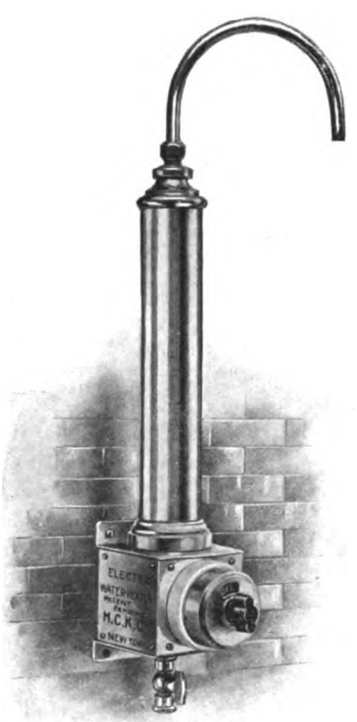
In the earlier type of electric heaters, the heating element, usually consisting of a resistance wire wound upon a suitable insulating frame, was placed within the tool or appliance to be heated. A certain amount of air space always surrounded the heating element, therefore the heat was never transmitted directly to the heating surface of the appliance. This indirect transmission of heat from the heating unit was found to be extremely inefficient, and the efficiency of the heater was further reduced on account of the limited temperature at which the resistance wire could be operated in the air.

Both the efficiency and the lasting qualities of the modern electric heating appliances have been materially improved by imbedding the heating element in an insulating compound which protects it from the atmosphere, permitting a much higher temperature than would be possible in the open air. The insulating compound, in addition to insulating and protecting the heating wire or strip, also serves as a much better medium than the air for transmitting the heat to the heating surface of the appliance, with which it is in direct contact.

Keeping the above in mind, and after considerable experimenting, and many tests conducted during the past year, the H. C. K. Company has produced a new form of electric heater for heating water instantaneously.

It was found during the tests that it would be impossible to heat water instantaneously by any other method than direct contact between the water and the heating element. This form of heater was then developed, but while the efficiency could be maintained extremely high and the heating of the water could be made as rapid as desirable, the life of the heating element depended altogether upon the presence of the water. The problem was solved when an automatic cutout was applied to the electric water-heater which would interrupt the current when the water ceased to flow, or if the flow should be reduced to such an extent that the water in the heater would boil.

At first sight, it might appear that the water flowing through the heater around the heating coil would introduce a ground on the electric system. This is, however, not the case, as insulating joints are provided at top and bottom of the heater tube and the resistance of the water is sufficiently great to prevent any flow of current. Where the heater is connected to the regular Edison three-wire system, the neutral, or grounded connection, is connected to the lower part of the heater, which absolutely prevents any grounds, as there can be no difference of potential.



HCK Instantaneous Electric Water Heater.

This is also the case where the heater is used on alternating systems where one side or the neutral of the secondary circuit is grounded.

The new instantaneous electric water-heater consists in the main of a supporting box, upon which is mounted a double-pole quick-break switch, an insulating joint of special design to the lower end of which is attached a one-quarter-inch water-valve. Screwed into the upper part of the insulating joint is a bronze fitting within which is placed the cutout which automatically opens and closes the electric circuit as the water is turned off and on. In the upper end of the bronze fitting there is held (in a similar manner as is a water-glass for a boiler) a porcelain tube, with one terminal at each end. Within the porcelain tube is placed the heating element, which consists of a specially designed spiral, made of a material which is guaranteed not to rust or corrode or be injured in any way by the action of the current and the presence of the water. At the upper end of the porcelain tube there is another bronze fitting with insulating joint above it which supports the spout. One wire leads from the switch to the upper bronze fitting on the porcelain tube, and the wire from the other side of the switch leads to the lower bronze fitting. The porcelain tube and the bronze fittings are surrounded by a brass tube, one and three-quarter inches in diameter. The total height of the heater from the bottom of the inlet valve to the top of the spout is twenty inches, and all fittings are nickel-plated and highly polished.

The device is ornamental and can be placed anywhere where an electric circuit can be installed.

The heater can also be furnished in combination with a water-tank, to be placed slightly above it, in which case it is not necessary to connect the heater with the water system, only connecting it to the electric wiring by means of an attachment plug and flexible cable of the proper kind. Under this condition, the water-heater is portable and can be installed in any hotel room, where it can be attached to the ordinary washstand.

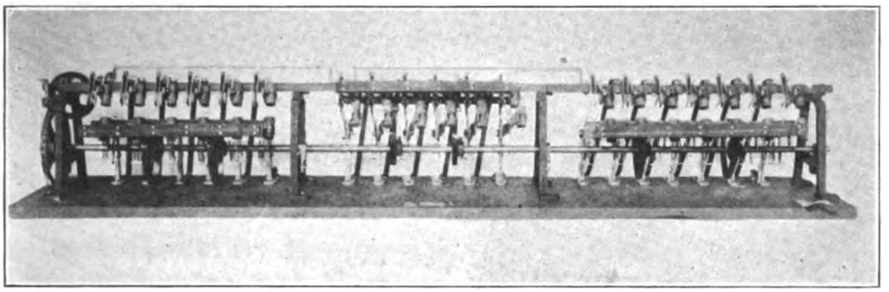
If the water-valve is open but the switch not turned on, cold water will flow from the heater. The moment the current is turned on the water becomes heated, and by regulating the flow of the water the heater can be adjusted up to 200 degrees Fahrenheit.

It is readily appreciable that on account of the electric current flowing through the water the heater also acts as a germ-killer, notwithstanding the fact that the water may not be brought up to any very high temperature.

The standard heater requires about ten amperes at 110 volts, and will heat a glass-ful of water to 190 degrees Fahrenheit in forty seconds, which at the rate of ten

Digitized by Google

cents per 1,000 watts would cost .014 cent. The same heater would heat one gallon of water to the same temperature in ten minutes for less than two cents. For an ordinary washstand there would be required about one quart of water at about 105 degrees Fahrenheit. The heater would require forty seconds to heat this water, and the cost would be less than .014 cent.



FLASHER FOR OPERATING 1,050 TEN-CANDLE-POWER INCANDESCENT LAMPS.

The absence of all odors, and the promptness with which the apparatus performs the work, should commend it for use in many places, a few of which may be referred to as follows: for hot drinks at soda fountains and cafés; hot water for barber shops, manicuring establishments, etc.; indispensable in hospitals, doctors' and dentists' offices for an instant supply of hot water for general use and for sterilizing instruments.

Hotels can use the instantaneous electric water-heater in many of the rooms for supplying hot drinking-water, and in rooms where there is no running water the heater can be installed in combination with the water-tank mounted above it. In this case the heater dispenses with the old-fashioned water-pitcher, and can be mounted on the washstand, discharging the water at any temperature directly into the washbowl. The cost of installing the HCK system is less than piping a building for hot and cold water, and the increased revenue possible will soon pay for the installation.

In the home and summer cottage the heater is most convenient for all supply of hot water. Where there is a warm-water supply the heater is installed for all quick service and for drinking purposes.

The new electric heater is made in several sizes, from ten to twenty-five amperes at 110 volts and five to twelve amperes at 220 volts, for either direct or alternating current of any frequency. The ten-ampere size will heat one glass of water to 190 degrees Fahrenheit in forty seconds, and the twenty-five-ampere size will heat one glass of water to the same temperature in fifteen seconds.

A Large Electric Flasher.

The illustrations appearing herewith will give a very good idea of what is probably the largest load handled by a flasher in the country at the present time, and very likely the only one of its kind in existence in the matter of voltage.

The work consists of two signs, the upper of which is single-faced, about ten by fifty feet in size, and is intended to be observed principally by passengers on the Union Loop, Chicago, Ill. This loop is used by all the elevated railroads in that city.

The sign projecting over the sidewalk is about twenty feet from the ground, over the main doorway of the terminal station of the Aurora, Elgin & Chicago Railway. It is double-faced, and visible for long distances both north and south on Fifth avenue. The upper sign is on the roof of the terminal station, which is below the elevated structure. The two signs combined contain about 1,050 ten-candle-power lamps, wired in series of fives. Sixteen-inch letters are used throughout. The three signs are divided into forty-two circuits, twelve circuits constituting the north side of the projecting sign, twelve circuits the south side of the projecting sign and eighteen circuits for the large sign on the roof. The signs have a metal background, painted black, and the letters are wood and metal combined, with a white-enameled face and red edge.

There are two sets of enclosed fuse cutouts, one on the live side and the other on the ground side, both in iron-lined boxes, about one foot wide by six feet long. One of these cutout boxes is shown projecting below the bottom of the roof sign, and the other lies on the roof behind the flasher case, which also is shown below the upper sign. Inside the cutout cabinet, twelve of the fuses are bunched together on the live side and lead to the flasher, twelve more are bunched in another group and lead to another section of the flasher, and the other eighteen are bunched in a third group, leading to the remaining section of the flasher. All wiring is in iron conduit throughout the work.

The flasher case is about seven feet long, twenty-four inches high and eighteen inches deep, has a sloping roof covered with galvanized iron and is weatherproof throughout. Inside it is lined with asbestos, which in turn is covered with galvanized iron. It opens from the front with a hinge door that drops down its entire length and is mounted on a light trestle about four feet high placed on the roof.

TWO LARGE FLASHED SIGNS, CONTAINING 1,050 TEN-CANDLE-POWER INCANDESCENT LAMPS.

The flasher is known as a No. 3110 Dull's series carbon flasher and was made by the Reynolds-Dull Flasher Company, 177 Adams street, Chicago, Ill. Although

Digitized by Google

the illustration seems to indicate a large number of switches, there are only three switches proper, having six, six and seven blades respectively. Each gang of blades is worked in unison, that is, there is one common yoke connecting them together in such manner as to cause all in each gang to be raised and lowered simultaneously by means of two cams on the main shaft. The diagonal bus strips shown in the back of the flasher are for connecting the various single switches of the gang in series. The current is taken in on the upper half of the left-hand switch and then travels through each individual blade in series before being taken out at the lower half of the switch on the right-hand side of the gang. Thus it will be seen that the current travels through six blades mounted together and connected in series. When the gang switch drops to open the circuit the current is broken by six air-gaps at once. The three group switches are operated by cams which are one-half of a circle and raise and lower the blades in succession, giving the following sequences: the large sign on the roof is thrown on, and before that goes out the north side of the projecting sign is thrown on. Before the latter goes out the south side of the projecting sign is thrown on and the large sign is thrown off, and the large sign is thrown on again before the south side of the projecting sign is thrown off. This gives a light on the sidewalk equivalent to one and one-half signs burning at all times and effects a flat saving of fifty per cent in current, at the same time giving twenty-four changes per minute in the three signs to attract attention.

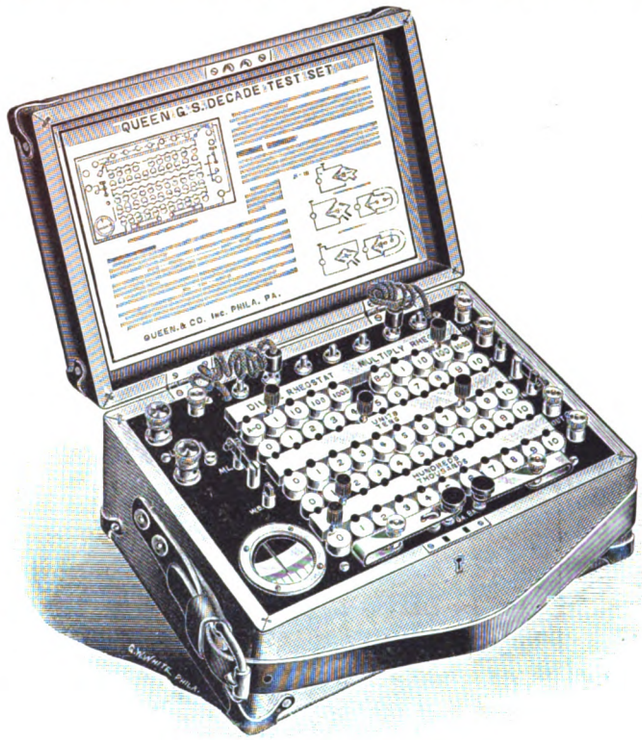
An excellent feature in connection with the operation of this flasher is as follows: When the service switch is thrown off slowly it will hold an arc four inches long, but when the flasher opens the same circuit it will not hold an arc on the gang switches greater than three-sixteenths of an inch, or, a total of one and one-eighth inches in the flasher will break the arc perfectly, while the service switch will hold the arc for the same load at more than three inches.

The flasher itself is twelve by fifty-six inches on the base, ten inches high, and is driven with a one-twentieth-horse-power, 110-volt motor, in series with four sixteen-candle-power lamps. While the flasher at present is handling 1,050 ten-candle-power lamps at 600 volts, its construction is such that any number of lamps can be added up to a total of 5,000 four-candle-power lamps or the equivalent.

New Navy Department Test Set.

The Queen G. S. portable test set illustrated herewith is a type recently put on the market to meet the revised Navy Department portable testing set specifications, which have been altered considerably and made much more exacting than heretofore.

The arrangement of this set has therefore been made with not only these specifications in mind, but also with a view to securing the maximum portability with due regard to convenience in mechanical arrangement, while the connections of circuits are such that a large variety of tests



QUEEN G. S. PORTABLE TEST SET.

beyond those indicated in the government specifications may be executed. It, therefore, forms an ideal set for the use of telephone and telegraph companies, electric light and power stations and electrical engineers who find it necessary to make a wide variety of measurements and prefer one complete testing instrument to a large number of individual pieces.

It consists in general of a Wheatstone bridge with a 1, 10, 100 and 1,000-ohm coil in each arm. The rheostat consists of ten coils of units, tens, hundreds and thousand denominations, the last or tenth coil being added for convenience in checking up the next higher series of coils; that is, the ten coils in the unit row in series can be checked with the first coil in the ten row, and likewise the tenth ten-ohm coil can be checked against the first 100-ohm coil, etc.; an operation which confirms the accuracy of adjustment, but one not possible to execute in a decade set where each row consists of but nine coils.

The bridge and rheostat are properly connected to an improved D'Arsonval galvanometer, dead-beat and of such high sensibility that a change of one-tenth of one per cent in the rheostat when measuring resistance of approximately 1,000 ohms value will give a decided galvanometer deflection. The needle is free from outside magnetic influences and so balanced that the test set can be used in practically any position; it is also provided with an adjustment lever so that the pointer of the galvanometer can also be made to indicate zero.

The battery consists of six chloride of silver cells connected so that any one or number up to six in series may be used, while a pair of binding-posts allows the use of an outside battery when desired.

Both the galvanometer and battery keys are on the front of the case in a most convenient location, and are made extra heavy with a liberal supply of platinum iridium at the actual contact points.

Binding-posts and a small switch allow the use of an outside galvanometer if desired.

A ground-post, as well as an auxiliary galvanometer switch, is provided so that both the Murray and Varley loop can be executed. The resistance coils in the bridge arms are adjusted to an accuracy of one-twentieth per cent while that of the rheostat coils is one-tenth per cent, the wire used being manganin and having a negligible temperature coefficient; all the spools being well shellacked, properly baked and aged before standardizing. To the hard-rubber plate, which is highly polished and of exceptionally good quality, are securely fastened the resistance coils, galvanometer, battery, etc., so that by removing this plate all interior parts are out at the same time.

The individual cells of battery can be removed by unscrewing a small section of the bottom of the case, which exposes them to view, when the connections can be easily loosened and new cells inserted should this be found necessary.

The overall dimensions of the set are

Digitized by Google

approximately twelve by eight by six inches, and the weight is about twelve pounds, the case being made of polished quartered oak, and protected with nickel-plated brass corner-pieces.

In addition to the usual measurements of resistance, this set can be used for locating grounds, crosses and other cable troubles utilizing either the Murray or Varley loop tests, while it can be used for insulation resistance measurements and numerous other tests, such as checking up voltmeters and ammeters, measuring battery resistance, etc.

The instrument is manufactured by Queen & Company, Incorporated, Philadelphia, Pa.

Results Obtained by the General Electric Company's Automatic Feeder Regulator.

The accompanying diagrams illustrate in a most interesting way the voltage regulation obtained by means of the BR type of automatic feeder regulator manufactured by the General Electric Company. The construction and operation of this type of regulator, as well as the type 1R automatic regulator made by the same company, have been described at length in this paper.

In principle the BR regulator is a variable ratio transformer or compensator having two separate windings. The primary or shunt winding is connected across the line, while the secondary or series winding is arranged in series with the line to be controlled, the regulator being connected between the generator and the load. Voltage is maintained constant by automatically changing the ratio of turns on the transformers and thus boosting or lowering the voltage to compensate for the fluctuations taking place when very heavy power service draws large momentary currents over the alternating-current feeder circuits.

The close regulation that is obtained with these regulators is seen by comparing Fig. 1 with Fig. 2. The charts were taken simultaneously with two Thomson curve-drawing voltmeters, one on either side of a type BR regulator designed to boost or lower the voltage ten per cent. The generator voltage (Fig. 1) was purposely varied over a wide range, so that the conditions are more severe than those usually holding in actual service.

In both charts the clearly defined record given by the Thomson curve-drawing instruments is well exemplified. The instruments used in taking these records were equipped with twenty to one ratio potential transformers. Therefore the voltage variations illustrated represent the actual voltage regulation obtained at the lamps when the feeder circuit is 2,300 volts, since the ratio of transformation between the feeder circuit and the lighting circuit is the same as the ratio in the potential transformers, twenty to one.

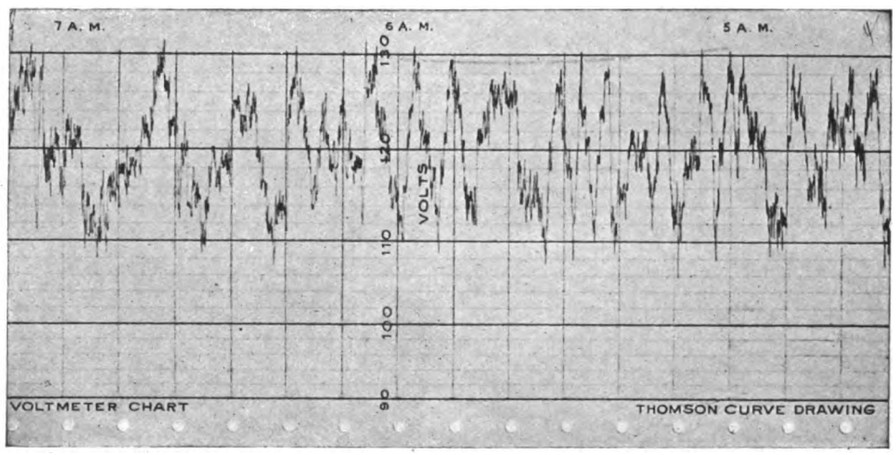


FIG. 1.—CHART SHOWING VOLTAGE VARIATIONS.

It will be noted that the actual maximum voltage variation on the generator side, during the total time of the run, was 508 volts, or approximately 22.1 per cent of the normal generator voltage, 2,300; whereas on the feeder side of the regulator the maximum voltage variation is held down by the regulator to approximately forty volts, or 1.7 per cent. This is true except at one point where the voltage variation was allowed to exceed the capacity for which the regulators were designed, as shown by inspection of the two charts. The point of minimum voltage (106) recorded at 5-09¾ on the chart of the generator side of the regulator (Fig. 1) is about 1.3 volts beyond the boosting capacity of the regulator, as indicated by the drop at the corresponding point on the chart of the feeder voltage. The apparent discrepancy in time is accounted for by the fact that the chart of the feeder side was started slightly ahead of the chart on the generator side of the regulator.

The practical result of this demonstration is the fact that a steady light can be obtained with incandescent lamps on a feeder circuit which also supplies power for heavy motor service. Not only will the regulators maintain a uniform illumination, but since the lamp voltage is practically constant the life of the lamp is greatly increased. Both the BR and the IRS types of regulators are built in standard sizes for cycles to boost and lower the voltage either five per cent, seven and one-half per cent or ten per cent above and below normal. The BR regulator is usually built in sizes from eleven kilowatts to twenty-two kilowatts, while the IR types for single or polyphase circuits range in standard sizes from 5.5 kilowatts to forty-four kilowatts. Their capacity, however, is practically unlimited and has

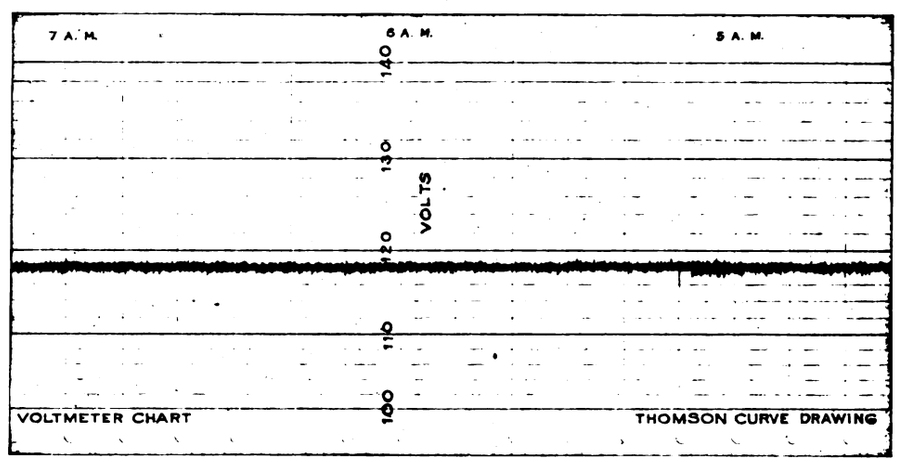


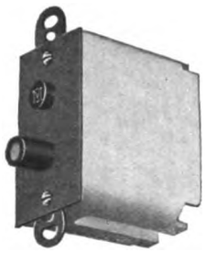
FIG. 2.—CHART SHOWING REGULATION—READING SIMULTANEOUS WITH THAT SHOWN IN FIG. 1.

Digitized by Google

already been extended to 800 kilowatts. The General Electric Company is also prepared to furnish automatic regulators of the same general construction as the standard types but wound for special voltages and frequencies.

New Design of Push-Button Switch.

The Marshall Electric Manufacturing Company, Boston, Mass., has recently perfected a new design of push-button switch. The novelty consists chiefly in the arrangement of the lug fastening which adapts this switch to all standard conduit boxes and permits the use of the Marshall and standard plates without alteration. The chief feature, however, is the patented fibre false plate which is sent out with all



Ten Ampere D. P. Push-Button Switch.

of these switches, protecting the switch mechanism from all plaster and dirt, which is a great source of switch trouble while the building is being finished and before the permanent plates are attached. This feature has been highly recommended by prominent architects and engineers.

These switches are carried in stock at the New York office, 227 Fulton street, and the Chicago office, 169 Adams street, as well as at the Boston works.

The "Young" System of Signaling for the Philadelphia & Western Railway.

The General Railway Signal Company has been awarded the contract for the complete automatic block signal equipment for the Philadelphia & Western Railway. This road runs from the terminus of the Philadelphia subway elevated structure, parallel to the Pennsylvania Railroad mail line, due west for twelve miles. The road is double track, but the right of way provides for four tracks eventually.

Signals will be spaced one and three-quarters miles apart, and all signals will be provided with an overlap of about 2,000 feet.

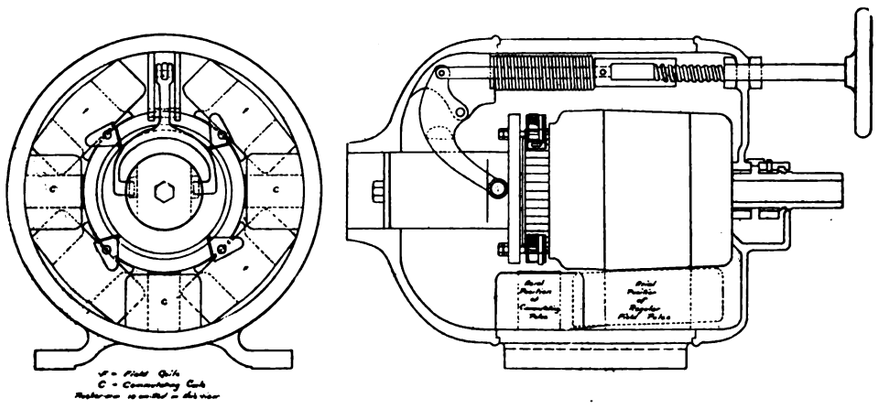
With the system to be installed on the Philadelphia & Western Railway an alternating current is used to supply the track circuits, and inasmuch as the transformers used for this purpose have an unlimited amount of power back of them, it has been found possible, where alternating-current track circuits are used, to operate blocks three miles in length, without cutting the section. It is essential in interurban roads operating on say five to ten minutes' headway to extend the length of the blocks from a mile and a half to two or even three miles in length, and this is made possible by the development of this alternating-current system. If the system were limited to short sections, as on steam roads, the cost of cutting these sections, involving the use of additional reactance bonds, etc., would in a way be prohibited.

The two-rail system will be employed; that is, both of the traffic rails will be available for the return of the propulsion current.

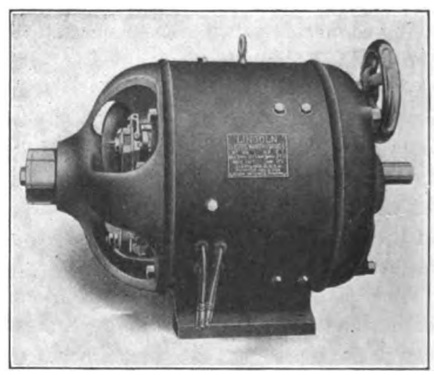
The alternating current for the operation of the signal system will be obtained from transformers in the main generating station, stepping down from 19,000 to 2,300 volts. This current is carried by a special transmission line the entire length of the road, and at signal locations this 2,300-volt current will be further reduced to fifty volts, which in turn will operate the track circuits, signal motors, signal lamps, relays, etc. While the main transmission line of the road is twenty-five cycles, the signal apparatus will also be operated at twenty-five cycles, the same as is being done by the General Railway Signal Company in its installation for the New York Central & Hudson River Railroad electric zone installation.

The Lincoln Variable-Speed Motor.

The Lincoln Electric Manufacturing Company, Cleveland, Ohio, has placed upon the market a variable-speed motor for which a wide variation in speed is claimed. The company asserts that with the peculiar design of this motor it is possible to obtain ranges in speed variation as high as ten to one. The design of the motor provides for the withdrawing of the armature from the influence of the field poles, decreasing the field area and magnetic flux, increasing the air-gap and resistance, permitting an increase in speed. A conical armature is used which gives a rapid increase in the air-gap and a greater increase in speed for a given



Sectional View of Lincoln Variable-Speed Motor.



Lincoln Variable-Speed Electric Motor.

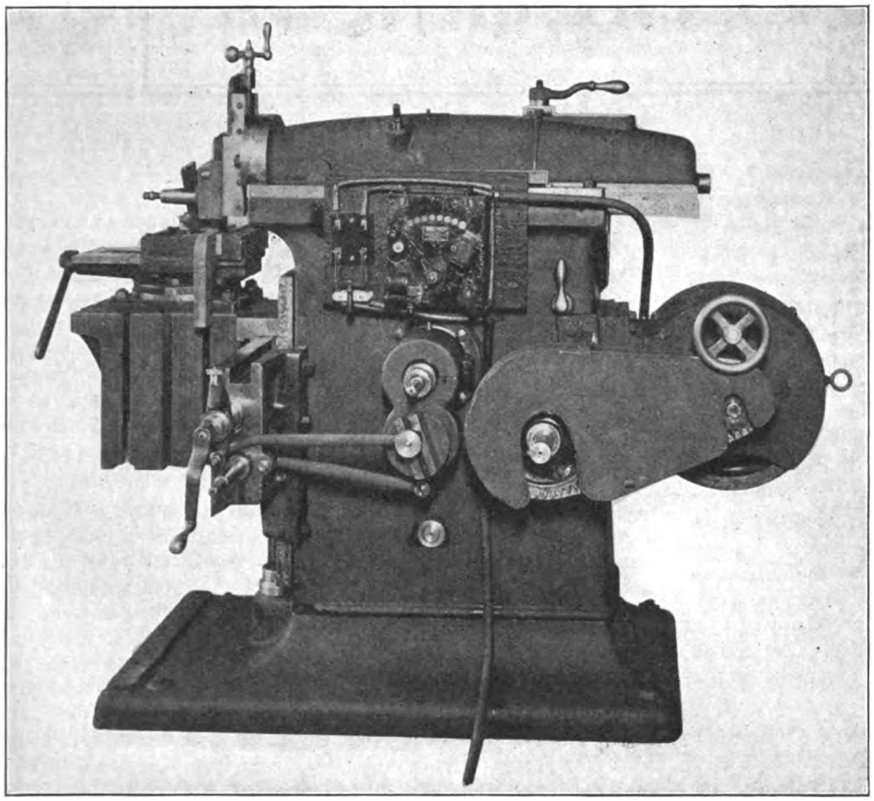
lateral adjustment than is possible with a cylindrical armature.

To accomplish this the company has perfected a thrust bearing which supports the commutator end of the armature, carrying an annular ball bearing to take both thrust and radial loads. The thrust bearing is actuated by a split lever having a central pull on opposite sides of the bearing, the movement of the lever being accomplished by means of a screw mechan-

Digitized by Google

ism and hand wheel. This is well shown in the accompanying illustrations. A spring around the lever connecting rod is so adjusted as to balance the magnetic pull of the armature.

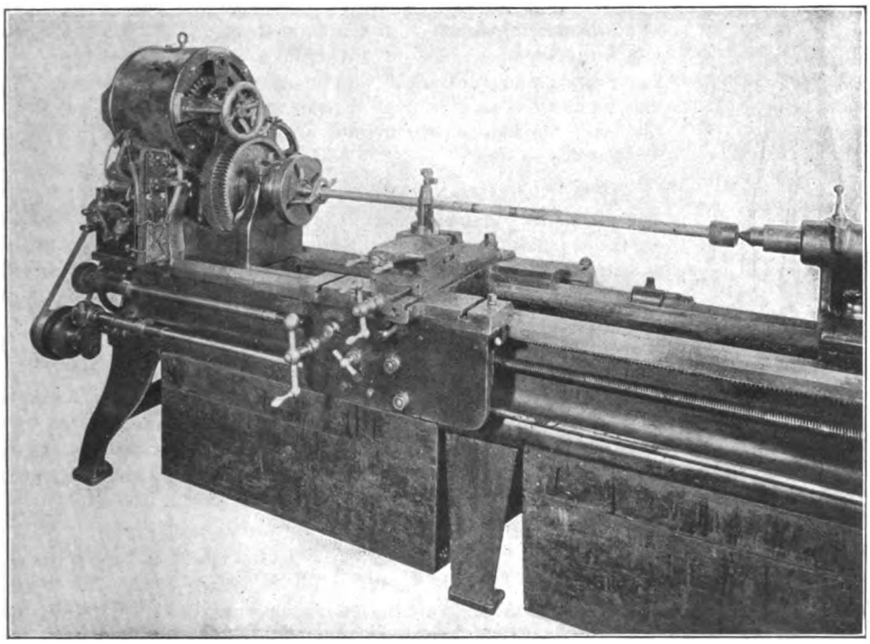
So far as installation is concerned, the machine is a two-wire, direct-current, shunt-wound motor. This system admits of speed variation inside the motor, doing away entirely with a controller and its accompanying resistance. The speed variation is under the immediate control of the machinist, who can secure any increase or decrease in speed that the work in hand may demand.



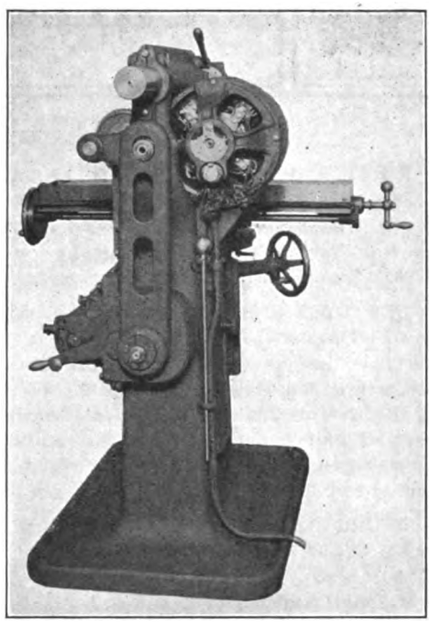
LINCOLN VARIABLE-SPEED INDUCTION MOTOR, MOUNTED ON SIXTEEN-INCH SHAPER.

The efficiency claimed is high, comparing favorably with good constant-speed motors. The efficiency at full load on a five-horse-power, five-to-one motor is said to show by test from eighty-six per cent at 300 revolutions per minute to seventy-five per cent at 1,500 revolutions per minute.

The perfection of this motor was attended with more than ordinary difficulty. Its practicability is based upon its record in actual operation. Every feature—the thrust bearing; the special commutating field, into which the armature is drawn at high speeds to ensure sparkless commutation from no load to fifty per cent overload; and the sleeve which carries the pulley or pinion, allowing the armature to slide through it in its lateral adjustment—were all tested and tried and proved efficient before the motor was placed upon the market. An additional claim which the manufacturer makes is that the motor will run in either direction, a simple reversing switch being all that is necessary as an auxiliary attachment.



LINCOLN VARIABLE-SPEED INDUCTION MOTOR, MOUNTED ON TWENTY-INCH REED LATHE.



LINCOLN VARIABLE-SPEED INDUCTION MOTOR ON UNIVERSAL MILLING MACHINE.

An Apprenticeship Course as a Preparation for Engineering Activity.

An address was delivered on August 30 before the engineering apprentices of the Bullock Electric Manufacturing Company, at Cincinnati, Ohio, by Professor V. Karapetoff, of Cornell University. The topic taken was "An Apprenticeship Course as a Preparation for Engineering Activity." The speaker called attention to the three essentials for a successful engineer—professional knowledge, knowledge of business forms and of human relations, and strong character. He enlarged upon these ideas, giving the apprentices a large amount of instructive and valuable information and advice. Among the suggestions made were the keeping of careful notes, reading the current engineering journals and standard engineering books. He also advised the apprentices to undertake original investigations whenever opportunity offered. Some suggestions were made to assist them in their study of men and business methods.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

FIRST EARTH TURNED FOR NEW YORK-CHICAGO AIR LINE—President Alexander Miller, of Chicago, on September 1, turned, with a silver spade, the first earth in the construction of the New York-Chicago electric air line at Laporte, Ind. A party of 300 Chicago railroad men and investors witnessed the ceremony.

LEWISTON & SOUTHEASTERN ELECTRIC RAILWAY COMPANY—The stockholders have authorized the directors to issue first mortgage five per cent bonds to the amount of $3,000,000 on the Lewiston & Southeastern Electric Railway Company, and $2,000,000 on the Central Idaho Development Company. The Scofield Company, of Philadelphia, Pa., has the contract to build 100 miles of line between Lewiston and Grangeville, Ida. Work will begin the coming fall.

REORGANIZATION OF THE INTERSTATE TELEPHONE COMPANY, OF TRENTON, N. J.—As a part of the reorganization plans of the company, a deed transferring the property of the Interstate Telephone Company, of Trenton, N. J., from the trustee in bankruptcy for the Court of Chancery has been filed in Paterson, N. J. The consideration mentioned in the deed is $575,000. The second mortgage is drawn in favor of the Mercer Trust Company, and is a general mortgage securing a loan of $4,000,000.

ANNUAL REPORT OF THE BROOKLYN RAPID TRANSIT COMPANY SHOWS A NET GAIN OF TWENTY-THREE PER CENT—The annual report of the Brooklyn Rapid Transit Company for the fiscal year ending June 30 last shows gross earnings for the year of $18,473,328. This compares with a gross of $16,333,444 in 1905. Net earnings for the last year were $8,031,950, against $6,529,574 in 1905. The surplus for the year, after all charges and appropriations, was $2,075,562, against $984,723 in 1905. The gain in gross for the year was 13.1 per cent, the increase in net being twenty-three per cent. The decrease in operating expenses was 3.5 per cent.

PLANS COMPLETED FOR TAKING OVER CANTON-AKRON TRACTIONS—Plans to finance the purchase of the Tucker-Anthony lines by the Northern Ohio Traction and Light Company have been completed, and the system will be taken over at a meeting of the stockholders September 18. The stock of the Northern Ohio Traction and Light Company will be increased from $7,500,000 to $10,000,000, of which $1,038,000 will be issued to exchange share for share for the common stock of the Canton-Akron line. The rest of the financing will be done by the Canton-Akron Consolidated Railway Company, whose capital stock will be increased from $10,000 to $2,500,000.

NEW UTAH POWER COMPANY—Articles of incorporation of the Salt Lake Public Service Corporation have been formed. The company has a capital of $3,000,000, and takes over the light, heat and power franchise granted by the Salt Lake City, Utah, council to J. S. Manley and L. H. Curtis. The officers are: James J. Chambers, president; John W. Dages, vice-president; J. S. Manley, secretary; E. M. Fullington, treasurer. Work has already been commenced, and it is expected that $1,000,000 will be expended within the next ten months. In addition to supplying light and power to Salt Lake City, the company will operate in Park City, Alta and several other mining towns.

MERGER OF CALIFORNIA POWER PLANTS—The Ventura County Power Company has been formed to take over the Ventura Water, Light and Power Company, the Oxnard Light and Power Company and the Santa Paula Electric Company. The capital stock of the new company is $2,500,000, and the officers are: J. A. Driffill, Oxnard, Cal., president and general manager; J. S. Torrance, Pasadena, first vice-president; W. R. Staats, Pasadena, second vice-president; James R. Martin, Los Angeles, secretary; T. E. Walker, assistant secretary; James A. Donlon, treasurer. The combination will permit the extension of the systems throughout the country surrounding Ventura, Oxnard and Santa Paula.

TO BUY CHICAGO TRACTION—A plan is under way to effect an organization of bondholders of the underlying companies to purchase the street railway lines of the Chicago Union Traction Company. It is the intention of the organization to take a twenty-year franchise from the city. The corporation is said to represent the holders of $1,000,000 bonds of the North and West Side companies, and has been chartered as the Chicago Street Railway Company, capitalized at $5,000. Chicago traction men are skeptical of the bondholders' scheme, and announce that this new move on the part of the minority bondholders is not big enough to interfere with the reorganization plans now being worked out in New York.

FEDERAL POWER PLANT PLANS—J. G. White & Company, of New York city, have been appointed consulting engineers to the government for the design of the new power plant of the Congressional group of buildings at Washington. This group includes the Capitol, the new House and Senate office building and the Congressional Library. The plant will supply light, heat and power to all the buildings on and adjoining the Capitol grounds, and will have a capacity of 14,000 horse-power. Bids were first advertised for and received September 30, 1905. On July 2 of this year these first bids were rejected, and J. G. White & Company retained to draw new plans. When these are completed new bids will be received.

NEW RAILROAD TO CROSS LONG ISLAND—Application has been made for a franchise for a cross-island trolley extension of the Huntington Railroad Company to run from the Huntington station of the Long Island Railroad, the present terminus of the Huntington Railroad, to Babylon, Farmingdale and Amityville, a distance of about twenty and one-half miles. The building of this line, which is virtually a Long Island Railroad enterprise, is one of the most important railroad extensions on Long Island. The line will be constructed in a thorough manner throughout, with heavy rails and substantial and modern electric equipment. The motor-cars, it is said, will be capable of a high rate of speed, and the whole enterprise will involve an expenditure of from $400,000 to $500,000.

CHEAPER GAS AND ELECTRICITY FOR SYRACUSE, N. Y.—The state gas commission, on September 6, announced its decision on the complaint against the Syracuse (N. Y.) Gas Company, requesting a reduction in the charges for gas and electricity in that city. The commission reduced the price of gas from $1 to ninety-five cents per thousand feet after October 1, and the charge for arc street lamps from $85.75 per lamp per year to $68. Commercial incandescent lighting rates are reduced, after October 1, for a year, from twelve cents per kilowatt-hour, with two cents discount if paid before the fifteenth of the month, to nine cents. After October 1, 1907, this is to be further reduced to eight cents. The decision in the Syracuse case is thought to foreshadow the commission's decision on similar complaints in other cities, including Rochester, Albany and Buffalo.

NEW NEW YORK POWER COMPANY—The New York & Ontario Power Company, of Waddington, St. Lawrence county, N. Y., has been given a hearing by the state gas commission on its application for consent to begin business by issuing $2,000,000 stock and $2,000,000 of bonds. The company announces that if it is authorized to do business it intends to supply Waddington, Lisbon and Ogdensburg with electric light, heat and power; to supply power for paper mills, and to send power two miles across the St. Lawrence river to Canada, to operate Canadian tin-plate and sheet-steel plants in Morrisburg, Ontario. In the purchase of the electric power rights at Waddington and in the development of the

Digitized by Google

facilities there the company expects to expend $3,500,000. It has a property valued at from $4,000,000 to $5,000,000. The plant will develop 30,000 horse-power.

MORE POWER FOR SAN FRANCISCO—Plans are under way for financing a project for utilizing water-power facilities in California, including the formation of a California company to be known as the Feather River Power Company, with an authorized capital of $25,000,000. This company is to take over the stock of the Eureka Power Company, the Golden State Power Company and the Western Power Company, of California, the stock of the Feather River Power Company to be held in turn by the Western Power Company, of New Jersey, which was incorporated on August 21. The Western Power Company, of New Jersey, is to have an authorized capital of $18,000,000, of which $6,000,000 will be preferred stock. In the plan as outlined the Feather River Power Company is to issue $25,000,000 of first mortgage five per cent gold bonds, to be secured by a first mortgage lien on the properties of the several power companies. The syndicate managers are: Edwin Hawley, F. H. Ray, J. N. Wallace, A. C. Bedford and Philip Stockton, of Boston, Mass.

ELECTRICAL SECURITIES.

While an irregular and unsettled condition existed apparently in the stock market last week, it is held in many quarters that the stability of the market is beyond question and that it has displayed remarkable resistance to what might easily be construed as adverse tendencies. The general average loss has been very small in the face of a monetary stringency, the rates going as high as 40 per cent. While the money market has checked the bull campaign, it is not likely that this will be in any wise permanent. The assistance rendered by the secretary of the treasury and the loosening of the foreign money market have brought about a favorable tendency which will, no doubt, be followed by increasing confidence and the releasing of money now held in reserve. The reports of leading industrials continue highly favorable, particularly the local tractions. Much satisfaction is found in the report of the Brooklyn Rapid Transit Company for the year ending last June, showing a gain of 23 per cent in net earnings. Indications are also at hand of further expansion in the iron and steel trade. The likelihood of a pacific condition in the coal trade, and, in fact, the general disposition to harmonize capitalistic and labor interests bid fair to make the coming fall and winter the most notable in the history of the country.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 8.

New York:	*Closing.*
Allis-Chalmers common	18¾
Allis-Chalmers preferred	44¾
Brooklyn Rapid Transit	81⅜
Consolidated Gas	139
General Electric	166
Interborough-Metropolitan common	38⅞
Interborough-Metropolitan preferred	79
Kings County Electric	160
Mackay Companies (Postal Telegraph and Cables) common	73⅜
Mackay Companies (Postal Telegraph and Cables) preferred	71
Manhattan Elevated	146
Metropolitan Street Railway	106
New York & New Jersey Telephone	125
Western Union	91
Westinghouse Manufacturing Company	150

During the seven months of the General Electric Company's fiscal year now ended, the volume of new business has been unprecedented and indicates a total for the fiscal year of between $55,000,000 and $60,000,000.

Directors of the Interborough Rapid Transit Company have declared the regular quarterly dividend of 2¼ per cent on the stock. The dividend is payable October 1 to voting trust certificates of record on September 17. Books close September 17 and reopen October 1.

The regular quarterly guaranteed dividend of 1½ per cent on Manhattan Railway is payable on October 1. Books closed September 14 and will reopen September 26.

The annual report of the Allis-Chalmers Company for the year ended June 30 shows as follows: profits on operation, $648,161; maintenance, depreciation, etc., $1,036,583; operating deficit, $388,422; balance brought forward, $545,903, leaving a surplus of $157,481. At the meeting of the company directors were reelected.

Directors of the Interborough-Metropolitan Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable October 1. Books closed September 10 and will reopen October 1.

Boston:	*Closing.*
American Telephone and Telegraph	139
Edison Electric Illuminating	237
Massachusetts Electric	73
New England Telephone	129
Western Telephone and Telegraph preferred	87

It is now estimated that Massachusetts Electric will show gross earnings of about $7,400,000 for the fiscal year ending September 30, 1906, as compared with $6,665,528 last year. Earnings for July and August have run approximately 10 per cent ahead of those for the corresponding period a year ago, and if September brings favorable weather the earnings for that month should increase by the same amount. How much of the increase for the entire year will be available for dividends it is impossible to say, as there is no means of figuring out what amount the management will appropriate out of earnings for improvements. In the event, however, that such expenditures bear the same relation to gross that they did a year ago, the surplus should be in the neighborhood of $1,050,000, which is equivalent to $227,704 in excess of the total dividend requirements on the preferred stock for one year.

There is reason to believe that American Telephone and Telegraph stock will be placed upon a straight 8 per cent basis at the next meeting of the directors, which will be held on September 19, or in December. Telephone dividends are now declared, 6 per cent regular and 1½ per cent extra per annum. Earnings of the company are now at the rate of about 13 per cent per share per annum.

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	70
Electric Storage Battery preferred	70
Philadelphia Electric	8⅜
Philadelphia Rapid Transit	29
United Gas Improvement	86
Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	140
Metropolitan Elevated preferred	66
National Carbon common	85
National Carbon preferred	119
Union Traction common	5
Union Traction preferred	20

Union Traction preferred advanced 2 points on the belief that the Mueller certificates will be pronounced illegal.

The directors of the South Side Elevated have declared the regular quarterly dividend of 1 per cent, payable September 29. Books close September 18 and reopen October 1.

DATES AHEAD.

American Electrochemical Society. New York city, October 8 and 9.

American Electro-Therapeutic Association. Philadelphia, Pa., September 18-20.

American Institute of Electrical Engineers. New York city, September 28.

American Society of Municipal Improvements. Birmingham, Ala., October 2-4.

American Street and Interurban Railway Engineering Association; American Street and Interurban Railway Association. Columbus, Ohio, October 15-19.

Colorado Electric Light, Power and Railway Association. Denver, Col., September 18, 19 and 20.

Empire State Gas and Electrical Association. New York city, October 12.

Illinois State Electrical Association. Springfield, Ill., September 19-20.

Kansas Gas, Water and Electric Light Association. Lawrence, Kan., October 16-17.

Michigan State Electric Association. Grand Rapids, Mich., October 10-12.

Old Time Telegraphers and Historical Society. Washington, D. C., October 9, 10 and 11.

Order of the Rejuvenated Sons of Jove. Boston, Mass., September 20.

Pacific Coast Gas Association. San Francisco, Cal., September 18-20.

Railway Signal Association. Annual meeting, Washington, D. C., New Willard, October 16, 17 and 18.

Digitized by Google

PERSONAL MENTION.

MR. L. P. SAWYER, manager of the Buckeye Electric Company, Cleveland, Ohio, was a Chicago visitor last week.

MR. J. M. BROUCHER, of the Brownell Company, Dayton, Ohio, has been appointed assistant general manager of sales for the Atlas Engine Works, Indianapolis, Ind.

MR. NORMAN G. KENAN has been elected president of the Union Gas and Electric Company, which is now operating the plants of the Cincinnati Gas and Electric Company.

MR. B. ROSENDORN, Selma (Cal.) agent for the San Joaquin Light and Power Company, has been promoted to the position of general solicitor, with headquarters at Fresno, Cal.

MR. SAMUEL C. SCHAFFNER, formerly engineer and general manager of the Illuminating Company, of Mobile, Ala., has joined the engineering staff of H. M. Byllesby & Company, Chicago.

MR. WALTER H. WHITESIDE, president of the Allis-Chalmers Company, has been elected a director of the company, filling the vacancy caused by the resignation of Mr. James Stillman.

MR. R. G. HUNT, formerly manager and engineer of the San Diego Consolidated Gas and Electric Company, has joined the engineering staff of H. M. Byllesby & Company, and will be located at their Chicago offices.

MR. ARTHUR REYNOLDS, who for a number of years was superintendent of the Lewiston, Brunswick & Bath Railroad, has been appointed superintendent of the Portland & Brunswick Street Railway Company, with headquarters at Portland, Me.

MR. GEORGE F. MADDOCK, formerly general superintendent of A. L. Ide & Sons, Springfield, Ill., and for some time past practicing consulting engineer with offices in Marquette Building, Chicago, has joined the engineering staff of H. M. Byllesby & Company, Chicago.

MR. O. A. FARRAR, formerly engineer of Allis-Chalmers Company, has joined the engineering staff of H. M. Byllesby & Company, and has charge of the reconstruction work of the large modern electric lighting plant which H. M. Byllesby & Company are constructing at Mobile, Ala.

MR. WILLIAM M. BRODIE has been appointed manager of sales of the Edison Manufacturing Company, Orange, N. J. Mr. Brodie has been connected with the Edison company for the past six years in the manufacturing department, and is therefore thoroughly familiar with the Edison battery. Mr. Brodie succeeds Mr. William S. Logue, who died last April.

MR. HOWARD E. TROUTMAN, for over ten years connected with the Buckeye Engine Company, and for several years manager of its Chicago office, has accepted the position of sales manager of the Corliss and high-speed engine department of the Atlas Engine Works, Indianapolis, Ind. Mr. Troutman's headquarters will be at the home office.

MR. NORMAN McD. CRAWFORD, for a number of years manager of the Hartford (Ct.) Street Railway Company, until its absorption by the Consolidated Railway Company in 1905, has accepted the position of vice-president of a system of interurban lines in Indiana and Ohio, of which the Cincinnati Northern Traction Company is the holding company. The system operates some 1,000 miles of road. His headquarters will be at Cincinnati, Ohio. Mr. Crawford recently returned from England, where he had spent six months investigating electric railways for the National Civic Federation.

MR. WILLIAM H. FOX has been appointed manager of the Burlington (Vt.) exchange of the New England Telephone and Telegraph Company. Mr. Fox graduated from Phillips Andover Academy and entered the Massachusetts Institute of Technology with the class of 1897. Two years after the completion of his course at the institute he entered the employ of the New England Telephone and Telegraph Company as an operator in the Lowell (Mass.) exchange. Shortly after he was transferred to Salem as chief operator. Later he returned to Lowell, where he took up inspection and instrument work, and also devoted some time to office work. From Lowell Mr. Fox was transferred to Worcester, Mass., where he was employed in the inspection department, until he was appointed assistant manager of the Milford and Franklin exchanges. Six months later he became manager of the South Framingham exchange district. He remained in this position nearly three years, when he went into the executive offices of the company in Boston, where he has been located for the past two years.

OBITUARY NOTE.

MR. JAMES DREDGE, for forty years connected with *Engineering*, London, died on August 15 at Pinner, England, in his sixty-seventh year. Mr. Dredge was born at Bath, England, in 1840, the son of a well-known civil engineer. He received his professional training under his elder brother, also a civil engineer, and until 1864 was employed in various engineering offices in London. During the latter years he was thrown with Mr. Zerah Colburn in certain literary work, and when the latter, in 1864, established *Engineering*, he persuaded Mr. Dredge to take charge of all matters connected with illustrations. From this time until a few years ago Mr. Dredge had given his attention almost entirely to building up this paper. He was much interested in all the great international exhibitions held during the past twenty years. For his distinguished work in these connections he was appointed an officer of the Legion of Honor and made a companion of the Order of St. Michael and St. George. He made numerous visits to this country and prepared studies on certain engineering undertakings. About three years ago Mr. Dredge suffered from an attack of paralysis, from which he never fully recovered, although for about a year he continued to devote a good deal of time to the editing of *Traction and Transmission*, a journal which he had established. He was a member of the Institution of Mechanical Engineers, of Great Britain; the Institution of Civil Engineers, of Great Britain; an honorary member of the American Society of Mechanical Engineers, and served for some time on the council of the Society of Arts.

NEW INCORPORATIONS.

LANSING, MICH.—St. Clair Edison Company, St. Clair. $100,000.

ST. PAUL, MINN.—St. Clair Telephone Company, St. Clair. $10,000. Incorporators: H. Thielman, H. A. Campbell, F. Zink and others.

MADISON, WIS.—Wausau Street Railway Company, Wausau. $60,000. Incorporators: Neal Brown, V. A. Alderson and M. C. Ewing.

TRENTON, N. J.—Muscatine Light and Traction Company. $600,000. Incorporators: H. O. Coughlan, B. S. Mantz and John R. Turner.

COLUMBUS, OHIO—National Electric Light Company, New Jersey. $650,000. Admitted to Ohio to locate in Cleveland. J. M. Lee, representative.

ST. PAUL, MINN.—Nelson Telephone Company, Nelson. $10,000. Incorporators: John Nelson, C. F. Schelin, N. O. Johnson, H. J. Ernster and J. P. Larson.

AUSTIN, TEX.—Citizens' Railway and Light Company, North Fort Worth and Arlington Heights. To construct suburban railways and sell electricity. $1,000,000. Incorporators: Warren Ecknell, W. O. Allen, George E. White, Sam Rosen and G. E. Montgomery.

HARRISBURG, PA.—Womelsdorf & Myerstown Street Railway Company. To build an electric railway about eight miles in length, completing a line from Harrisburg to Reading, nearly sixty miles. $50,000. Incorporators: William McIlvain, Walter A. Rigg, J. Milton Miller, Harry R. Riegel and W. K. Eckert, all of Reading.

NEW MANUFACTURING COMPANY.

READING, PA.—Arrowsmith & Company, Incorporated, have filed their charter of incorporation. The company will deal in electrical supplies of every description and is capitalized at $10,000. The sum is divided into shares of $50 each, held by A. V. Arrowsmith, S. S. Arrowsmith and P. K. High, all of this city.

Digitized by Google

ELECTRIC LIGHTING.

COOKEVILLE, TENN.—Prominent business men of Algood are installing a $15,000 electric light plant.

BURLINGTON, IOWA—Sibley is to have a new lighting plant, upon which work is to be begun at once.

COLUMBUS, OHIO—The citizens of Westerville will shortly vote on the proposition of establishing a municipal electric light plant.

HAVELOCK, NEB.—An electric light plant for Havelock is now assured. P. T. McGere, who secured a franchise several months ago, will begin work on the system shortly.

LOGAN, OHIO—Logan will erect a municipal electric light plant next spring. L. B. Engle is president of the board of trustees of public affairs.

CARBON, IND.—J. H. Bennett, of Brazil, has made arrangements with the Carbon town council to begin operating the electric light plant which has been idle for several months.

BOSTON, MASS.—The gas commissioners have authorized the Worcester Electric Light Company to issue 2,000 additional shares of stock at $160 a share, to pay for additions to the plant.

BEARDSTOWN, ILL.—The city council has made a five-year contract with the Beardstown electric light company for seventy street lamps and forty incandescent lamps at a cost of $330 a month.

WILMINGTON, DEL.—The new plant of the Wilmington Light, Power and Telephone Company is rapidly nearing completion, and it is now assured that the company will furnish electric current by October 1.

RICHMOND, IND.—The Richmond council has approved the contracts entered into by the board of public works with the electrical supply companies for the additions to be made at the municipal electric light plant.

BOSTON, MASS.—The gas commissioners have refused the petition of the Hyde Park Electric Light Company to issue $62,500 additional capital stock for the payment of liabilities on account of additions to the plant.

LOGANSPORT, IND.—With a view to taking over the Andrews Light and Water Company's plant, which is now in the hands of a receiver, residents of Andrews are endeavoring to organize a company among themselves.

DAYTON, OHIO—The Dayton Citizens' Electric Light Company has negotiated the purchase of property at Third and Webster streets for a site for its new power plant. The price paid was $60,000. The company will erect a $200,000 power plant.

WILKESBARRE, PA.—The Dickson Electric Light Company, which has operated a plant for years in the borough of Dickson, besides supplying Throop borough with light, has been sold to the Scranton Electric Light Company for $30,000.

PARIS, ILL.—The city water board at a recent meeting took up the question of a new electric light system for the city. It was decided to send City Engineer Blackburn to St. Joseph, Mo., where the magnetite system is in use, with a view of installing the system here.

LINTON, IND.—The Linton city council has voted to accept the proposition of Samuel Parrott, of Indianapolis, to lease the city electric light plant for five years. Mr. Parrott took charge of the plant September 1 and will operate it at his own expense for the five years.

FLINT, MICH.—The Fenton Light and Power Company, the recently reorganized company which took over the Fenton gas and electric plant, has filed notice of a trust mortgage for $50,000 to the Detroit Trust Company to cover an issuance of bonds to make improvements in the plant.

SPOKANE, WASH.—The Chiwaukum Power and Tunnel Company, headed by O. Gondler, has filed notice at Chiwaukum, west of Spokane, of water rights in the Chiwaukum river. The stream has a drop of more than 2,000 feet per mile for more than nine miles, and it is estimated that 100,000 horse-power is available.

GARY, IND.—Articles of incorporation have been filed at Indianapolis for the incorporation of the Gary Light, Heat and Water Company. The capital stock is $10,000. The directors of the new concern are: George A. Thorpe, Thomas J. Hyman, A. F. Knotts, Kemper K. Napp and Eugene Buffington. The company will establish an electric plant at Gary.

MOUNT VERNON, OHIO—M. W. Hisey, of Zanesville, has purchased the Mount Vernon Electric Light Company, the Mount Vernon Electric Street Railway and Lake Hiawatha Park. The consideration amounted to $100,000, and a similar sum is to be spent by Mr. Hisey in improvements. The properties were purchased from the Jackson-O'Neill syndicate.

COLVILLE, WASH.—The Northern Electric Company, with its principal offices in Spokane, has filed a deed of trust in the office of the county auditor by which it transfers to the Spokane & Eastern Trust Company, of Spokane, all of its electrical plant and property at Newport for a consideration of $15,000. The deed is made to secure an issue of $15,000, ten-year six per cent bonds, of denominations of $500.

STILLWATER, MINN.—The Stillwater Gas and Electric Company will increase its facilities by building an electric power-house near its gas house. R. S. Feurtado, superintendent, says that all plans for the improvement have been made. The Apple river plant of the company is overtaxed to supply power for St. Paul and other points, and the new facilities will be used to tide over all emergencies which may arise.

SPOKANE, WASH.—The Hancock Irrigation and Power Company, recently incorporated for $250,000, with J. A. Young, formerly of Spokane, as president, is planning to erect a large power plant at Priest Rapids, where 50,000 horse-power will be developed. It is expected to irrigate 25,000 acres of land in the northeastern part of Benton county, southwest of Spokane, the water coming from the Columbia river.

HAVERHILL, MASS.—The board of gas and electric light commissioners has approved the petition of the Haverhill Electric Company that it be permitted to issue additional capital stock to the amount of $75,000. This increase is to be devoted solely to two purposes: $62,500 for the payment of outstanding promissory notes, and $12,500 to defray the expenses of making additions to the company's plant. The board also fixes the price at which the new shares shall be offered for sale at $160.

SPOKANE, WASH.—W. A. White, of New York, who is heavily interested in the Washington Water Power Company, of Spokane, announces that the company's Medical Lake line will soon be extended into the Big Bend country, and that it will also supply power for lighting and other purposes to the various towns along the railway. The plant at Post Falls, Ida., is now in operation, and Mr. White says there is sufficient power to extend the line to Colfax and Palouse, 100 miles, and tap a dozen other towns south of Spokane.

ALBANY, N. Y.—The Southern Dutchess Gas and Electric Company, of Fishkill and Matteawan, an electric light company operating under lease the plant of the Citizens' Railroad, Light and Power Company, has made application to the commission of gas and electricity for consent to issue bonds to the amount of $90,000 for the purpose of acquiring and improving the property lately owned and operated by the Fishkill and Matteawan Gas Company, a gas plant recently sold under forclosure of a mortgage given to the Knickerbocker Trust Company to a committee of the bondholders.

TEXARKANA, TEX.—At a meeting of the city council on the Texas side of town an ordinance was adopted, giving to W. P. Harrison and associates, owners of the Texarkana Telephone Company, a franchise to establish and operate an electric lighting plant and system in that section. J. B. King, the local representative of the company, states that he expects to have the plant installed and in operation not later than January 1 next. By the provisions of the franchise electric lights are to be furnished the public at a rate approximately one-third less than is now being paid.

BAKER CITY, ORE.—General Manager John Thomsen, of the Freemont Power Company and the Red Boy mine, situated in the Granite district, about thirty miles west of Baker City, reports that he will have the Olive Lake power plant in operation by Octo-

Digitized by Google

ber. This plant will furnish 5,000 horse-power and will not only operate the Red Boy mine, which is to be rehabilitated, but will furnish power for neighboring mines and cities. This is one of the largest undertakings in recent years in the Baker City mining camps. Machinery has been delivered and most of it is in place.

GRAND RAPIDS, MICH.—The Boyne River Power Company has filed articles of association with the secretary of state. The capitalization is placed at $100,000, all of which is subscribed. The company will acquire the flowage rights on the Boyne river owned by E. A. Stowe and C. C. Follmer and will erect a thirty-two-foot dam three miles east of Boyne City, utilizing power to light this city. The company will furnish power to Boyne Falls, Clarion and the resorts on Walloon Lake. Frederick C. Miller will manage the concern, with headquarters at Boyne City. Work on the construction of the dam will be started at once.

COLORADO SPRINGS, COL.—A proposition has been submitted to the city council by William Gessford & Company. Mr. Gessford offers to furnish Colorado City with all the electric current necessary to light the city free of charge for twenty years, providing the city will erect and maintain at its own expense the necessary poles, wiring and street lamps, also that a proper and just agreement be made as to the price of electricity for use in business houses and residences. Mr. Gessford proposes to furnish the current from a plant which is to be located near Manitou on French creek. A similar proposition has been made by Mr. Gessford to the Manitou city council.

WATERTOWN, N. Y.—J. O. Mange, general manager of the Watertown Electric Light Company, is superintending extensive improvements that are being made by his concern. In the building on Main street a plant almost new will be installed. C. B. Hodge & Company are the contractors for the work and have started to remove practically everything from the building, leaving only the four walls and the roof. Concrete floors will be placed throughout the structure. A new wheel pit, generator pit and concrete flume are in course of construction. A new switchboard is being installed, and all the old apparatus that will be used again is being thoroughly renovated. The new generators, the water power that the company is now buying and other new facilities will double the capacity of the plant.

ORANGE, N. J.—By a unanimous vote the common council of Orange decided to proceed with the erection of a municipal electric plant for street lights. The plant is to be built in conjunction with the water-pumping plant, under a law which was passed by the legislature last winter. Complete plans and specifications for the plant will be submitted in September, and the bids for the work will be advertised for, to be received about September 20. It is expected that contracts will be awarded by October 10, and the plant will be completed, if the figures are satisfactory, by February. This will make Orange the first city in New Jersey to erect a municipal lighting plant. After the plant is in operation the question of going into the private lighting business will be submitted to the voters. At present Orange pays $85 an arc light of 2,000 candle-power. According to Consulting Engineer Seymour the cost under municipal operation will be less than $50 a year. Mr. Seymour is to run the plant for the city for six months after it is installed. The plant will be used also for pumping for the water and sewer departments.

DENVER, COL.—The board of supervisors at a special meeting ratified the terms of the charter amendment carried at the election, May 15, providing for a reduction in the price of street arc lights from $90 to $60 per year. The new rate dates back to June 1 and saves the city $3,000 a month in the light bill. In return for this reduction in rates the city abrogates its right to purchase the Lacombe lighting plant. By the terms of the franchise granted the Lacombe company in 1901 the plant was to be sold to the city at its option, the opening price being $225,000. A credit of $20,000 per year was to be given the city on the purchase price. To date this amounts to $100,000, leaving the plant open to purchase for $125,000. An eastern expert last spring, after an examination of the property, stated it would require an investment of $400,000 to put the Lacombe plant in proper condition to supply the demand, and that an entirely new plant would be a better investment. Mayor Speer then urged the adoption of a charter amendment to abrogate the purchasing clause and for the company to give a $60 rate for ten years. The provision also calls for 2,000-candle-power arc lamps, the same as furnished under the $90 per annum contract.

UTICA, N. Y.—The engineers and foremen of the tower line of the Hudson River Electric Power Company have commenced work on the line between Utica and Clark Mills. The line will be tapped at Clark Mills to furnish motive power for the electrification of the West Shore Railroad between Utica and Syracuse. Power is now being delivered in Amsterdam over the tower line, and construction is under way west of Amsterdam toward Utica. It is expected that the tower line will be completed into Utica in the fall. The steam turbine plant will then be used only as an auxiliary, the main power being furnished directly from Spier falls. The company will be able to deliver all the power needed in Utica for the operation of the trolley system, manufactories and lighting. About thirty men have been placed at work between Utica and Clark Mills. The tower line runs from Utica at the power plant to Yorkville, New York Mills, then to Clark Mills. The distance of the line to Clark Mills from Utica is about seven miles and from Clark Mills to Amsterdam, sixty-two miles. The towers are fifty-five feet high, of steel, seventeen feet square at the base, and rest on concrete foundations. They will carry a double circuit of three wires each, with an extra wire for emergency. The work between Utica and Clark Mills will be completed in about six weeks. The construction costs about $5,000 per mile.

ST. LOUIS, MO.—Harbor and Wharf Commissioner Whyte at a meeting of the St. Louis board of public improvements, suggested an ordinance for the letting of a twenty-year contract to light the streets, parks and public places in St. Louis. If the bids received do not reach the proper figure, Mr. Whyte suggests that a municipal lighting plant be installed. The present lighting contracts will expire on August 31, 1910. When the last contracts were let, in 1900, the city was kept in darkness for several weeks by the failure of the municipal assembly to make any provision for lighting during the letting period. Mr. Whyte claims that the prices, which now average $98 a year for arc lights, should not be more than $60 or $65 a year. These prices are based on the operating expenses of the municipal lighting plant at Detroit, Mich. The city could save, Mr. Whyte says, by these lower prices, enough money to brilliantly light the business district of the city. His figures are based on the use of 2,000 lamps, which will result in a saving of $150,000 a year. Thomas Carter, supervisor of city lighting, has been working on plans for a municipal lighting plant for some time. It is estimated that the cost of erecting a municipal lighting plant with its necessary conduits in the so-called underground district would be $800,000. The operating expenses for such a plant is estimated at $400,000 a year. Even at the maximum price of $70 for each lamp 700 new lamps could be installed each year.

PASADENA, CAL.—By an act of the city council a plan has been evolved whereby funds amounting to $52,000 are to be provided through direct taxation for the immediate construction of the municipal light plant, for which the citizens voted bonds some time ago. When the council met two ordinances were read. One creates the department of municipal electric lighting works and provides for a general manager. The other fixes the tax levy at $1 on each $100 of valuation for all municipal purposes and fifteen cents for school purposes. A levy of eighty-two cents per $100 valuation on the city assessment will provide sufficient funds to maintain all the city departments. The eighteen cents extra levy will provide a fund of $52,700, as the total taxable wealth for general purposes is $29,310,065, and the fund thus derived will be used to establish a municipal lighting plant. Charles C. Glass, an electrical engineer, who was engaged by the city some weeks ago, has prepared estimates for the installation of a suitable power-house and the establishment of 100 arc lights and 1,500 incandescent lights of sixteen candle-power each. He places the cost of maintenance at $7,000 per year. The total cost of the plant as planned will be $51,700, leaving $1,000 derived from the extra levy to go toward the operating expenses. With the money left in the lighting fund this year and the $14,000 that has been placed in the budget for lighting purposes the city will have $21,000 in addition to the $1,000 to be devoted to maintenance and extensions. The council figures that the light bills of the Edison company average $1,425 per month, or $17,000 per year. The city plant will cost only $7,000 to maintain, leaving $10,000 for a sinking fund.

Digitized by Google

ELECTRIC RAILWAYS.

OWOSSO, MICH.—J. A. Phick has been granted a franchise for an electric line through the streets of Owosso.

COLUMBUS, OHIO—An addition to the power-house of the Columbus Railway and Light Company is to be built.

NEWARK, N. Y.—The Rochester, Syracuse & Eastern Railroad Company is operating its line from Lyons to Fairport, a distance of twenty-five miles.

WESTFIELD, MASS.—A deal has been consummated by which the Woronoco and Western Massachusetts Street Railway companies pass into the hands of the Springfield Street Railway Company.

EASTON, PA.—President Fehr, of the Easton Transit Company, has closed contracts for thirteen new cars and other equipment for the company's lines now in operation and those under construction.

CLEVELAND, OHIO—The new Cleveland Electric Railway franchise ordinance will provide for a franchise grant of twenty years, practically universal transfers and seven tickets for a quarter with five-cent cash fare.

CHICAGO, ILL.—The Chicago & Milwaukee Electric line between Kenosha and Racine was opened for traffic on September 1. Through trains run between Evanston, Ill., and Racine, Wis., in one hour and forty minutes.

STEUBENVILLE, OHIO—An ordinance for a double-track interurban railroad along the Ohio river has been passed by the council, giving the Ely syndicate and the Steubenville Traction Company a franchise for twenty-five years.

PARIS, ILL.—Word has been received that the contract for the construction of the Paris-Charleston interurban line has been awarded to the Wallace-Coates Engineering Company, of Chicago, and that work will be commenced at once.

MORRISTOWN, N. J.—Residents of Morristown voted to grant a franchise to the Morris County Traction Company to operate an electric street railway on Speedwell avenue, from the park to the town limits. It is Morristown's first trolley line.

BISMARCK, N. D.—The Hughes Electric Company has leased the state's electric street-car line for two years and will run it upon a continuous service, thus shortening the present running time over one-half. The rental is understood to be but nominal, the line having been a heavy loser.

PITTSBURG, PA.—A new street railway company is being organized in Homestead, to be known as the Homestead, Whitaker & Homeville Street Railway. It is proposed to connect the three towns named and Munhall, and to build about five miles of line. The company will have $25,000 capital.

CINCINNATI, OHIO—At the annual meeting of the Mansfield Railway, Light and Power Company an excellent statement of earnings for the year was made, and the following officers were elected: Leopold Kleybolte, president; Arthur S. Huey, vice-president, and George Koehler, secretary and treasurer.

BURLINGTON, IOWA—The Burlington board of supervisors has granted to B. L. Behr and associates, of St. Louis, permission to use the upper Augusta country road for a period of twenty-five years for an electric railway line, on condition that the same be built and in operation by September 1, 1909.

SHARON, PA.—The Mahoning & Shenango Street Railway Company will spend $1,000,000 for new equipment in Sharon, Youngstown and New Castle. Included will be about fifty modern street cars. The recent statement made by the company shows that it is earning satisfactory interest on its investment.

MEMPHIS, TENN.—Surveyors have begun a preliminary survey for an electric railway from Covington, Tenn., to Memphis, about thirty miles, and almost parallel to the Illinois Central. Business men at Covington and along the route have subscribed to pay the survey, and they propose to build the road.

JACKSON, TENN.—The Jackson Railway and Light Company has let the contract for the construction of a new power-house. All preliminary arrangements for the extension of the car lines to Bemis have been completed, and the company expects to have cars traversing the new route within the next nine months.

CARROLLTON, GA.—Interest is again being aroused in the proposition of erecting an electric railway line from Villa Rica to Carrollton, Bowden, Franklin, Heard county, and thence to some convenient point in Alabama. Ample capital has been secured if sufficient cooperation by the people at these points and the granting of the right of way can be had.

GUTHRIE, OKLA.—The city council of Edmond has granted a franchise to the Newkirk, Tonkawa & Southern Interurban Company which proposes to build an electric line connecting the principal towns of Kay, Noble, Logan and Oklahoma counties. The company puts up a $500 cash guarantee to begin work within the city limits inside of ninety days.

CHANUTE, KAN.—It is reported that contracts have been let for the Rawlins interurban electric system. This system will be 150 miles long and will extend from Chanute to Joplin, Mo. There will be two branches, one running from Chanute *via* Thayer to Cherryvale, Coffeyville and Independence, and the other *via* Erie and Parsons to Columbus, Weir, Galena and Joplin.

CHENEY, WASH.—Charles P. Lun, of Spokane, is at the head of a company which will build an electric railway between Spokane and Cheney, Wash., eighteen miles, to be in operation early next year. Franchises have been granted by the towns of Hayford and Cheney. The line will be equipped with two high-power sixty-foot coaches, and it is planned to make seven trips daily.

SPOKANE, WASH.—W. H. Plummer, president of the Spokane & Big Bend Electric Railway Company, is authority for the statement that the line between Spokane and Davenport, Wash., will be in operation before June, 1907. Surveys have been completed and seventy-five per cent of the 120 miles of right of way has been secured, and it is stated that work will begin some time this month.

NEWBURGH, N. Y.—The Orange County Traction Company has been purchased by a local syndicate of which ex-Governor Odell is the head. The company owns about twenty miles of line. For three weeks there had been a strike of the regular employés, and strike-breakers have been running the cars. The new owners have made a settlement with the men and are said to have granted every demand.

NAPA, CAL.—Preliminary steps are under way for the construction of the new electric road to be built by the Bay Counties Railway Company from Napa to San Francisco, a distance of forty-five miles. The route of the railroad will be from San Francisco to the Marin county shore by ferry and from there to Napa by electric road. At the Napa line it will connect with the Napa and Lake Port Railroad.

STERLING, ILL.—An electric road from Belvidere to Geneva lake is a part of the building project of the company which is back of the purchase of the De Kalb-Sycamore line, and which proposes to build from Sycamore to Genoa and from Genoa to Belvidere. The incorporation papers also provide for lines to a number of other cities, but the Belvidere line is the one to which the company will first devote its attention.

NEW WESTMINSTER, BRITISH COLUMBIA—After returning from his trip over the proposed Chilliwack line, Managing Director Buntzen, of the British Columbia Electric Railway Company, stated that the cost of construction was estimated at $1,250,000, and that the company would endeavor to have the line built within two years of the completion of the surveys. The running time from New Westminster would be about three hours.

NEW HAVEN, CT.—In addition to the double-tracking of the Consolidated Railway from Lake Whitney to Mount Carmel, which is to be undertaken, the Connecticut Railway and Lighting Company contemplates double-tracking its line from Mount Carmel to Cheshire, and possibly to Waterbury, so that by another year the summer travel between these points, and as far north as Meriden, will be greatly facilitated. This will do away with the present delays in making connections.

BRISTOL, TENN.—The Bristol Belt Line Company is making preparations to extend its electric car line over the various streets

Digitized by Google

of Bristol, Va. Up to this time its tracks have all been in Bristol, Va., except for a short time a few years ago, when its cars reached the Virginia Institute, on the northern suburbs. The line was taken up and removed because of a disagreement with the city council regarding the duty of the Belt Line Company in regard to keeping up the streets on which its line ran.

PHILADELPHIA, PA.—The tracks of the Morton, Swarthmore & Media trolley line have been connected with those of the Philadelphia Rapid Transit Company on Woodland avenue above Ninth street in Darby. This will give the Philadelphia Rapid Transit Company a through line to Media and Chester, independent of the lines of the Chester Trolley Company. The former company recently secured a lease of the Morton, Swathmore & Media line. Its cars have hitherto run only to the Darby terminus.

SPOKANE, WASH.—E. P. Coles, of Philadelphia, who is one of the backers of the Lewiston & Southeastern Railway, and E. M. Scofield have returned to Spokane from a trip over the proposed electric line between Lewiston, Ida., and Grangeville, and announce that the railway will be built. It is likely that the Idaho Development Company's plant on the Salmon river will be acquired when the company will furnish power to the Buffalo Hump mining district in western Idaho. The railway will tap rich agricultural districts on the Nez Perce and Camas prairies.

ROCHESTER, MINN.—Southern Minnesota capitalists are considering the leasing of the Winona-Rochester branch of the Chicago Great Western and turning it into a trolley line. This piece of track, it is said, is being used less frequently every year, and it is believed that little difficulty would be found in inducing the railroad officials to lease it. The cost of converting the railroad into a trolley line would not be great. The plans of the promoters have not yet been entirely perfected, but, it is said, they are about ready to open negotiations with the railroad officials.

WASHINGTON, D. C.—The stockholders of the East Washington Heights Traction Company at their annual meeting elected the following directors: O. C. Brothers, Jr., C. A. Barker, Arthur E. Randle, D. C. Fountain, George H. Judd, S. R. Norman, A. L. Martin, C. B. Hilliard and James E. Davis, of Baltimore. The United States Realty Company, of Washington, holds a controlling interest in the road, which was established to provide rapid transportation to Randle Highlands, and the other properties which are being developed by this company. The road extends from the eastern terminus of the Capital Traction Company over the Pennsylvania avenue bridge to Minnesota avenue.

EAU CLAIRE, WIS.—The plans of the Chippewa Valley Electric Railroad Company with regard to carrying out the projects in connection with the granting of the franchise, which extends until 1928, have been outlined by C. T. Bundy. Surveyors will be put to work next week to lay out the interurban line between Eau Claire and Menomonie. A prominent engineer of Minneapolis has been engaged to superintend the work of developing power from the Red Cedar and installing new wheels at the Dells dam, and the reconstruction of the Eau Claire light and power plant. It is also proposed that outstanding bonds of the Chippewa Valley Electric be retired and new ones issued in order to realize part of the money needed to carry out the projects under consideration.

LA CROSSE, WIS.—A project which contemplates the construction of an electric railroad system from Menomonie to Chippewa Falls, Eau Claire, Black River Falls and La Crosse has been proposed. The plan as conceived is to extend and recapitalize the Chippewa Valley electric railroad, which now runs from Chippewa Falls to Eau Claire. Arrangements have been made for the issuing of new bonds and realizing part of the money needed for the development of new power. There is a possibility, if the plan is carried out and the line is extended to La Crosse, that the La Crosse Water Power Company may supply the power from its dam now building at Hatfield, for part or all of the system of railroad.

PITTSTON, PA.—The Lehigh Valley Railroad Company, backed by capitalists from New York and Wilkesbarre, is about to enter negotiations for the electrification of a branch of the road from Tunkhannock to Montrose and for the construction of an extension of the line from Montrose to Binghamton. From authentic sources it has been learned that the surveys are complete, and the financial backing for the project has been secured. Although no definite date has been fixed, it is understood that plans are being made for the commencement of construction early next spring, and it is believed that the installation of the electric system on the Montrose branch of the Lehigh, at least as far as Lake Carey, will be taken up at about the same time.

LIMERICK, ME.—Plans for a new electric railroad to be known as the Ossipee Valley Line, to run between Springvale and Bridgton Junction, are being perfected and a charter will be petitioned for at the next session of the legislature. The road is to be forty miles long, running through the towns of Hiram, Sanford, Shapleigh, Newfield, Limerick, Parsonsfield, Porter and Cornish. The capital stock will be $160,000. A meeting of those interested was held recently, and the following directors were elected, at least one representative being chosen from each town through which the road will pass: George W. Hanson, of Sanford; Prescott A. Thing, of Shapleigh; Harry H. Moore, of Newfield; Charles G. Moulton, of Limerick; J. Merrill Lord, of Parsonsfield; Allen Garner, of Parsonsfield; Owen L. Stanley, of Porter; H. Kimball, of Cornish, and Milton Easton, of Limerick.

LOUISVILLE, KY.—The first steps toward paralleling the Chicago, Indianapolis & Louisville Railway, the Monon route, from Chicago to Louisville, entering Louisville from Jeffersonville, have been taken at Indianapolis, where articles of incorporation of the Chicago & Western Indiana Traction Company have been filed. The directors are Edward H. Barrows, Daniel W. Bolen and John S. McCulloch. The capital stock is fixed at $100,000. It is set forth that the line will pass through Lake, Porter, Newton, Jasper, Benton, White, Tippecanoe, Montgomery, Putnam, Owen, Monroe, Lawrence, Orange, Washington, Floyd and Clark counties, which is the identical route of the Monon from Chicago to Louisville. The line is to be called the "Educational Route," from the fact that, if built, it will pass through Lafayette, Crawfordsville, Greencastle and Bloomington, at which places large colleges are located, the Indiana State University being at the last named.

ST. LOUIS, MO.—The St. Louis county court has granted the franchise sought by the Hillsboro, Kimmswick & Northern Railway Company for an electric road from the southern part of the city to the line between Jefferson and St. Louis counties. The franchise carries with it the right to build a bridge over the Meramec river for the railroad, wagons and pedestrians. The line is to extend from the terminus of the Jefferson Barracks road southwesterly to the bridge, which is to be located near Telegraph and Fine roads. The company is to improve the bridge approach at its own expense. The final terminus of the line is to be at Montesano park, and is to be completed within two years. Private right of way is to be used for the entire distance. A five-cent fare is all that can be charged for the run through St. Louis county. Cars are to be operated each way at least thirty minutes apart from early morning to midnight and at least one hour apart between midnight and morning. The company will be required to file a bond for $5,000 to indemnify the county and deposit $1,000, upon which the court may draw to make repairs.

SPOKANE, WASH.—Jay P. Graves, president of the Inland Empire Electric Railway Company, whose bonds to the extent of $30,000,000 were recently underwritten by E. H. Rollins & Sons, of Boston, and Peabody, Houghtaling & Company, of Chicago, announces that the line of the Spokane & Inland Railway will be extended from either Moscow, Ida., or Palouse, Wash., to the Snake river with a view to making Lewiston, Ida., giving the road 150 miles of line. The new line between Spokane and Lewiston will be thirty-five miles shorter than the Northern Pacific line between the two points. Work is to begin the coming fall. F. A. Blackwell, chairman of the finance committee, also announces that a line from Spokane to Lake Pend d'Oreille, Ida., fifty-six miles, will be in operation in a year. This line is in opposition to the projected railway by the Spokane-Lake Pend d'Oreille Rapid Transit Company, of which C. H. Reeves, one of the original owners of the famous Hercules mine, is president. The last-named company has run its surveys, secured right of way and terminal grounds in Spokane and at Squaw Bay, Ida. The outcome of the fight for supremacy is being watched with interest by railway men in the Pacific Northwest, as both concerns claim title to the lake property.

Digitized by Google

INDUSTRIAL ITEMS.

THE MARSHALL ELECTRIC MANUFACTURING COMPANY, Boston, Mass., announces that the new push-button switch with fibre false plate is meeting with a large demand. The company is increasing its capacity in this line to keep pace with orders.

THE AITON MACHINE COMPANY, New York city, has ready for shipment a four-head tandem armoring machine. This is one of the largest machines for armoring ever built, and it should prove of interest to manufacturers making armored cable. The machine can be seen at the Harrison, N. J., works of the company.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., enjoys the distinction among supply houses of having a room fitted up and devoted exclusively to the display of fixtures. This is located on the first floor of the new building at 264-270 Fifth avenue, in connection with the company's retail department, and all the latest styles and finishes of electric and combination fixtures are found on exhibition.

THE SUNBEAM INCANDESCENT LAMP COMPANY, Chicago, Ill., has issued an attractive booklet of verses entitled "Scintillating Sunbeams." This is a pleasing little originality illustrated with appropriate line drawings. A copy will be sent to any one interested, upon request, to the general distributing agent for the Sunbeam lamp, the Western Electric Company, Chicago, Ill., or any of its branch houses.

THE WESCO SUPPLY COMPANY, St. Louis, Mo., is placing on the market its Wesco soldering paste and Wesco soldering stick, particularly adapted to armature work, especially in connection with soldering the armature leads to the armature. The company announces that the Wesco stick or paste has a tendency to act more as an insulator than as a conductor of current, so that if any of it is left in the armature there is no danger of its causing a burnout.

FAIRBANKS, MORSE & COMPANY have placed the management of its eastern electrical department in the hands of Baxter Reynolds, with offices at the company's headquarters, 12 Dey street, New York. Mr. Reynolds is a graduate of the technical and engineering courses of the Sheffield Scientific School at Yale University, and prior to his present connection Mr. Baxter was identified with the Nernst Lamp Company. Fairbanks, Morse & Company have taken over a line of alternators and dynamos and motors which have heretofore been manufactured by the Commercial Electric Company, of Indianapolis.

THE NATIONAL BRAKE AND ELECTRIC COMPANY, Milwaukee, Wis., reports the following recent orders for electrical machinery: George W. Pitkin & Company, Chicago, Ill., one 100-kilowatt engine-type alternator; Clinton Sugar Refining Company, Clinton, Iowa, one 400-kilowatt and one seventy-five-kilowatt engine-type alternator; Alliance Electric Light and Power Company, Alliance, Neb., one 100-kilowatt belted-type alternator; Fort Morgan Electric Light and Power Company, Fort Morgan, Col., one seventy-five-kilowatt engine-type alternator; Stillwater Gas and Electric Company, Stillwater, Minn., one 250-kilowatt engine-type alternator; Clymer Power Company, Riegelsville, Pa., one 500-kilowatt water-wheel alternator; Hendrie & Bolthoff Manufacturing and supply Company, Denver, Col., two 150-kilowatt water-wheel alternators; Rockford Malleable Iron Works, Rockford, Ill., one 200-kilowatt engine-type direct-current generator; Romadka Brothers, Milwaukee, Wis., one 150-kilowatt engine-type direct-current generator.

THE BALL ENGINE COMPANY, Erie, Pa., announces the following recent sales of its new design side crank automatic engine: one 100-horse-power, Commonwealth Trust Company building, Pittsburg, Pa.; two 200-horse-power, Commonwealth Trust Company building, Pittsburg, Pa.; one 200-horse-power, Chicago Varnish Company, Chicago, Ill.; one 165-horse-power Holdrege Lighting Company, Holdrege, Neb.; one 100-horse-power, Holdrege Lighting Company, Holdrege, Neb.; one 335-horse-power, Philadelphia Post Office building, Philadelphia, Pa.; one 100-horse-power, Deepwater Railway Company, Deepwater, W. Va.; one 320-horse-power, Henderson Light and Power Company, Henderson, N. C.; one 210-horse-power, T. A. Gillespie & Company, Pittsburg, Pa.; two 320-horse-power, United Hebrew Charities, Chicago, Ill.; one 150-horse-power, Germain-Boyd Lumber Company, Atlanta, Ga.; one 150-horse-power, Washington Gas and Electric Company, Washington Court House, Ohio; one 320-horse-power, Taylor Coal Company, Beaver Dam, Ky.; one 210-horse-power, Isthmian Canal Commission, Washington, D. C.; one 150-horse-power, Natalbany Lumber Company, Montpelier, La.; two 100-horse-power, Jewish Hospital, Cincinnati, Ohio; two 150-horse-power, West Unity Light and Power Company, West Unity, Ohio; two 100-horse-power, Sweetbrier Institute, Amherst, Va.

Record of Electrical Patents.

Week of September 4.

829,951. ILLUMINATED SIGN. John L. Dawes, Pittsburg, Pa. Filed September 29, 1905. A central longitudinal section is perforated and supports the lamps, movable sign-boards being placed on each side.

829,968. RAILWAY SIGNAL AND SAFETY APPLIANCE. Charles J. Kintner, New York, N. Y. Filed June 6, 1904. Renewed December 28, 1905. The supply conductor is divided into sections, and the signals are displayed automaticallly in the presence of a car on any section.

829,969. SAFETY APPLIANCE FOR RAILWAYS. Charles J. Kintner, New York, N. Y. Filed January 27, 1905. Renewed May 9, 1906. A signaling conductor placed adjacent to one of the track rails, the wheel flanges completing the circuit between the two.

829,974. ELECTRICALLY OPERATED MINE-DOOR ACTUATING MECHANISM. John C. Lincoln, Cleveland, Ohio, assignor to the Lincoln Company, Cleveland, Ohio. Filed April 10, 1903. A flexible door carried on a motor-driven roller.

829,975. VARIABLE-SPEED ELECTRIC MOTOR. John C. Lincoln, Cleveland, Ohio, assignor to the Lincoln Company, Cleveland, Ohio. Filed June 27, 1905. The variations in speed are produced by axial movements of a cone-shaped armature in its field.

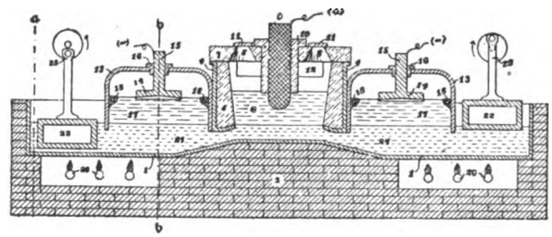
830,025. DYNAMOELECTRIC MACHINE AND THE LIKE. Ludwig Torda, Barking, England. Filed June 2, 1905. Commutating poles are provided, the pole-faces being connected to the main poles by conducting strips.

830,041. ELECTRIC TIME SWITCH. Clayton A. Ballou, Providence, R. I.—Filed June 30, 1905. A clock-driven time switch.

830,051. APPARATUS FOR THE ELECTROLYTIC EXTRACTION OF METALS. Courtland F. Carrier, Jr., Elmira, N. Y., assignor to Elmira Electrochemical Company, Elmira, N. Y. Filed January 30, 1905. The chamber containing the molten material is deeper at the extremities and is divided into compartments by downwardly projecting bells.

830,119. CONTROL OF APPARATUS GOVERNING THE PASSAGE OF CARS OR VEHICLES ALONG A RAILWAY. Herbert A. Wallace, New York, N. Y., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed June 13, 1906. An electrical method of controlling block systems.

830,131. ELECTRIC RAILWAY SYSTEM. William M. Brown, Johnstown, Pa., assignor to the Lorain Steel Company. Filed April 27, 1905. A closed conduit system in which a sectioned rail is made alive by the passage of the car.



830,051. APPARATUS FOR THE ELECTROLYTIC EXTRACTION OF METALS

830,158. SYSTEM OF MOTOR CONTROL. Axel Magnuson, New York, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed July 6, 1905. An electric elevator system in which the motor is controlled by means of current from a storage battery which is charged by a generator driven by a motor, the generator also acting as an automatic brake.

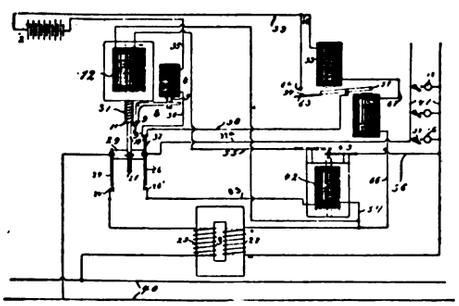
Digitized by Google

830,161. TELEPHONE. John Z. Miller, Erie, Pa. Filed October 30, 1902. A selective telephone system for two instruments on one line.

830,164. ELECTRICALLY OPERATED LINE INDICATOR FOR RAILWAYS. Claud D. McPhee, Arnprior, Canada, assignor of one-half to James Robinson, Montreal, Canada. Filed October 2, 1905. An automatic arrangement for electrically indicating the condition of a track, the signals being sent over the telegraph line.

830,201. PRESS FOR MANUFACTURING ARC LAMP ELECTRODES. André Blondel, Paris, France. Filed November 18, 1902. The press enables compound or hollow carbons to be formed.

830,209. AUTOMATIC TRANSFORMER CUTOUT. De Witt C. Conkling, Hoboken, and John E. Winn, Weehawken, N. J., assignors to Electric Economies Company. Filed November 14, 1904. Renewed February 17, 1906. By means of an auxiliary circuit the primary circuit to the transformer is open when there is no load on the secondary.



830,209. AUTOMATIC TRANSFORMER CUTOUT.

830,217. ELECTRICALLY CONTROLLED OPTICAL APPLIANCE. John C. Fredell, Pocatello, Ida. Filed August 25, 1905. An electrical method of controlling a shutter, such as is used in cameras.

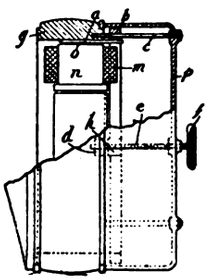
830,242. SYSTEM OF MOTOR CONTROL. Axel Magnuson, New York, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed September 20, 1905. An alternating-current motor drives a small generator, the current from which regulates the rate of acceleration.

830,247. SELECTIVE SIGNAL SYSTEM FOR RAILWAYS. Frank R. McBerty, Evanston, Ill., assignor to Western Electric Company, Chicago, Ill. Filed July 24, 1905. A selective system employing three line wires, enabling a number of independent signals to be made.

830,253. TELEGRAPH KEY. Jesse T. Sheets, Covington, Ky., assignor of one-half to Solomon P. Kineon, Cincinnati, Ohio. Filed November 9, 1905. An improved method of construction.

830,254. FIRE-PROTECTING SIGNAL SYSTEM. John E. Shepherd, Chicago, Ill. Filed April 25, 1904. An electric alarm is sounded whenever the sprinkler system is brought into operation.

830,258. COMBINED REFLECTOR AND CLUSTER FRAME. William H. Spencer, Brooklyn, N. Y., assignor to George Frink Spencer, Newark, N. J. Filed May 2, 1905. A method of constructing a cluster for electric lamps.



830,262. CONTINUOUS-CURRENT ELECTRIC MOTOR AND GENERATOR.

830,262. CONTINUOUS-CURRENT ELECTRIC MOTOR AND GENERATOR. Ludwig Torda, Barking, England. Filed May 6, 1905. Variations in the speed or voltage of the motor or generator are made by means of paramagnetic plates inserted in gaps in the pole-pieces.

830,271. TELEPHONE SYSTEM. David H. Wilson, Chicago, Ill., assignor to Robert Bines, Chicago, Ill. Filed January 2, 1906. The primary windings of the induction coil are on two cores, the secondary being wound on a third placed between them.

830,272. TELEPHONE APPARATUS. David H. Wilson, Chicago, Ill., assignor to Robert Bines, Chicago, Ill. Filed January 2, 1906. Two separate iron cores are provided in the transmitter circuit, the receiver coils being placed on two other cores interposed between the first.

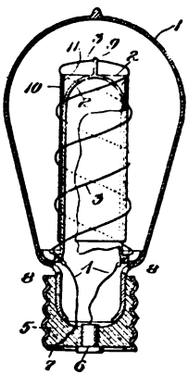
830,279. TELEPHONE TRANSMITTER. Henry F. Albright, New York, N. Y., assignor to Western Electric Company, Chicago, Ill. Filed October 21, 1904. A supporting-plate with a central opening spanned by a bridge-piece which supports one electrode; the cup carrying the carbon granules is mounted on the diaphragm.

830,299. METHOD OF PRODUCING AMMONIA AND CAUSTIC ALKALI. Gunnar E. Cassel, Stockholm, Sweden. Filed August 22, 1904. A solution of a metallic hydroxide is treated by air through which electrical discharges have taken place.

830,306. ELECTRIC LIGHT AND POWER CONTROLLER. Frederich C. Damm, St. Louis, Mo. Filed September 18, 1905. A switch for attaching to and controlled by the person occupying a chair.

830,316. JUNCTION BOX. Edwin T. Greenfield, Monticello, N. Y. Filed October 10, 1904. Lamps are provided for holding the cables in place.

830,317. JUNCTION BOX. Edwin T. Greenfield, Monticello, N. Y. Filed October 28, 1904. Lamps are provided for holding the conduits in place.



830,477. INCANDESCENT LAMP.

830,347. ELECTRIC MOTOR. David Mendelson, New York, N. Y. Filed November 8, 1905. The moving part of the motor is mounted as a pendulum, its motion controlling the flow of current through both movable and fixed coils.

830,364. WATCHMAN'S ELECTRIC TIME CONTROLLER. Pedro Reitz, Munich, Germany. Filed March 6, 1905. Alarms are sounded at predetermined times, except when manually interrupted at various controlling points.

830,391. ELECTROTHERMAL DEVICE. Charles E. White, Chicago, Ill., assignor to Frank B. Cook, Chicago, Ill. Filed June 22, 1903. A protective device for electrical apparatus actuated by air heated electrically.

830,409. TROLLEY. Herschel L. Bryant, Tonkawa, Okla. Filed October 31, 1905. The trolley wheel is automatically thrown outwardly when there is a tendency to leave the wire.

830,419. FIELD-COIL INSULATION AND PROCESS OF FORMING SAME. Louis W. Downes, Providence, R. I. Filed October 22, 1904. A double insulation, the inner being fibrous and the outer of asbestos.

830,457. ELECTRIC BRAKE. Frank L. Sessions, Columbus, Ohio, assignor to Joseph A. Jeffrey, Columbus, Ohio. Filed January 17, 1905. A brake held normally in action, but released by the current operating the motor, acting through a compound-wound magnet.

830,473. ELECTRICAL-WOUND CLOCK. Percy L. Clarke, Bristol, Ct., assignor, by mesne assignments, to the National Self-Winding Clock Company, Champaign, Ill. Filed October 13, 1902. Renewed January 8, 1906. A reciprocating mechanism for clock-winding.

830,474. DRIVING MECHANISM FOR CENTRIFUGALS. William L. D'Olier, Philadelphia, Pa. Filed April 6, 1903. A method of suspending a motor in vertical position.

830,475. POTENTIAL INDICATING DEVICE. George N. Eastman, Chicago, Ill., assignor to Minerallic Company, Chicago, Ill. Filed May 5, 1904. A type of portable electroscope.

830,477. INCANDESCENT LAMP. James W. Forster, Chicago, Ill. Filed March 24, 1905. The filament is wound upon heat-absorbing material, radiation from the inner surface of the latter being prevented.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 12. NEW YORK, SATURDAY, SEPTEMBER 22, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK

PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO

WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON

NEW ENGLAND OFFICE, M. W. BARBER, Mgr., DELTA BLDG., 10 Post Office Sq.

LONDON

EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
- Radioactivity and Future Power Supply . . . 447
- Fuel Analysis for Steam Users . . . 447
- Three-Phase and Direct-Current Transmission Systems Compared . . 448
- The Action of Electrical Oscillations on Magnetized Bodies . . . 449
- The Electric Arc Destructively Applied . . . 449

The Rotating Magnetic Field, by R. E. Hellmund . . . 450
New Lamps and New Opportunities . . . 453
The Truckee River General Electric Company . . . 454
Electric Motors in Competition with Gas Engines . . . 458
Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw . 459
Electrical Spectacle at Baltimore, Md . . . 462
The National Association of Cotton Manufacturers . . . 462
Aspects of the Inner Structure of Metals, by J. A. Ewing . . . 463
BOOK REVIEWS . . . 467
Adirondack Murray Memorial Association . . . 468
The Meeting of the Electrical Jobbers at Niagara Falls . . . 469
Johns Hopkins University Offers Graduate Courses in Applied Science . . 469
Meeting of the American Institute of Electrical Engineers . . . 469
New York Electrical Society . . . 469
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 470
METHODS OF GETTING NEW BUSINESS . . . 472

INDUSTRIAL SECTION:
- Allis-Chalmers Motor-Driven Centrifugal Pumps . . . 475
- New Cleats and Break-Arms . . . 475
- A New Line of Alternators . . . 476
- Another Electric Motor Conquest . . . 478
- New Flame Arc Lamps . . . 479
- Copper Production—Increase in the United States . . . 479
- Homer Commutators . . . 479

CURRENT ELECTRICAL NEWS . . . 480
RECORD OF ELECTRICAL PATENTS . . . 487

Copyright, 1906, by Electrical Review Publishing Co.

RADIOACTIVITY AND FUTURE POWER SUPPLY.

The recent controversy aroused in England over the subject of radioactivity is dealt with at some length in *Engineering*, London, August 31, the following interesting conclusions being drawn:

Of course, like any other physical theory, this one of atomic disintegration may, as observations accumulate, prove unequal to the description of new experiments; but, as matters stand, no competing explanation of the phenomena involved seems to cover and unify so wide a range of observed facts, and it will certainly not be abandoned until some other hypothesis is developed which will afford an equally intelligible and adequate model of the internal structure of the atom. The whole question is in its infancy, and much light may be expected during the next few years. Though, at the present time, the matter is of no immediate practical importance, the material interests of the race are involved in no remote degree. Our present civilization is based upon the possession of coal, and the output of mechanical power is increasing rapidly from year to year. In the no very distant future the supply of this indispensable commodity will be exhausted, and unless the human race can find some other source of energy, a relapse into barbarism seems inevitable. Recent experiments at Cambridge go to show that it may not prove wholly impossible to unlock the enormous reserves of internal energy which, on the hypothesis now under debate, are assumed to be locked up in the atom; though, in the experiments in question, this release of energy is only effected to a degree but little removed from the infinitesimal.

The controversy over the new theories of radioactivity can be settled only by continued experiment and it is the duty of their opponents, as well as of their supporters, to produce experimental evidence. Mere discussion, while helping to clear away misunderstandings, does not add to our knowledge. What are needed are facts and a mind to correlate them.

The suggestion of a faint possibility that one day we may become independent of coal may bring a grain of comfort to those, if any there be, who are worrying over our future needs, but it does not give us license to go on indefinitely in the wasteful methods of to-day.

FUEL ANALYSIS FOR STEAM USERS.

On a number of occasions attention has been called to the importance to steam users of paying more attention to their fuel. Coal, as any other commodity, varies in value, even when taken from a single mine, and since its cost is one of the large items of the operating expense of the boiler room, it is fair neither to the purchaser nor to the seller to pay a fixed price, no matter what the condition or what the quality of the coal delivered.

Another important item in boiler house economy is the proper burning of the coal. This feature has received a lot of attention from boiler house operators, but generally dependence has been placed upon old notions, and only of late has thought

Digitized by Google

been given to the chemistry of the process, which is, of course, of the greatest importance.

Another problem of consequence in the boiler house is the procuring of pure water, for if this be not available either the tubes of the boilers become coated and lose in efficiency or a water-softening process must be employed. In either case the engineer in charge should know just what is the character of the water he is using.

These three questions—the purchasing of the fuel, the burning, and securing pure water—all involve chemical problems, which, although not intricate, are not generally familiar to engineers. Their importance is, however, now becoming realized, and it is not at all difficult for any one with any scientific training at all to become sufficiently skilful in the analysis of coal, of chimney gases and of water to enable him to know just what he is getting and how his boilers are behaving. With the object of furnishing this information the ELECTRICAL REVIEW has secured from Mr. John B. C. Kershaw, a series of articles on "Fuel, Water and Gas Analysis for Steam Users." The first instalment appeared in the issue of September 8. Mr. Kershaw is a widely-known analytical chemist, and has had a large experience in engineering work. He treats the subject from the standpoint of the steam user, and not from that of the theoretical chemist. All the information that is needed for successfully carrying out this work, so that the operation of the boiler house may be put on a scientific basis, will be given in this series.

THREE-PHASE AND DIRECT-CURRENT TRANSMISSION SYSTEMS COMPARED.

An interesting and instructive comparison between the three-phase system of electrical transmission of power and that known as the Thury system, which employs direct currents of high potential, has been made by Signor Giacinto Motta, of the University of Milan, on behalf of the city council of that city. The city of Milan owns a municipal lighting plant and has acquired certain water rights on the upper Adda river. In order to utilize these Signor Motta was retained to investigate the advantages of the two systems of transmission and decide between them. His report is given in abstract in the *Electrician* (London), August 24. It is in favor of the three-phase system.

The water rights to be utilized make available 38,200 horsepower at the turbine shafts, which, it is thought, should make available at Milan 28,000 kilowatts at the secondaries of the transformers. The transmission line will be ninety miles long and will pass over the Orobie Mountains at a point 3,500 feet above the sea level. The comparison was made on a basis of 150,000 volts direct current, and 60,000 volts alternating three-phase current.

The Thury system would consist of ten generating groups, each made up of four generators driven by one turbine. The voltage limit of each group was to be 15,000. At the receiving end, direct-current motors were to be employed, driving generators for local distribution. The three-phase system was to consist of a number of alternators operated in multiple in the usual way, with a frequency of forty-two cycles.

Considering first the efficiency of the two systems based on a full load of 28,000 kilowatts, that of the hydraulic system is the same for both methods. With the continuous-current system the efficiency of the line was estimated at 95.3 per cent, while for the three-phase system it was ninety-one per cent. The former system loses, however, due to the method of distributing to the secondary systems. The efficiency of the motors was taken at ninety-two per cent, and that of the alternators at ninety-three per cent. The overall efficiency of the continuous-current system was computed to be fifty-three per cent, which is about three per cent less than that found for the three-phase system, the latter being 55.8 per cent. On this count, therefore, the three-phase system wins.

Coming next to the cost of the two systems, Signor Motta finds that the cost of the continuous-current system would be about $2,000,000, and that that of the three-phase system would be $2,032,000, a difference in favor of the direct-current system of 1.6 per cent. These costs include those of the generating equipment, the line and the substation apparatus.

It is interesting to point out that although the costs for the two systems are so nearly the same, there is a considerable difference in the various items. For example, the operating machinery for the direct-current system was put down at $1,400,000, while the line is charged at $600,000. For the alternating system the machinery was estimated to cost $750,000, while the line, including the lightning arresters and similar auxiliary appliances, was charged at $1,242,000. The calculated cost for the substation machinery alone for the Thury system was $720,000, while that of the transformers for the three-phase system was not over $178,000. The three-phase line was to consist of three wires, each having a cross-section of 240 square millimetres (480,000 circular mils), and the direct-current line was to consist of four wires, two for each side, each having 140 square millimetres (280,000 circular mils) cross-section.

One feature which had great weight in deciding in favor of the three-phase system was that the plans for the Thury system called for 104 commutators in series, and thus, while this system undoubtedly gains in simplicity so far as the line and switchboard apparatus is concerned, it loses more than it gains when this feature is borne in mind. The advantages claimed for the direct-current system are economy in line construction and simplicity in regulation. While it may be a simpler matter to control and maintain constant the current at the generating station than to maintain constant potentials at various points a hundred miles or so away, this large number of commutators in series certainly forms a weak point in the system which would probably not infrequently give rise to troubles, not only upsetting the regulation but interrupting the service. In this particular instance the economies in the line barely offset the increased expense of substation apparatus. If the transmission line were longer, the advantage of the direct-current line would be more pronounced; but reliability is equally as important as economy

Digitized by Google

and the direct-current system labors under the disadvantage that it has been tried in but few instances. It is true that a system of this kind has recently been put in service in southern France, but this makes only the second or third system of any importance, and as against this may be mentioned the large number of three-phase systems both in this country and in Europe. The Thury system was under consideration for the proposed Victoria Falls transmission in South Africa, where the great distance over which the power has to be carried makes the cost of the line a controlling factor; but as yet no definite plans for this undertaking have been given out. Signor Motta's comparison is of much interest, and there seems to be no question that his decision is correct, but one can not assert from this that the three-phase system will be the better under all conditions, although from present knowledge it must be admitted that it is looked upon far the more favorably.

THE ACTION OF ELECTRICAL OSCILLATIONS ON MAGNETIZED BODIES.

About four years ago Mr. William Marconi announced the invention of a new type of indicator for electrical oscillations. It had been found that the oscillating currents set up by the electrical waves produced a decrease in the magnetization of a magnetized piece of iron, and this decrease in magnetization could be utilized by means of a secondary current thereby set up to detect the waves. In other words, it offered a method of constructing a wireless telegraph receiver. The explanation of this action which is usually given is that the oscillations affect the iron in much the same way as any vibration; that they annul or decrease the hysteresis effect and allow the iron to approach a condition more nearly normal or that in which there will be no hysteresis loss. This matter has been investigated by Dr. W. H. Eccles, who discusses it in a recent paper before the Physical Society, of London, and who comes to the interesting conclusion that this explanation is incorrect.

The means of carrying out the work consists in brief in magnetizing two similar bundles of iron wire by two similar magnetizing coils, both coils being connected in series and both coils and bundles being placed so that each neutralizes the effect of the other on a magnetometer interposed between them. Around one of these bundles of wire was placed the coil through which the electrical oscillations were sent. The method of experimenting consisted in carrying the bundles of wire through magnetic cycles until a stable condition was reached. Then an oscillation was set up in the special coil, and the effect upon the magnetization of the iron was noticed by reading the change in the magnetometer deflection. The latter instrument was set up so as to be exceedingly sensitive. Readings were taken for various points on hysteresis loops corresponding to various maximum intensities of magnetization. The oscillation was provided by the discharge of a static machine, and it made no difference which pole of this machine was connected to the oscillation coil. It was found that, under similar conditions, similar deflections of the magnetometer could be secured, thus indicating a satisfactory arrangement of the apparatus; and that the effect of the oscillation varied according to the degree of magnetization, it being a maximum when the magnetic condition of the iron was that represented by the point of inflection of the hysteresis curve.

But the most interesting result of the investigation was that the oscillation has the same effect whether on the up or down side of the hysteresis loop—that is to say, in both cases the magnetization of the iron was decreased, while, as is well known, jarring the iron on the up curve would increase its magnetization. The oscillation, therefore, would seem to have an action different from the annulling of hysteresis. What it is is not known, though the author suggests that there may be intrinsic forces in the magnetized material tending to drag it into a more stable condition, which is not that defined as the normal curve of magnetization. He believes that the oscillations actually do work on the iron, thus being absorbed in hysteresis losses, and hints at certain other results which support this conclusion, but does not give them. The experiment, however, is exceedingly interesting, as it shows that in one case the oscillating current produces an effect in the same direction as the magnetizing force; while, in the other, it is opposed to it.

THE ELECTRIC ARC DESTRUCTIVELY APPLIED.

The use of the electric arc for constructive purposes, as in welding, tempering and other such uses, is more or less familiar. It has been adopted in a large number of industries. The use in the opposite sense, for destructive purposes, is new, and the suggestion made by Mr. R. A. Frickey in a recent issue of the *Journal of Electricity, Power and Gas* is interesting because it involves this idea. Some time ago an experiment was made with the electric arc for cutting metals, but nothing has since been heard of this plan, probably because it was found expensive as compared with mechanical cutting and because of the character of the surface left by the arc.

But these factors are minor ones in the application as proposed by Mr. Frickey, which is the use of the arc for clearing away the tangled mass of steel in the building ruins of San Francisco. This city, fortunately, is amply supplied with electric power, and in its rebuilding time-saving devices will be of the greatest value. But, preparatory to erecting new buildings, the ruins of the old must be cleared away, and the task of slowly sawing by hand one's way through a distorted tangle of steel beams must be discouraging and irritatingly slow. To get around this trouble it is suggested that the electric arc be employed for cutting up the metal, and with this idea in view Mr. Frickey has made a number of experiments to determine the rate at which beams might be cut up. He found that in fifteen or twenty minutes he could cut through a large I-beam, which if sawed by hand, would require several hours. Moreover, since the arc can be applied in any direction, beams may be cut by means of it which it would be very difficult to get at in the ordinary way. Since the character of the cut made is of no importance, and the cost of the operation is of small moment compared with its rapidity, the suggestion is well worthy of an extended trial.

Digitized by Google

THE ROTATING MAGNETIC FIELD.

BY R. E. HELLMUND.

The nature of the rotating magnetic field, its distribution over the pole faces, its speed of rotation, etc., have been matters of discussion since its discovery by Ferraris. All publications known to the writer, however, although in many cases extremely valuable, are incorrect or misleading in some way or other.

He has, therefore, endeavored to give in the following a correct discussion of these phenomena.

In considering the rotating field, it is necessary to make a sharp distinction between the time distribution of the various fields and the space distribution of the field over the pole faces of the motor or apparatus. If we consider the flux passing through any part of the motor as a function of time, we deal with the "time distribution of the flux." If we consider, however, the densities on different parts of the pole face at a certain moment, we deal with the space distribution of the field over the pole faces. Most authors in determining the space distribution over the pole faces assume sinusoidal currents

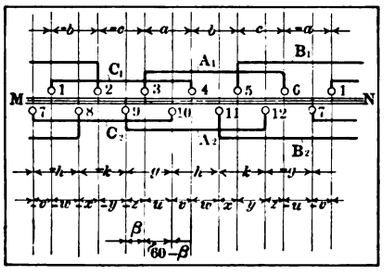


FIG. 1.—DIAGRAM OF THREE-PHASE WINDING.

to flow in the primary windings, and then figure the resulting magnetizing effect of all the windings upon a certain part of the pole. They find therefrom the flux densities at various parts of the pole face. After having determined the space distribution and the total value of the flux for different instants of time, and from these the average value of the magnetic field, they assume this average field to rotate with uniform speed and thus determine the electromotive forces induced thereby in the conductors of the machine.

This way of proceeding is objectionable for various reasons. First of all, it is not logical to start from the currents flowing, because in practice not the currents but the impressed electromotive forces are given, and the currents flowing are, in their value and character, only a consequence therefrom. Moreover, the above method gives incorrect results for the induced electromotive forces, since, as will be shown later on, the magnetic field does not rotate with uniform speed.

In order to obtain a true and exact picture of the nature of the rotating field, it is logical and advisable to follow up all phenomena in such sequence as they follow in actual practice. As mentioned before, the impressed electromotive force of a motor is given, and therefore the natural way of proceeding in outlining the theory is as follows:

A state of equilibrium is possible only if the counter-electromotive force of the motor is equal and opposite in value to and of the same wave-shape as the impressed electromotive force. Therefore, the electromotive force to be induced in the motor follows directly from the impressed electromotve force. Since for inducing a certain electromotive force a certain field is necessary, the field, in intensity and character, may be derived from the counter-electromotive force to be induced and, finally, the current values which are necessary to induce the field may be found. This way of proceeding has been partly used of late in some publications. The greater number of them neglect, however, the very important effect which the currents flowing in the secondary circuits have upon the field distribution. A very valuable treatment of the phenomena has been given in the Sibley *Journal of Mechanical Engineering*, by A. S. McAllister, which calls attention to the influence of the secondary currents. The conclusions derived in this publication are, however, not quite exact.

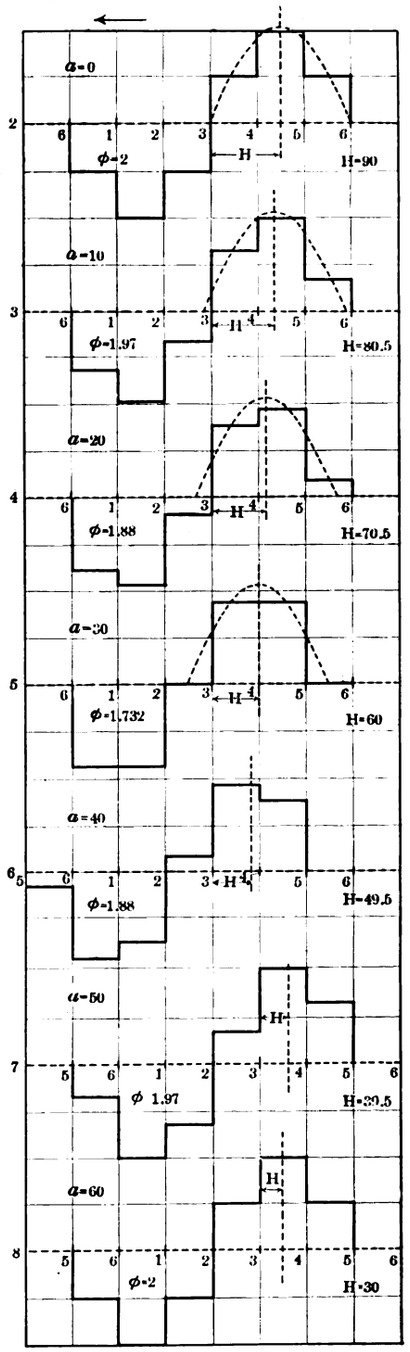
In the following discussion, a three-phase motor, with one slot per pole per phase in both members, will be considered in detail:

In Fig. 1 the lines M, N represent the air-gap; A_1, B_1 and C_1 are the three primary windings; A_2, B_2 and C_2 are the secondary windings. If we consider the current in each slot to be concentrated into a mathematical point in the figure, and the air-gap to be perfectly uniform, we may assume, according to the laws of magnetic induction, that the flux density in the air-gap between two current points, no matter whether said current points are placed on the primary or secondary member, is uniform.

Let total flux between the current points 3 and 10 be u, that between 10 and 4 be v, etc., as indicated in Fig. 1. Then it may be easily shown that the flux of equal areas, which are shifted 180 degrees from each other, must be equal and opposite in value, and are so assumed in Fig. 1. The following equations may now be written (see Fig. 1):

$$u + v = a;\ w + x = b;\ y + Z = c.$$
$$Z + u = g;\ v + w = h;\ x + y = k.$$

If potentials of sinusoidal wave shape and 120 degrees phase displacement are impressed upon the primary coils A_1, B_1 and C_1 the counter-electromotive forces



FIGS. 2-8.—SHOWING SPACE DISTRIBUTION OF MAGNETIC FIELD.

induced in these coils must be also sinusoidal and of 120 degrees phase displacement.

Let the induced potentials be:

in A_1, $E_1 = \sin a$

in B_1, $E_2 = \sin (a + 120)$

in C_1, $E_3 = \sin (a + 240)$

where a is a function of the time.

From these it follows at once that the

Digitized by Google

flux surrounded by each primary coil must be:

for coil A_1, $\phi_1 = \frac{d E_1}{d a} = \cos a$

for coil B_1, $\phi_2 = \frac{d E_2}{d a} = \cos (a + 120)$

for coil C_1, $\phi_3 = \frac{d E_3}{d a} = \cos (a + 240)$

From the figure it follows:

$\phi_1 = a + b + c = \cos a$

$\phi_2 = c - a - b = \cos (a + 120)$

$\phi_3 = b - c + a = \cos (a + 240)$

Solving, we have:

$a = \cos a + \cos (a + 240)$

$b = -\cos (a + 120) - \cos (a + 240)$
$= \cos a$

$c = \cos a + \cos (a + 120)$

These equations must be true no matter whether there are currents flowing in the secondary or not.

Consider first the condition with the secondary circuits open. No currents are flowing in the secondary, and the current points 7, 8, 9, 10, 11 and 12 may be considered as not existing. Then the flux a is uniformly distributed between the points 3 and 4, the flux b is uniformly distributed between the points 4 and 5, etc. Therefore the density per space degree will be—

between 3 and 4 $D_a = \frac{1}{60} [\cos a + \cos (a + 240)]$

between 4 and 5 $D = \frac{1}{60} \cos a$

between 5 and 6 $D_c = \frac{1}{60} [\cos a + \cos (a + 120)]$, etc.

From these equations we may find the space distribution of the field for different values of a as shown in Figs. 2—8. We also may easily find the values of the total flux ϕ for different values of a.

As will be seen from the figures, the field moves along the air-gap in the indicated direction, but its space distribution is not sinusoidal. The fact that the induced counter-electromotive force in the primary coils must, in spite of this, be sinusoidal, as shown in the previous considerations, is due to three phenomena which combine with the rotation of the field.

1. The resultant field does not rotate with uniform speed. If we consider as centre line of the field that line which has an equal number of lines at each side, we find that its distance H from the current point 3 is as given in the figures. As will be seen, the centre line travels from the position in Fig. 2 to that in Fig. 5, thirty space degrees, during thirty time degrees, but the speed of the centre during this time interval is not uniform. The average speed during the time interval $a = 0$ to $a = 10$ is $\omega = 90 - 80.5 = 9.5$, during the time interval $a = 10$ to $a = 20$, we have $\omega = 80.5 - 70.5 = 10$ and during the time interval $a = 20$ to $a = 30$, we have $\omega = 70.5 - 60 = 10.5$. This proves the statement made above that the speed of the field centre varies during the time interval thirty degrees.

2. The various parts of the field travel at different speeds. While in Fig. 2 the total field is distributed over three teeth, in Fig. 5 it is distributed over only two teeth, showing that although the centre of the field has travelled through thirty space degrees during thirty time degrees while changing from Fig. 2 to Fig. 5, the portion of the flux ahead of the centre must have travelled with a lower average speed, since in Fig. 5 it is not thirty degrees ahead of its position in Fig. 2. Correspondingly, the portion behind the field centre must have travelled with an average speed greater than that of the centre. If, however, we compare Figs. 2 and 8, we see that the fields of these two figures are equal in all parts but are shifted sixty space degrees. This means that the speeds of the various portions of the field differ from each other and vary during a time interval of sixty degrees.

3. The total number of magnetic lines varies during the time interval of sixty degrees. As will be seen, the total field is two in Fig. 2, 1.97 in Fig. 3, 1.88 in Fig. 4, etc., and is again two in Fig. 8.

The average value of the total number of lines is 1.905. If a sinusoidal field of a strength equal to this field is assumed to rotate with uniform speed, the induced electromotive force would be proportional to $\frac{1.905}{2} = .9525$, while in reality, as follows from the previous considerations, the electromotive force is proportional to 1, *i. e.*—5 per cent larger. It is, therefore, not permissible to assume a sinusoidal field equal to the average value of the true field. In the case under consideration, for instance, if an equivalent sinusoidal field of uniform speed be introduced for the actual field, its strength must be assumed equal to the maximum value, which the field assumes in Figs. 2 and 8.

If, therefore, we consider any problem involving the theory of a rotating field and an open secondary, we must bear in mind the following facts:

(*a*) A field of irregular space distribution rotates.

(*b*) The space distribution of this field is determined by the distribution of the windings, the character of the pole-pieces and the wave-shape of the impressed electromotive force.

(*c*) If sinusoidal electromotive forces are impressed, and a uniform air-gap be assumed, the centre of the field travels with a periodically changing speed; the various portions of the field travel with speeds which are different from each other and change also periodically with the time, and the total strength of the field changes periodically with the time.

(*d*) The resulting effect of the rotation of the irregular field and the phenomena under (*c*) is that sinusoidal electromotive forces are induced in the primary windings.

(*e*) Therefore, it is for certain studies permissible to assume a sinusoidal space distribution of the field and a constant speed of rotation.

(*f*) The strength of this imaginary sinusoidal field may be determined for full pitch windings from the maximum number of lines which must pass through a certain coil in order to induce the necessary counter-electromotive force. If coils which are shifted in space with respect to each other are connected in series, this phase displacement must, of course, be taken into account when determining the electromotive force of the single coil.

The determination of the currents which are necessary to flow in order to induce a field of the previously described character is very simple in our case. A glance at Fig. 1 shows that the flux b is induced by coil A_1 only. If the magnetic reluctance of the flux be assumed to be constant, the current in A_1 must therefore be proportional to the flux b. We find, therefore—

$$I_{1a} = b = \cos a.$$

and similarly—

$$I_{1b} = \cos (a + 120).$$
$$I_{1c} = \cos (a + 240).$$

In practice, the reluctances of the motor are not quite constant, and therefore the current waves are not quite sinusoidal, but somewhat more pointed.

Consider now the phenomena of the rotating field with closed secondary circuits. If a field of constant strength and distribution rotate with uniform speed, and the secondary circuit rotate in synchronism with the field, there would be no electromotive force induced in the secondary circuits and no currents would flow in them. In this case the secondary circuits would, of course, have no influence whatever upon the field.

We have seen, however, that the field induced by the primary member rotates with irregular speed and varies also in strength. If, therefore, the secondary

Digitized by Google

circuit rotates with uniform speed equal to the average speed of the field, there will necessarily be electromotive forces induced in the secondary circuits on account of the varying field speed and the varying field strength, these electromotive forces being dependent upon the difference between the uniform secondary speed and the speed of the field, and upon the rate of change of the field strength. These electromotive forces will, of course, set up currents in the secondary circuit as soon as the latter are closed, and these currents will have a magnetizing effect upon the field, which combines with the magnetizing effect of the primary.

Now we know that the currents in any short-circuited winding having no ohmic resistance will always adjust themselves so that the field passing through the winding will be kept constant. Since the secondary resistance of induction motors is always very low, we may assume that the fields passing through any of the secondary windings will be constant. If this be true, it may easily be shown that the total field of each secondary tooth must be also constant in the case under consideration. We know, therefore, that in our particular case the fluxes g, h and k must be constant values. We know, moreover, from our previous considerations the values which the fluxes a, b and c must assume in order to induce a sinusoidal electromotive force. Since, moreover, we assumed in our case an equal number of slots for the primary and secondary members, we know that there must be, if the secondary rotate, a time point t at which points 3 and 9 and 4 and 10 coincide respectively. At this instant the flux g must be equal to the flux a and we have

$$g = a = \cos\ a + \cos\ (a + 240),$$

and since g is constant, $\cos\ a + \cos\ (a + 240)$ is its constant value. Similarly, the constant values for h and k may be found to be:

$$h = b = \cos\ a$$
$$k = c = \cos\ a + \cos\ (a + 120)$$

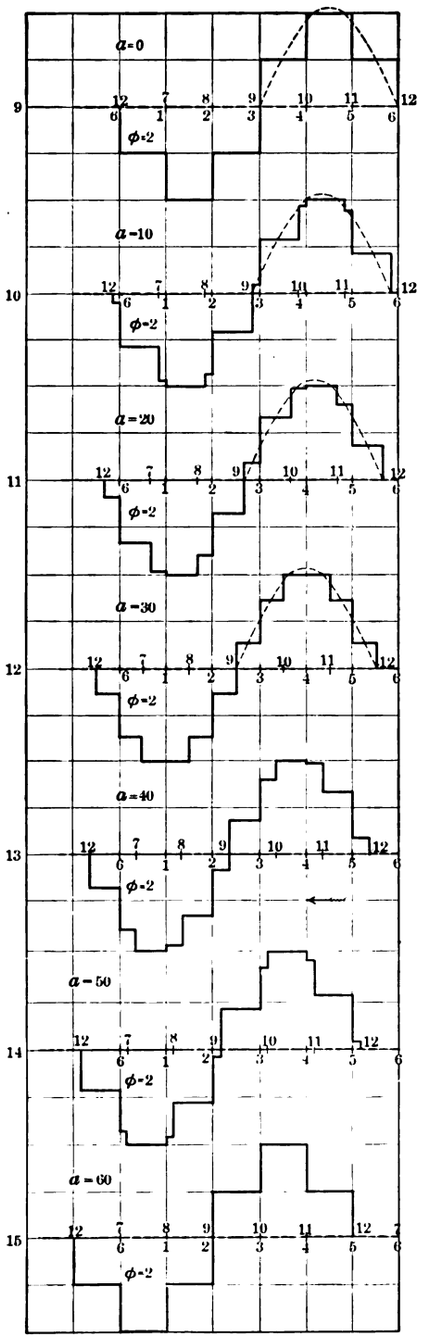
From Fig. 1 follows:

$$g = u - z$$
$$a = u + v$$
$$h = v + w$$
$$b = w + x$$
$$k = x + y$$
$$c = y + z$$

From these equations we find:

$$u = \tfrac{1}{2}\ (a - h + b - k + c + g)$$
$$v = \tfrac{1}{2}\ (h - b + k - c + a - g)$$
$$w = \tfrac{1}{2}\ (b - k + c + h - a + g)$$
$$x = \tfrac{1}{2}\ (k - c - g + a - h + b)$$
$$y = \tfrac{1}{2}\ (c + g - a + h - b + k)$$
$$z = \tfrac{1}{2}\ (-g + a - h + b - k + c)$$

From this it is possible to find, as was done above for the open-circuit secondary, the density per degree, if we know the angles between the various current points. Since the secondary is moving, the angles between the points 3 and 9 and 3 and 10, etc., will of course be constantly changing. We know, however, that the total



FIGS. 9-15.—FIELD DISTRIBUTIONS WITH CLOSED SECONDARY.

angle between two stator current points or two rotor current points is always sixty degrees. If, therefore, we know the angle β between 9 and 3, we also know the angle between 3 and 10 to be $60 - \beta$ (see Fig. 1).

If we consider now the angle of two pole faces respectively of one pole pair to be 360 degrees, and assume the rotor to rotate with synchronous speed, we know that the time angle β is necessary to move the rotating member by the angle β forward. If now, as assumed before, the primary and secondary current points coincide at the time t, *i.e.*, if the angle $\beta = 0$ at the time point t, the angle β will be at any other time, a, as follows:

$$a - t = \beta$$

because we must have at the time $a = t$

$$t - t = \beta = 0$$

We see now, from Fig. 1, that the densities per degree are as shown below:

$$D_v = \frac{1}{\beta}\ v = \frac{1}{a - t}\ v$$

$$D_u = \frac{1}{60 - \beta}\ u = \frac{1}{60 - a + t}\ u$$

etc.

The value of t is more or less a matter of chance, and may be anything. Therefore the densities D_u, D_v, etc., may assume a great many values.

For a certain value of t, however, the densities, and therefore the character of the rotating field, are positively determined.

In Figs. 9 to 15 the field distribution is given for $t = 0$, and $a = 0$ to $a = 60°$. As will be seen, the field distribution is, with closed secondary, totally different from the field distribution with open secondary, as shown in Figs. 2 to 8; with the exception of Figs. 2 and 9 and 8 and 15, which are equal respectively.

As will be noticed, the field for the closed secondary case is still irregular and has a step form. It may also be shown that the speed of the middle line of the field, as well as the speed of the different parts, is, as before, not uniform. It will be seen, however, that for those values of a for which the secondary reaction has changed the field, the new field shape is much more of an approach to the sine wave, which is shown in dotted lines in some of the figures for comparison, than it was when associated with an open secondary.

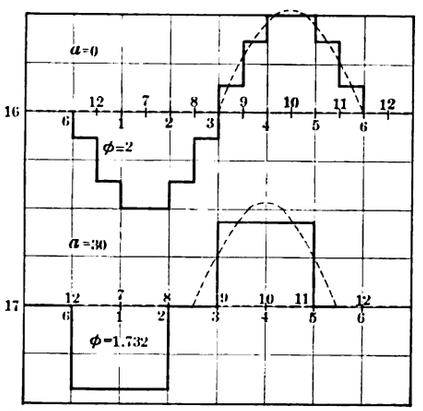
It will be also noticed that the total field is now, for all values, equal to the equivalent sine field, and the maximum densities come much nearer to the maximum densities reached by the sine field.

These latter facts will also be noticed if the field distribution is determined for other values of t. For each value of t, however, there will be some values of a for which the primary and secondary current points coincide, and for these values the field distribution will not be changed, at least not in the case under consideration, by the secondary reaction. If we assume, for instance, $t = -30$, we find

Digitized by Google

for $a = 0$ the field distribution shown in Fig. 16, and that for $a = 30$ in Fig. 17. This last figure shows that there are also, with the closed secondary, cases possible in which the total field is smaller than the equivalent sine field, and in which the maximum density is considerably smaller than that of the equivalent sine field.

We may conclude, therefore, that with a closed secondary, the rotating field changes also in value and speed as brought out in detail for the motor with an open secondary, but the secondary reaction strongly tends to change the field into a



FIGS. 16 AND 17.--SPACE DISTRIBUTION OF FIELD.

sinusoidal field of uniform strength and uniform speed. In motors with more than one slot per pole per phase, the changing of the field on account of the secondary reaction toward a sinusoidal field is much more emphasized than in the case under consideration, and therefore we may, in practice, in almost all cases start with the assumption of a sinusoidal field of uniform strength and speed, although it is, for the explanation of some phenomena, necessary to consider the actual facts, as has been done above.

New Lamps and New Opportunities.

F. W. Willcox, in his paper on "New Lamps and New Opportunities," read before the Put-in-Bay convention of the Ohio Electric Light Association, strongly endorses active work by the central stations in pushing the newer units. He refers to the policy that the gas companies maintained for a long period in reluctantly putting out the Welsbach mantles, which have now become their only salvation. After speaking generally of the advantages of a liberal attitude on the part of public service companies to patrons, he proceeds to outline a method by which to introduce the new high-efficiency lamps, in the course of which he incidentally refers to the new system of ratings as superior to the old method in use, as allowing even-watt ratings instead of fractional ones, and as ensuring a more uniform appearance and a more uniform performance of individual lamps by reason of the even degree of incandescence or efficiency at which a filament so rated will burn. It also permits central stations to gradually advance their standard of efficiency from time to time to meet changing conditions. Attention is called to the voltage markings arranged in a vertical column in steps of two volts apart. These voltages are known as the "top," "middle" and "bottom," or first, second and third voltages. Central stations now using 3.1-watts-per-candle lamps would naturally adopt the new lamps at full efficiency (top voltage) and thus keep their watt consumption per lamp unchanged. While the total cost of lamp renewals would be increased somewhat on this basis, the added charge is a small one to pay for the ability to give consumers twenty-five per cent more light for the same revenue. Central stations now using 3.5 watts-per-candle lamps could opportunely adopt the new lamp in the middle or second voltage. This would share the improvement with the consumer, giving twelve per cent more light with fifteen per cent less wattage. The total cost of lamp renewals, which are very low for the present 3.5-watts-per-candle lamps—only about one-third cent per kilowatt-hour, would be only slightly increased, and there is hardly any lighting company that could not profitably afford to make the change to at least this intermediate efficiency of the new lamps. Its useful life, 750 hours (with average life materially longer), is commercially sufficient, as it is equal to that formerly given by 3.5-watts-per-candle lamps. The life of 3.5-watts-per-candle lamps is at present too long for the most economic service and could with advantage be shortened to correspond with that given by the new Gem lamp in middle voltage. The writer advocates the policy of free lamp renewals as desirable, and in this connection refers to the 1906 National Electric Light Association Question Box on this point, pages 250 to 260. The answers to a number of questions on lamp supply and renewal policy show overwhelming testimony in favor of free and liberal renewals. Indeed, says the writer, practice goes much further, in many instances giving free signs to burn the lamps in; a policy which experience has shown pays handsomely. With the advent of the new Gem lamp the importance of central station direction and control of lamps is greater than ever. Full and complete control is only obtained with free renewals, and the adoption of a free-renewal policy where not already in vogue could therefore most opportunely be made with the introduction of the new Gem lamp. Companies now giving free renewals should do likewise with the new lamp; and those now charging for lamps should supply this new lamp without any increase of price. Unless the policy for the new lamp be at least as liberal as that for the present lamps, the introduction and general use of the new lamps is apt to be retarded. The writer gives interesting data in tabulated form with reference to the tantalum lamp units in comparison with the ordinary carbon filament and the Gem, and touches on reflectors, with especial reference to the new bowl holophanes. In conclusion, the writer says that the liberal policy he recommends embraces the following points:

1. To secure free renewals and promote a more liberal use of lamps.
2. To furnish suitable and efficiently designed reflectors to consumers on as liberal terms as possible.
3. To undertake illuminating engineering work on all lighting installations both old and new, to the end of aiding consumers to secure the most efficient illuminations.
4. To eliminate as far as possible all the worthless reflectors and replace them with efficient types, and to generally improve conditions of lighting service in every way possible.

Since the introduction of the Welsbach lamp there has been quite an overhauling of lamps, fixtures and shades for gas lamps to the great improvement of gas lighting service, and large amounts of money have been spent by consumers for the new devices. Electric lighting installations must undergo a similar overhauling to improve lighting results and enable the electric light to withstand the improved conditions of gas competition. The introduction of higher-efficiency incandescent lamps is the logical time to make this overhauling and to induce customers to discard their old lamps and fixtures for new ones, to also displace their old reflectors with new and improved ones. What has been done and is being done in the gas way can be done in the electric business if only central station companies will see the handwriting on the wall, and reap the full advantages of the new lamps and the new opportunities.

Digitized by Google

The Truckee River General Electric Company.[1]

THE Truckee River General Electric Company was organized in the fall of 1899, for the purpose of supplying power to the famous Comstock mines, at Virginia City, Nev. These mines had long been partially idle, due to the inability to successfully handle the water in the lower levels, and the working out of the upper levels. The electric power was expected to make the draining of the lower levels possible, as well as to cheapen operation in every way, as steam power was very expensive. The company was organized with Mortimer Fleishhacker as president and Herbert Fleishhacker secretary, with the firm of Hunt, Merideth & Cory, consulting and constructing engineers.

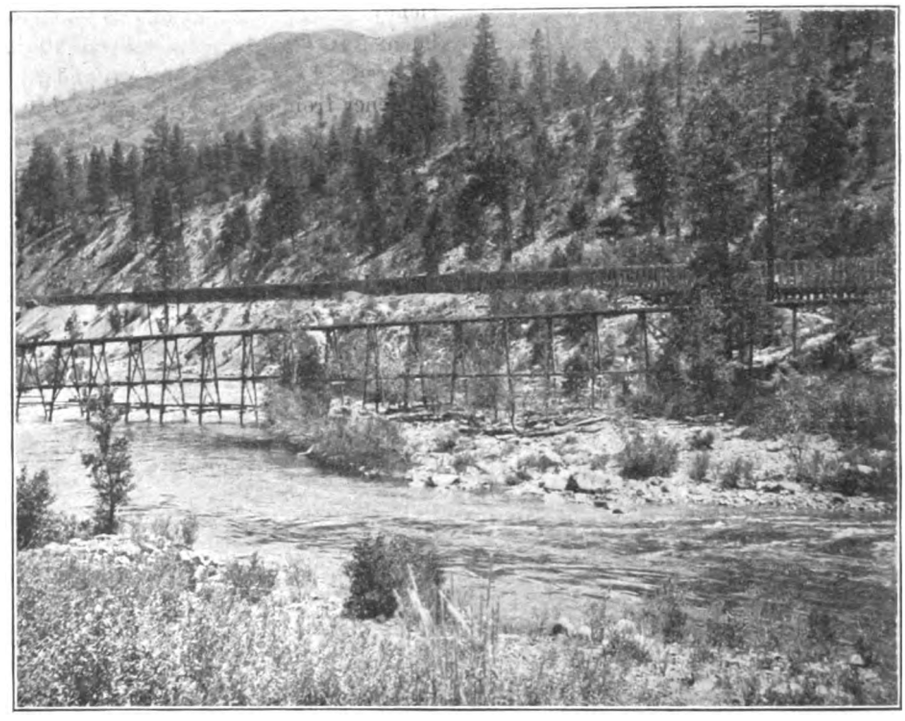
The original plant was constructed at Floriston, Cal., on the Truckee river, thirty-three miles from Virginia City.

The dam is constructed of twelve by twelve-inch timbers, drift bolted together, filled with rocks, and sheeted with double two-inch planking, the headgates and bulkheads being of similar construction.

The flume, about two miles in length, is built entirely of mountain pine, and was originally ten feet by six feet six inches. It has since been raised to eight feet six inches in depth. It has a grade of six inches per 1,000 feet, and carries about 300 cubic feet per second. Considerable trouble was experienced with ice in this flume, and various screens and methods were tried, to overcome it. The present method has been in use about three years, and has proven very satisfactory. The screen is made of flat iron, one and one-quarter inches by one-quarter inch spaced one inch apart, and is made in sections, hinged at the upper end, and with a chain on the lower end so that it may be raised. This screen is placed diagonally in the flume, the flume having been widened for this purpose. It is placed directly at the penstock, and the entire screen and penstock is housed in, so that it is protected from storms, and so that men can work in the coldest weather.

A steam boiler is also installed, and steam jets used, to keep the gates and screen from freezing solid. During very cold weather the screens are raised, allowing the water to flow under them, while the screens and a boom keep out all surface ice, which passes over a spillway. From the penstock, two six-foot wood stave-pipes lead to the power-house, where a head of eighty-five feet is obtained.

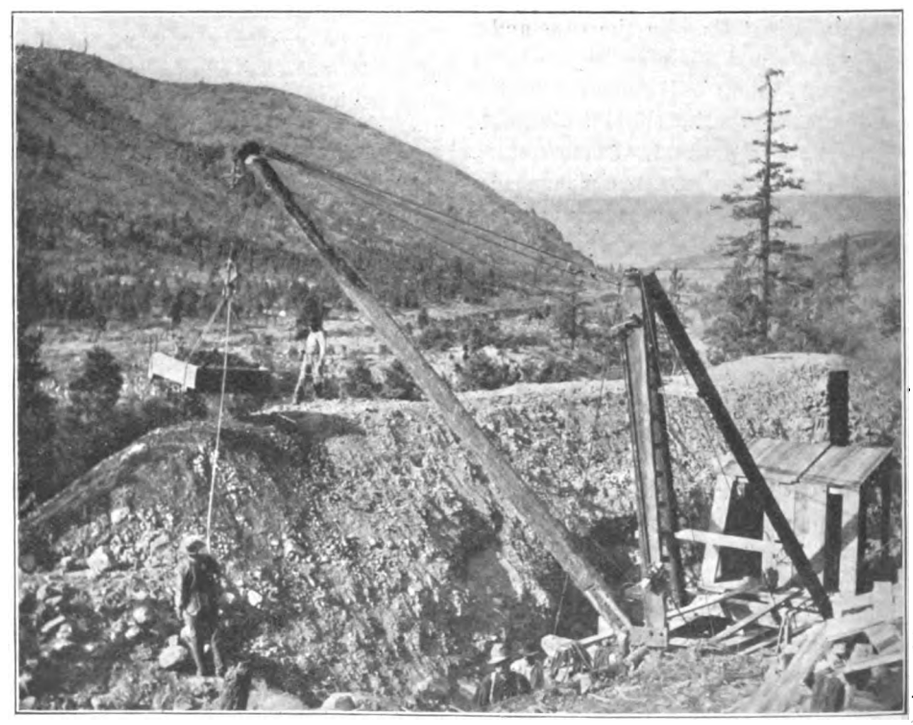
[1] Part of a forthcoming volume on "Hydroelectric Plants of the United States, Canada and Mexico," by A. W. Clapp.



TEMPORARY BRIDGE FOR TRANSFERRING LUMBER ACROSS RIVER, DURING CONSTRUCTION, TRUCKEE RIVER GENERAL ELECTRIC COMPANY.

The power-house contains two sets of McCormick twin, horizontal wheels, direct-connected by flexible leather links to two 750-kilowatt, three-phase, 500-volt, sixty-cycle, Westinghouse generators.

The wheels are governed by Lombard type "B" governors. Some trouble was first experienced with these, owing to the oil used, which rusted all the steel and iron parts, and also due to oil pump With the oil now furnished with these governors, and the improved pumps, th

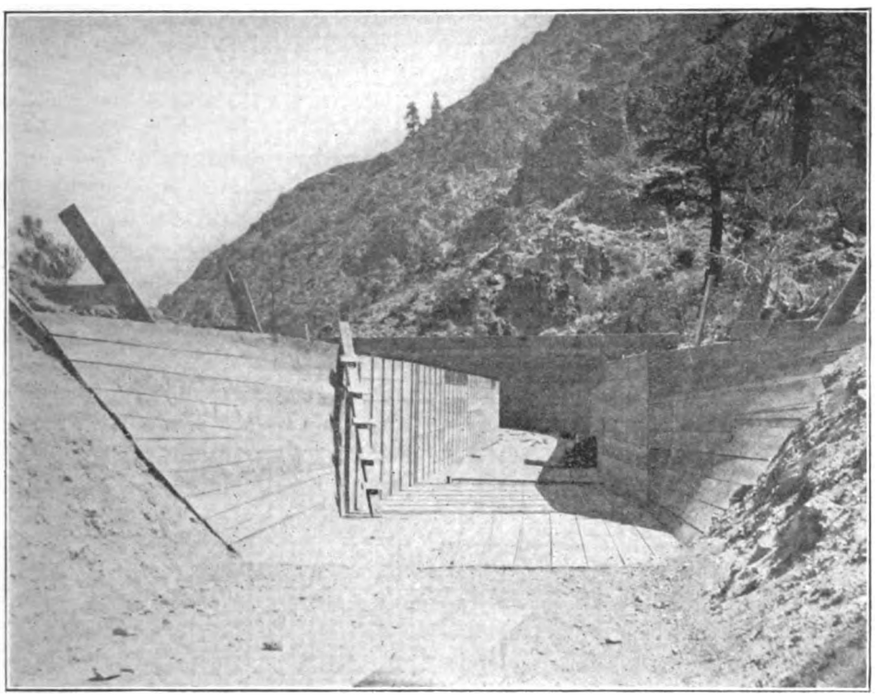


EXCAVATING DITCH, TRUCKEE RIVER GENERAL ELECTRIC COMPANY.

Digitized by Google

have given excellent satisfaction. The wheels were originally installed with an eighteen-inch relief valve, which was connected with the gate rigging, so that it worked in unison with the gates. Owing to waste of water and trouble with ice, this did not prove satisfactory and it has been abandoned. The original runners in these wheels were cast iron or steel, with the buckets cast into a separate rim. These rapidly cut and wore loose and have been replaced with solid bronze runners, which have worn very well.

Two Westinghouse twenty-two and one-half-kilowatt exciters were originally direct-connected to McCormick horizontal turbines, but owing to the exceedingly small openings between the guide vanes, they easily clogged, especially with ice. One of these units was therefore belted to an induction motor, and the induction motor belted to a Risdon water wheel, the belting being necessary to get proper speed. This set is entirely self-governing, and the only difficulty found was under a very heavy short-circuit, when plant was slowed down, the belts would be thrown off. An overload and underload circuit-breaker, installed in the induction-motor circuit, overcame this by cutting out the motor and allowing the water wheel to carry the exciter alone for the time.



ENTRANCE OF FLUME, FROM DITCH, TRUCKEE RIVER GENERAL ELECTRIC COMPANY.

DITCH, TRUCKEE RIVER GENERAL ELECTRIC COMPANY.

An electric signaling apparatus shows the height of the water in the penstock, and at the head of the flume. That at the head of the flume is merely a resistance that is cut in and out by a float, and which varies the current through an ammeter on the switchboard. That in the penstock is a number of colored lights, placed on top of the switchboard, which light and extinguish one after the other.

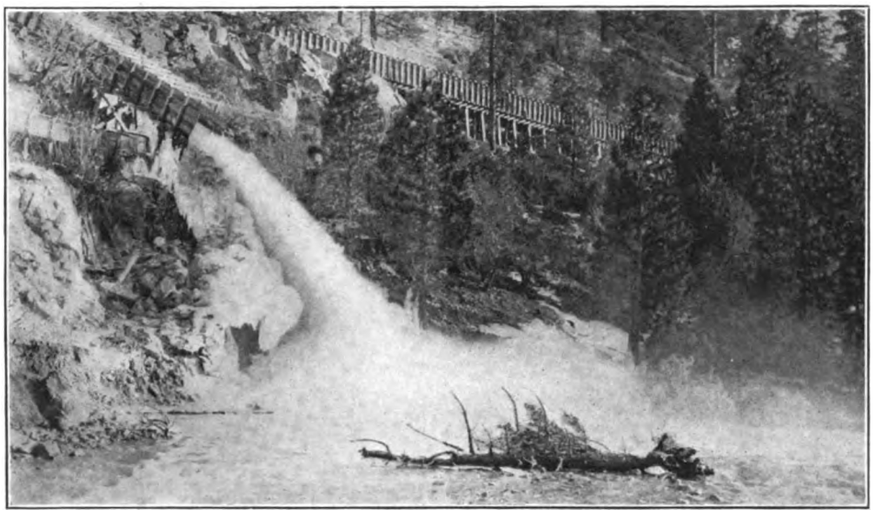
The generators deliver current at 500 volts to two sets of 300-kilowatt Westinghouse air-cooled transformers, which step the voltage up to 22,000 for the line. The transformers are delta connected on low-tension, and star connected with neutral grounded, on the high-tension side. The high-tension side passes through two sets of D. T. Masson Taylor switches which are only used for changing circuits, however, and never opened under load. From the power-house a single-pole line is run to Virginia City, thirty-three miles distant, carrying two circuits of No. 4 bare copper wire, strung on Locke seven-inch glass insulators. A line also extends two miles to the Floriston Pulp and Paper Company. A branch line leaves the main line about half way to Virginia City, and delivers power, a distance of six miles, to Reno.

The plant has been in operation for five years, and during the past two years has been delivering its full capacity of about 2,200 horse-power almost continuously, one machine being shut down every Sunday for cleaning and repairs.

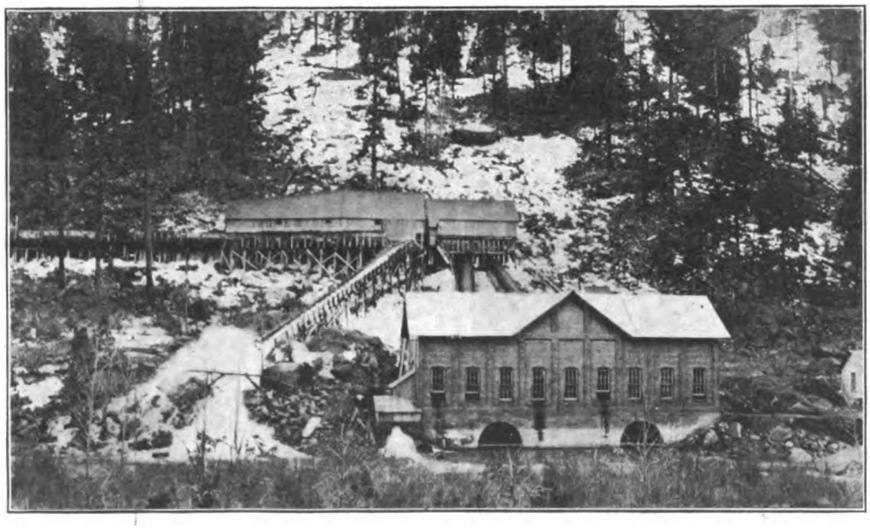
The success met with on the Comstock under the direction of Leon M. Hall, in both handling water on the lower levels, and in hoisting and general work, decided the mines there to install further pumping plants. Mr. Hall has accordingly designed a plant, consisting of duplicate units, handled by two 800-horse-power induction motors. To supply the power for these, and also for the constantly increasing general business, the Truckee river company decided to install an additional plant. The Fleish plant is located on the Truckee river, five miles nearer Virginia City than the old

Digitized by Google

plant. The water is diverted by a rock-filled crib dam, and carried through 9,000 feet of flume and 3,000 feet of ditch, to a point where 125 feet head is obtained. The flume is ten feet by six feet six inches inside, has a grade of six inches per 1,000 feet, and is designed to carry about 275 cubic feet per second. The planking is tongue and grooved Oregon pine, surfaced, which leaves a very smooth interior. The ditch is twelve feet wide on the bottom, sides slope one to one, and will carry six feet of water with the grade same as flume. The flume timbers are of mountain pine, bents eight feet apart, with four posts ten by ten inches, four stringers eight by fourteen inches, yokes two feet eight-inch centres, of six by eight inch.



FLUME LINE AND SPILLWAY, MARMOL PLANT, TRUCKEE RIVER GENERAL ELECTRIC COMPANY.

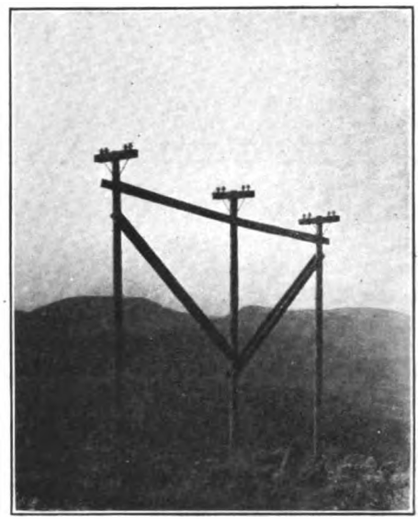


FLORISTON OR FARAD PLANT OF THE TRUCKEE RIVER GENERAL ELECTRIC COMPANY.

with six by six-inch caps. The screen is similar to the one in the old plant, and is placed at the penstock. One steel pipe line, eight feet diameter, leads from the penstock to the power-house, where a 3,000-horse-power Victor, spiral-flume turbine will be direct-connected to one 2,000-kilowatt, 2,200-volt, Westinghouse generator. The wheel is fitted with two Lombard relief valves, and controlled by a Lombard type "N" governor. Only one exciter is being installed at present, it being belted to generator, while provision for another, with independent drive, is being made.

The switchboard contains a Tirrill regulator, main switch, exciter switch, one ammeter, one voltmeter, one power-factor meter, one frequency meter, one synchroscope, one General Electric curve-drawing wattmeter, and rheostats. One marble panel also contains all lighting and signaling circuits. Two water signals, one at the head of the flume and one at the penstock, will be installed, which will vary current through ammeters by means of movable cores in choke coils. The cores will be operated by twelve-inch copper ball floats and bicycle wheels. The power-house is of granite, and all wiring is carried in tiling under the floor, and to a separate stone transformer house, where four 750-kilowatt transformers and Westinghouse lightning arresters are placed. Immediately outside the transformer house are located nine three-pole, 23,000-volt, air-break, horn-type switches. Through these switches pass the two old lines and the new line, so that any combination of lines and generators can be handled. A second pole line is constructed to Virginia City, using thirty-five feet, eight-inch top, cedar poles, spaced 200 feet regularly, with long spans and double construction over canyons, with one circuit of No. 00 stranded aluminum, six-foot centres, carried on one and three-quarter-inch pins and Locke seven-inch glass insulators.

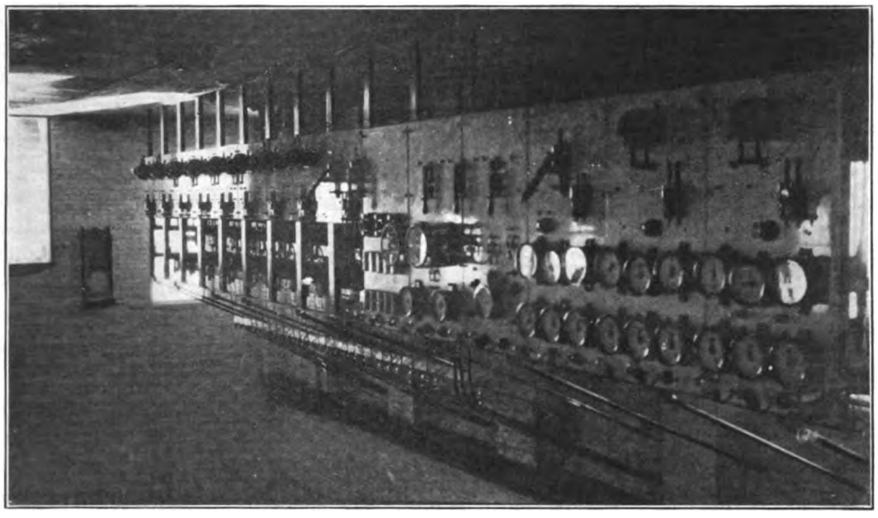
The lines leading from the Truckee River Company's plants consist of two high-tension three-phase copper lines, carried on the same pole, from Farad to Virginia City, with a branch leading to Reno and Sparks, Nev. At Fleish, Nev., a third line of aluminum wire joins the two mentioned above and parallels it to Virginia City. Sets of nine high-tension switches are located at both Farad and Virginia City, making it possible to run with almost any imaginable combination. This arrangement makes a shutdown from failure of the lines almost an impossibility, as it is hardly likely that all three lines will fail at the same time. From the main Farad-Fleish-Virginia City line a number of single branch lines are run to supply the neighboring towns, mines and larger ranches. The copper lines are of No. 4 wire, the six wires being arranged in the form of two thirty-six-



THE BEGINNING OF A 986-FOOT SPAN.

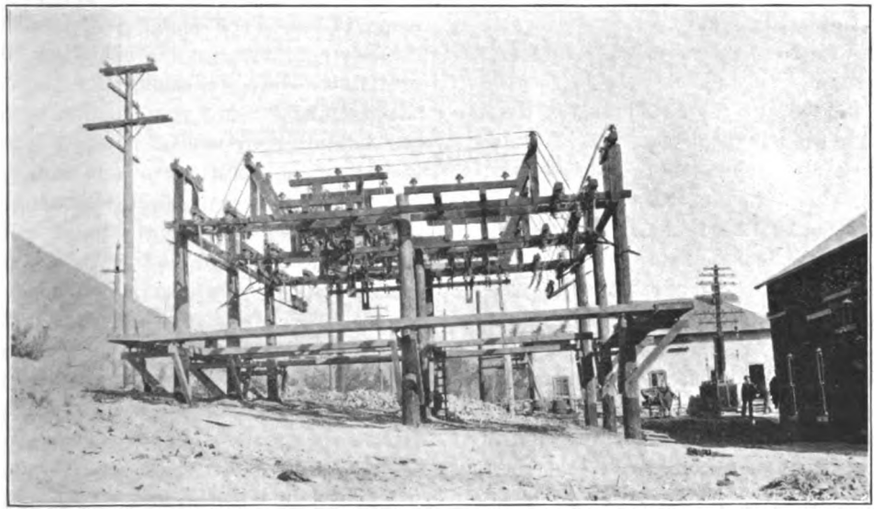
Digitized by Google

inch equilateral triangles, one on each side of the pole. The pins are of eucalyptus wood boiled in oil, upon which are mounted seven-inch Locke glass insulators. Spans are about 125 feet. The aluminum line is of No. 00 seven-strand wire supported on pins and insulators of the same character as in the copper lines. The cross-arms are of five-inch by six-inch Oregon pine. The insulators are spaced to form a six-foot equilateral triangle. Where the pole line is straight, the top pin is put into a hole bored in the top of the thirty-five-foot cedar poles. This is prevented from cracking by eight or ten turns of No. 10 iron wire securely stapled in place. The poles on this line were spaced with the intention of making them 200 feet apart but on account of the rough condition of the country it was impossible to follow this plan throughout. There are about twelve spans over 400 feet long, and two of these are respectively 986 and 1,105 feet in length. The method of bracing and supporting is shown in the accompanying illustrations.



SWITCHBOARD, VIRGINIA CITY SUBSTATION, TRUCKEE RIVER GENERAL ELECTRIC COMPANY.

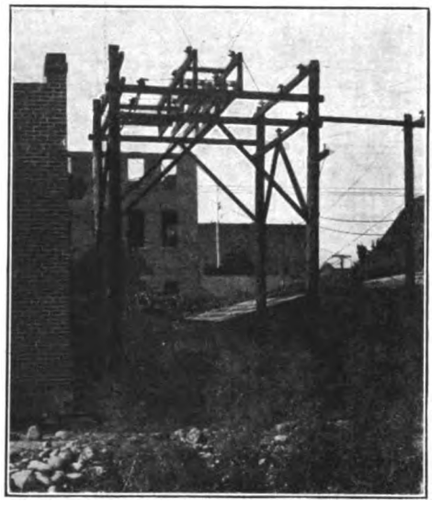
The largest single substation on the circuit is located at Virginia City. This station has four 625-kilowatt and six 250-kilowatt transformers, all stepping the voltage down from 22,000 volts to 2,200 volts. The 625-kilowatt transformers are of the standard water-cooled type, as manufactured by the Westinghouse Electric and Manufacturing Company. The 250-kilowatt transformers were originally of the simple oil type, but water coils for cooling have been added to increase the capacity. The transformers are all connected through quick-acting valves to large steel oil-tanks located outside the building, in order that they may be emptied almost instantly in case of necessity.



HIGH-TENSION SWITCHES, VIRGINIA CITY SUBSTATION, TRUCKEE RIVER GENERAL ELECTRIC COMPANY.

The substation building is of brick with a galvanized-iron roof. A photograph of the switchboard is shown herewith. It has two sets of bus-bars, so that the load can be operated separately, a very important feature on account of the character of the load. The switchboard contains the usual complement of voltmeters, ammeters and wattmeters, also a synchroscope and frequency and power-factor meters. There are two integrating wattmeters, either of which is capable of measuring the entire output of the station. The individual circuits are so arranged that wattmeters can be put on at any time this may be desired, space being left over each automatic oil break switch controlling the different circuits, so that a panel can be readily mounted.

The altitude of Virginia City is in the neighborhood of 7,000 feet above the sea level. It has been found that the ordinary number of units found satisfactory for making up a set of lightning arresters do not operate satisfactorily here, inasmuch as they discharge continuously. This is very evidently due to atmospheric conditions. Some fifty per cent more units are used at Virginia City than is found necessary for similar work in lower altitudes.



SUBSTATION SWITCHES AT RENO, NEV.

There are two substations in the city of Reno. The first was built by the old Truckee River General Electric Company, and the second was acquired by the Reno Light and Power Company upon its consolidation with the Washoe Power Company. The original station is a brick building containing four 200-kilowatt Stanley water-cooled transformers connected to convert 22,000-volt, three-phase current into 2,200-volt, two-phase current. The lightning arresters and switch-

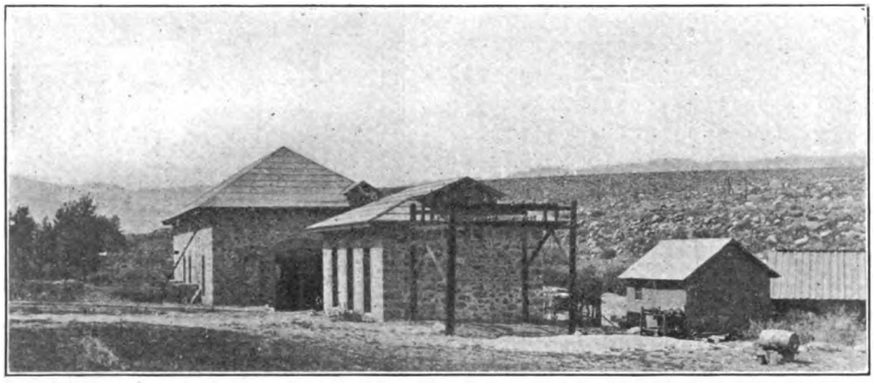
Digitized by Google

board are of the conventional type, made by the Stanley company.

The Washoe substation in Reno consists of three 250-kilowatt Stanley water-cooled transformers converting 22,000-volt, three-phase, into 2,200-volt, three-phase. Transformers are connected delta on both sides. A peculiarity of this system is that part of the high-tension system is star-connected and part delta-connected, operating together without trouble. The lightning protection is the same in this station as in the other substation, with the addition of water resistance in circuit with the arresters.

The Sparks and Carson City, Nev., substations are similar, each containing three 125-kilowatt Stanley water-cooled transformers, transforming from 22,000 volts to 2,200 volts and protected by the standard Stanley arresters.

In addition to these there are a number of smaller substations at various points for irrigation and mining work. These consist of oil-cooled transformers of various makes set on concrete floors in isolated wooden buildings of small size. Lightning arresters are generally dispensed with in these small stations, depending on the arresters at the larger stations. So far there has been no burnout of these small transformers from any cause.



POWER-HOUSE OF THE WASHOE POWER AND DEVELOPMENT COMPANY.

The Reno plant of the Reno Power, Light and Water Company consists of one 400-kilowatt Westinghouse generator, two-phase, 2,200 volts, direct-connected through a bevel gear to a vertical Morgan-Smith turbine. This little plant connects direct to the 2,200-volt distributing system of Reno. It has no governor, as it never operates except in connection with one or more of the larger plants, which holds the speed steady. The exciter is a seven and one-half-kilowatt, 125-volt machine belted direct to the shaft of the main generator. The head is about thirty-five feet. Water is carried from the river about three-quarters of a mile in a ditch; from thence it passes into a flume about 1,000 feet long and through 500 feet of wood-stave pipe into the water-wheel.

Electric Motors in Competition with Gas Engines.

Some interesting features of electric motor service in competition with gas engines are pointed out in the paper read by Mr. Wm. Wolls before the Ohio Electric Light Association, at Put-in-Bay, August 22.

Some of the points made follow:

In the case of the individual drive, machines can be located irrespective of any main line shaft; the use of quarter turn belts or angle drive where they would otherwise be required is eliminated and friction loses reduced thus to a minimum. Another advantage is found in the fact that whereas with a single prime mover with one main shaft, it is difficult to move machines any great distance from the main shaft, in the case of the individual motor the machines can be located any place and in any position where there is room regardless of the position of the prime mover and shafting; so that after a shop has been planned and machinery installed, if changes are found desirable they can be readily made with electric motors. The adaptation of electric motors to pumping plants is spoken of, and the writer states that during the past year he has displaced a number of gas engines by direct-connected motor-driven outfits. The advantages are reliability of service, automatic control, and maintenance of the water level in a compression or open tank; attendance merely nominal, whereas with the gas engine it is necessary to fill oil cups and note condition of the water jacketing guarding against freezing during the winter and the general operation of the unit. In the failure to start much valuable time is often wasted. Another point that has been worked out in the vicinity of the writer's plant is the feature of fire protection; the pump discharge is so arranged that it is possible to cut out the tank under fire conditions and pump direct to the fire main. An instance is given of the variation in angular velocity which unfits the gas engine for use where constant torque or pull is desired, and causing an effect very telling on the upkeep of the shop equipment of shafting, hangers, belts and the alignment of same. There are also many conditions where the application of gas engines could not be considered, such, for example, as the driving of a large newspaper printing press. The cost of power should not be the sole determining factor in the choice of the motive power. A comparison as to the first cost, weight, floor space occupied, cleanliness, noiselessness, ease of manipulation, freedom from repairs and reliability of operation shows every point to be in favor of the electric motor. Furthermore, the gas engine has no overload capacity, and consquently it is necessary to install an engine to meet maximum demands, which, in many cases, will be entirely too large for average operating conditions, seriously affecting the efficiency at such load. It is also necessary to put in a heavy foundation to mount the gas engine upon, while the motor is usually placed upon the floor or mounted out of the way on the side wall or ceiling. The gas engine is not self-starting; hence a loose pulley or clutch device must be used to enable the machine to reach full speed before taking the load. To the increased first cost of the gas engine over an electric motor of same horse-power must be added the heavy annual cost of repairs and depreciation, which will materially discount the claim of low fuel consumption by the gas engine; even more important is the loss of time due to frequent and annoying shut-downs as the efficiency of a shop or factory depends upon continuity of operation. There is no doubt that the gas engine of to-day, operating under the supervision of an expert, is a success as to the economical use of fuel; but for the commercial operation of shops and factories the electric motor is well capable of maintaining its position. It is, of course, necessary that the solicitor of power business have an engineer's training, as each prospective installation calls for most careful consideration of details, it being seldom that the conditions in any two plants will be precisely similar. It is usually upon the judgment of the solicitor that the success of the installation to the satisfaction of the customer depends.

Digitized by Google

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW, F. I. C.

II.—The Approximate Analysis of Fuel.

PREPARING THE SAMPLE.

The sample of fuel after the operation of sampling as described in Article i should amount to about one pound, with no particles that exceed one-quarter inch in diameter. The sample should now be passed through a brass wire sieve (A), Fig. 2, of one-twelfth-inch mesh, and the portion which will not pass through should be finely crushed by grinding in a No. 3 Kenrick coffee mill. Fig. 2 B shows a small mill, adapted for the preparation of laboratory samples of fuel. If the fuel be very wet, or if the sample contain any very hard lumps of shale, this method of preparing the sample requires modificaton.

The excessive moisture can be removed by spreading out the whole of the fuel sample on a piece of paper, and by leaving it exposed to the air for two or three hours in a warm place in the laboratory before sieving and grinding. The difficulty caused by lumps of very hard shale can be dealt with by picking these out of the sample and by crushing them separately in the steel mortar C shown in Fig. 2. Care must be taken that none of the shale is lost in this operation, for shale possesses little heating value, and the proportion of it in a sample of fuel has great influence upon the tests for ash and calorific value. Shale and dirt are, in fact, the chief causes of the difference in value of bituminous fuels, and when the thermal results are worked out upon pure coal or combustible matter only, the variations are small and are chiefly those due to differences in the chemical constitution of the coal. For this reason, it is wise to cover the mortar and the coffee mill with a card or towel when crushing shale, since bits have a decided tendency to jump out and to get lost during this operation. After crushing in the mortar, the whole of the shale must be passed through the coffee mill, and the ground material returned to the general mass of the sample, which will now occupy double the former volume, and resemble in appearance a heap of coarse gunpowder.

The sample is then reduced by repeated mixing and quartering, as described in Article i, until only about 100 grammes (one-quarter pound) remain. This is divided into two equal portions, one of these being used for the following tests, and the other being reserved in a stoppered bottle for use in case of any mishap in carrying out the tests with the first portion.

The remaining portions of the sample are likewise not thrown away, but are retained in the one-pound tin, in case of

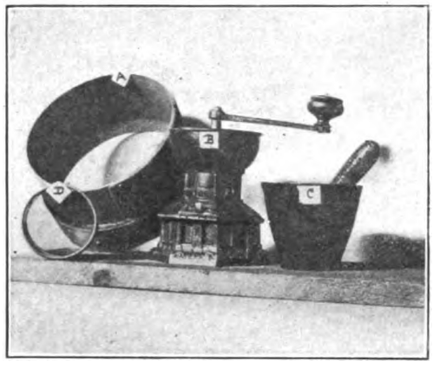


Fig. 2.—Fuel Sampling Apparatus.

accident or dispute. Each sample tin should bear a label giving full particulars of the date of sampling, the origin of the fuel, and any other information regarding it that may be necessary for proper identification of the sample and test. In cases where a large number of samples are being dealt with at one and the same time, considerable care is necessary to prevent confusion of the samples; and the use of written labels is all the more urgent. For testing purposes the samples may be simply marked A, B, C,

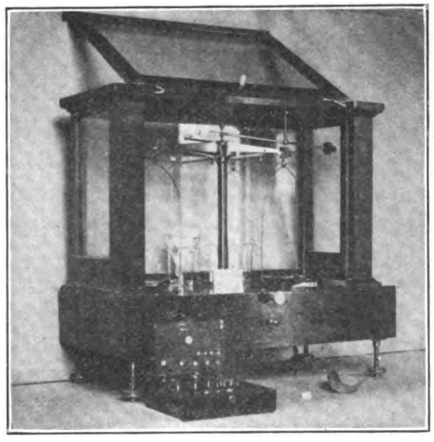


Fig. 3.—Chemical Balance for Fuel Testing.

etc., if the original sample tins bear corresponding letters, in addition to the full details of the fuel and date of sampling.

TESTING THE FUEL.

The approximate analysis of fuel covers the estimation of the following constituents: 1—Moisture, 2—Ash, 3—Volatile Matter, 4—Coke, 5—Fixed Carbon and 6—Sulphur. These will now be dealt with in the order named.

1—Moisture—Ten grammes of the fuel sample, prepared as already directed, are weighed out upon a chemical balance reading to one milligramme, and are heated for two hours at 230 degrees Fahrenheit (110 degrees Centigrade), in a copper or aluminum air-bath. The loss of weight multiplied by ten gives the percentage of moisture in the original sample. A desiccator must be employed for cooling the sample before weighing, as perfectly dry fuel absorbs moisture from the air and gains in weight, even while being weighed on the balance. It saves time, however, if the crucible be allowed to go nearly cold in the air with the lid on, before being placed in the desiccator. On no account must the crucible be placed on the balance pan and weighed while still hot, as this will give increased weighings.

The crucible must be covered during heating in the air-bath and the lid removed only when weighing.

The balance shown in Fig. 3 is most suitable for fuel-testing work; it carries a load up to fifty grammes, and reads correctly to one milligramme. The weights should always be placed in the left-hand pan, the fuel in the right. The sample of fuel should not be weighed out directly upon the pan, but in a tared porcelain crucible. (A No. 1 Berlin crucible holds ten grammes of most fuels.) A lead counterpoise can be made from sheet lead with little trouble, and the operation of weighing out ten grammes of the fuel sample with this crucible is then very rapidly performed, since the lead counterpoise undergoes little change in weight; and only rarely requires fresh adjustment. The lead counterpoise should be bent into the form of the letter L, to facilitate removing on and off the pan of the balance. The second weighing of the fuel sample, after heating two hours at 230 degrees Fahrenheit, can be most quickly performed by placing the lead counterpoise and the ten-gramme weight on the left-hand pan of the balance, and by adding the fractional parts of one gramme to the right-hand pan in which the crucible is placed, until equilibrium is obtained. The final adjustment should always be made by means of the rider (the little platinum weight which rides across the beam and records decimal fractions of one centigramme) with the front of the balance

[1]All rights of reproduction and translation are reserved. Copyright, 1906, by John B. C. Kershaw

Digitized by Google

case closed, in order to avoid any disturbance by draughts.

The total of the weights placed in the right-hand pan to restore equilibrium after heating then represents directly the loss of moisture, and multiplied by ten gives the percentage of moisture in the original sample.

The air-bath most suitable for heating fuel is shown in Fig. 4. It is made of copper, and is provided with a thermometer reading up to 300 degrees Fahrenheit, and with an automatic gas regulator which keeps the temperature within five degrees Fahrenheit of that desired. That shown in Fig. 4 is the Reichardt Muencke type of regulator. The burner is a Bunsen gas burner with a rose top, and this must be placed quite close to the bottom of the oven. Unless a gas regulator be used, the air-bath requires constant attention, for the gas pressure varies greatly at different hours of the day. The only precaution necessary with a gas regulator is to see that there is no danger of lighting back when the main gas current is entirely cut off and only the by-pass supply is in use.

A water-bath is less troublesome than an air-bath, but the temperature attained in these can not rise above 212 degrees Fahrenheit, and therefore they are of no use for determining the moisture in fuels, the last traces of which can only be got rid of by heating above 212 degrees Fahrenheit.

Should it be necessary to determine the total moisture in very wet fuels, or in the fuel as delivered, it is necessary to determine the loss which occurs during the grinding and sampling operation.

For this purpose, the whole of the sample contained in the sample tin is placed on a porous plate, and is weighed as accurately as possible on a pair of ordinary scales. The plate with its contents is then placed in the sun, or in a warm place on the boilers for two hours, and the fuel is twice turned over during this period. A second weighing of the plate is made when cold. The loss of weight during this preliminary drying is then worked out as a percentage on the original weight of fuel, and must be allowed for in the final calculation of the moisture, as ascertained by the second and more accurate drying operations.

The remaining tests are all carried out with the ten-gramme sample of fuel, after drying in the air-bath at 230 degrees Fahrenheit (110 degrees Centigrade). This sample must, however, be still further reduced in fineness before commencing these further tests. The sieve D and steel mortar and pestle C shown in Fig. 2 are employed for this work. The former is of very fine brass wire, one-sixtieth-inch mesh, equal to 3,600 holes to the square inch; the latter is of cast steel and is four

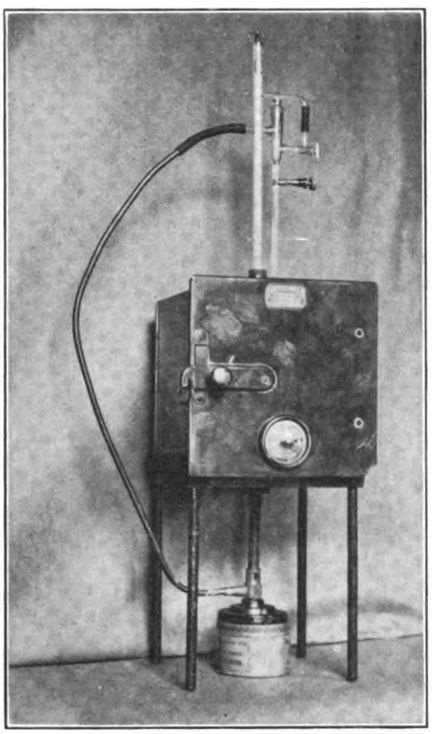


FIG. 4.—AIR-BATH, WITH GAS REGULATOR.

inches in diameter. The whole of the ten-gramme sample must be passed through this sieve. It will be found that this is most quickly carried out by repeated sievings, and return of the larger particles to the mortar, free from the finer portion. With semi-anthracite and shaly fuels, this final grinding operation is troublesome, but it is essential that it be

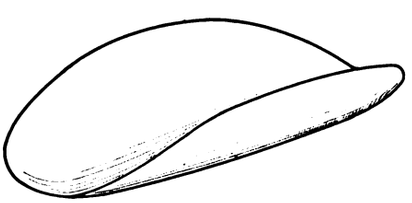


FIG. 5.—COPPER FOIL WEIGHING SCOOP.

carried out carefully, and that the whole of the ten grammes be passed through the one-sixtieth-inch mesh sieve, if correct results are to be attained. The final particles of very hard coal or scale which resist crushing to the last, must on no account be rejected. As already stated in Article i, correct sampling is the basis of correct testing, and it is too often slovenly and carelessly performed. If left to untrained persons, it is certain to be badly carried out, and the whole of the test results are then worthless.

The finely ground sample is now carefully mixed on a sheet of glazed paper and is then transferred to a No. 00 (two and three-quarter-inch diameter) porcelain basin, which is covered with a clock glass, and is placed in the air-bath for one hour's reheating at 230 degrees Fahrenheit.

This is necessary to remove the moisture taken up during the final grinding of the sample. The sample is now ready for the remaining tests, and must be transferred to a stoppered glass weighing tube, or kept covered in the porcelain basin in the desiccator. Should the tests be delayed some hours, a reheating of the sample in the air-bath for one hour will be necessary.

2—Ash—Two grammes of the finely ground and perfectly dry sample are weighed out in the pan of the balance,[1] and are transferred to a No. 00 size Berlin porcelain basin. This is placed upon an asbestos board having a hole cut in its centre for the reception of the basin (see Fig. 6), and is heated until all the carbonaceous matter of the fuel is volatilized or burnt. The heating of the basin is best carried out over a No. 1 Bunsen burner, the asbestos board being supported by a tripod stand tilted at an angle as shown in Fig 7, so that the products of combustion may pass away behind, and a current of heated air flow over the fuel from the front.

Bituminous fuels require very gentle heating at first in order that the volatile matter may escape gradually without carrying off any particles of solid fuel, and that the residue may not bake itself into a very hard mass of coke. The fuel should be turned over repeatedly with a platinum wire or spatula, during this stage of the heating process, to facilitate the escape of the hydrocarbon gases, and to prevent sintering together of the mass. After the hydrocarbon gases have escaped, the heat of the flame can be gradually increased, until the bottom of the basin where the fuel rests is at a dull red heat. The fuel as the fixed carbon burns away gradually becomes lighter in color, but it is somewhat difficult to get rid of the last few per cent of carbon. In order to effect

[1] If the balance is unprovided with removable pans, a piece of copper foil two and half by two inches can be cut to the shape shown in Fig. 5, and bent into the form of a small scoop. A lead counterpoise must then be made to balance exactly this piece of foil.

Digitized by Google

this, the basin should be removed from the flame, allowed to cool on a piece of asbestos board, and the ash carefully crushed with a small agate or glass pestle. The ash adhering to this is then brushed back into the basin with a small camel's-hair brush, the fine carbon dust which collects around the edges of the basin is brushed down into the centre, and the whole is again raised to a red heat, commencing with a small flame to avoid cracking the porcelain basin.

The first heating of the fuel to remove the hydrocarbon gases and to burn off the greater part of the fixed carbon of the coke requires generally from thirty to sixty minutes; and a further ten to twenty minutes' heating is required to remove the last traces of carbon.

From one and one-half to two hours are therefore required for carrying out the ash test, and any attempt to reduce this time with bituminous coal will produce incorrect results. The ash should be light in color and quite free from black specks, which denote unburned carbon. The basin, after removal from the flame, is allowed to nearly cool in the air, and is then placed in the desiccator and its contents weighed when cold. The ash is carefully brushed out of the basin on to the pan of the balance or on the copper foil for weighing, and the spatula or wire used for mixing the fuel must also be carefully brushed free from any particles of ash

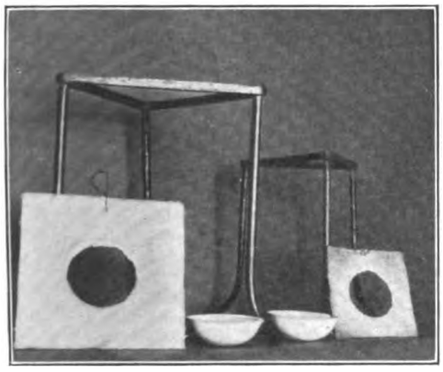


FIG. 6.—APPARATUS FOR ASH TEST.

adhering to it. The weight of ash multiplied by 50 gives the percentage of ash in the dry fuel.

Ash which is red in color denotes the presence of iron impurities in the fuel, probably as "coal brasses" (pyrites).

The behavior of bituminous fuels on heating is quite different from that of semi-anthracite and anthracite fuels; and after a little experience in testing coals from various sources, much information can be obtained as to the character and quality of the fuel by careful observation during the ash test.

When a large number of ash tests have to be performed daily, it saves time to use a muffle heated to redness in a gas-muffle furnace, the fuel samples being contained in shallow trays made from platinum foil. These must be numbered from 1 to 6 or 12 by notches cut with scissors in their edges, and great care must be given to avoid confusion of the samples, and to the question of a proper current of air over the samples. If the heating be too rapid or if the draught be too great, some of the finer particles of fuel or ash may be carried away with the exit gases. For this reason, the porcelain basin method is the safest for ash determinations, especially for those non-conversant with muffle furnace management. The ash obtained from each fuel test should be placed in a small

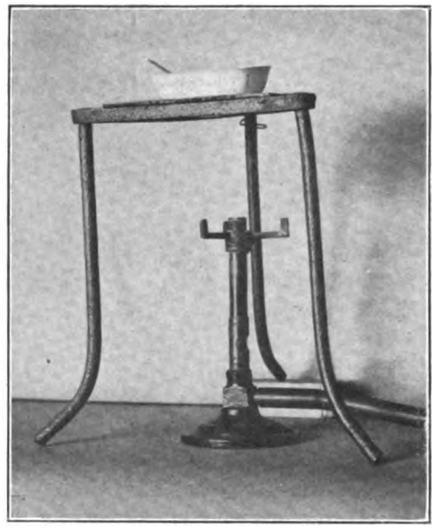


FIG. 7.—ARRANGEMENT OF APPARATUS FOR ASH TEST.

paper bag and kept in the tin with the original fuel sample, for reference in case of trouble with the fuel, or of dispute.

3, 4 and 5—Volatile Matter, Coke and Fixed Carbon—These three constituents of fuel are all determined by the one test, which consists in heating one gramme of the finely crushed and dry sample of fuel in a covered platinum crucible until all the hydrocarbon gases are expelled. The crucible and its contents are then again weighed. The loss in weight multiplied by 100 gives the percentage of volatile matter, and the weight of the residue multiplied by 100 gives the percentage of coke. On deducting the percentage of ash as ascertained in test No. 2 from the percentage of coke, one obtains the percentage of fixed carbon. Very careful manipulation is required in carrying out this test in order to obtain correct results, and the following conditions must be strictly adhered to. The apparatus is shown in Fig. 8. The platinum crucible should measure 1.40 by 1.10 inches diameter and should be provided with a very closely fitting lid. If the crucible has been bent out of shape, causing the lid to

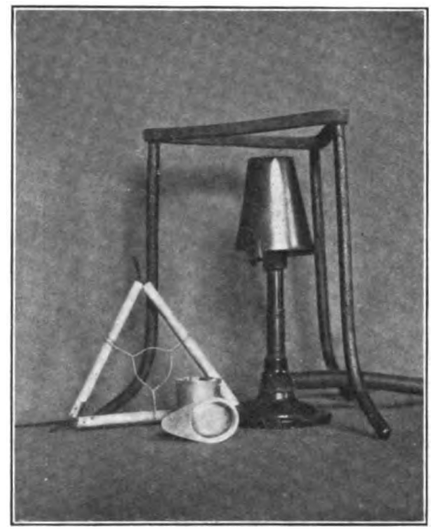


FIG. 8.—APPARATUS FOR COKE TEST.

fit badly, it can be restored to its original circular form by rolling on a hard surface while hot, with pressure applied by a rounded stick or glass rod in its interior. The crucible and lid should be thoroughly cleaned after each test, by burning off the adhering graphite and soot, and by polishing inside and out with wet sea-sand. The gray deposit formed by the burner flame on the bottom of the crucible (due to formation of a carbide of platinum) should also be removed by sea-sand after each test, as a platinum crucible rapidly corrodes and deteriorates when dirty and dented.

A platinum wire triangle is made for holding this crucible, by twisting together three pieces of thin platinum wire, and by mounting these in the centre of an ordinary pipe-stem triangle, as shown in Fig. 8. No other method of supporting the crucible in the flame is admissible for coke tests, since it is absolutely essential that the crucible and its lid should be entirely surrounded by flame during the test. The Bunsen burner must be of No. 1 size, and should give a steady colorless flame at least seven inches high. The tripod stand should be eight inches in height, and must be so arranged that the bottom of the crucible when supported by the platinum wire triangle is not more

Digitized by Google

than one and one-half inches from the top of the burner. If the place where the test is carried out is at all subject to side draughts, cardboard screens must be arranged round the tripod and burner, to prevent access of air to the crucible while the heating is in progress.

A lead counterpoise should be made for the crucible and its lid, to facilitate the weighing operation. This counterpoise will require adjustment at short intervals of time, since the platinum crucible will lose gradually in weight by the frequent cleanings. The one gramme of fuel must be very carefully weighed into the crucible, with a possible error of not more than one milligramme.

The crucible is then covered, inserted in the triangle and placed upon the tripod stand in the centre of the gas flame, which has been previously ignited and surrounded with any draught-protecting device that may be necessary. The hydrocarbon gases commence to escape from under the lid as soon as the crucible attains a red heat, and these burn with a yellow and smoky flame, for a period which depends upon the percentage of volatile matter in the fuel.

As a rule the gas evolution lasts from one to one and one-half minutes with bituminous fuels, and its duration and volume enables one, with a fair degree of accuracy, to judge the character and nature of the fuel. As soon as the last luminous "candle" has disappeared from the Bunsen flame above the crucible lid, the crucible is removed from the flame, very carefully, by lifting away the tripod which supports it without disturbing the lid, and is allowed to go nearly cold in the air, before placing in the desiccator. When quite cold it is then weighed with the lid still on, and from the loss in weight, the percentage of volatile matter, coke and fixed carbon is calculated as already described. The final weighing must be within one milligramme. The deposit of soot found upon the inner surface of the lid, and the deposit of graphite upon the inner walls of the crucible, are ignored in the final weighing, since although they appear to be of considerable volume and importance, they weigh only from three to five milligrammes.

The coke left in the crucible after the expulsion of the hydrocarbon gases is very hydroscopic, and on this account it should not be exposed to the air before weighing. The appearance and character of the coke differs greatly with different coals, and it may be obtained either as a powdery non-adhering residue or as a solid cake. With the South Wales steam coals, which cake together on heating, a slight explosion often occurs during the coke test, and some of the fuel is generally thrown out of the crucible. This effect appears to be due to the formation of an impermeable crust of coke around the fuel, before all the volatile matter has escaped.

The best way to obtain correct coke tests, with this and similar fuels which produce detonations, is to use only 0.70 or 0.50 gramme for the test, in place of one gramme.

6—Sulphur—The determination of sulphur in fuel involves the performance of an ordinary gravimetric analysis, and some practice in quantitative analysis will be necessary before accurate results can be obtained. It is therefore useless to attempt this test without some training in the methods and apparatus used by chemists in analytical work. The directions for carrying out this determination are consequently only given in condensed form.

If a bomb calorimeter be used for finding the calorific value of the fuel, the determination of the sulphur is simplified, for the liquid obtained by rinsing out the bomb after the explosion contains all the sulphur in the form of sulphate. The whole of the rinsings are transferred to a porcelain basin, and are evaporated to dryness with addition of five cubic centimeters of pure hydrochloric acid (1.18 S. G.) in a water-bath, in order to remove the nitric acid formed by oxidation of the nitrogenous constituents of the coal. The residue is dissolved in 100 cubic centimetres of water, two cubic centimetres of pure hydrochloric acid are added, and the solution is filtered before precipitating the sulphur with barium chloride. Boiling the solution for five minutes after the addition of the barium chloride renders the precipitate more dense, and less likely to pass through the filter paper.

The remainder of the determination is carried out in the usual way. The weight of barium sulphate finally obtained multiplied by 0.1375 gives the corresponding weight of sulphur, and this multiplied by 100 and divided by the weight of fuel used in the calorimeter, gives the percentage of sulphur present in the coal.

Should a bomb calorimeter not be available, the sulphur in the fuel must be oxidized by means of lime or magnesia and sodium carbonate, according to the method described by Garrett & Lomax.[1] One gramme of the fuel is placed in a small platinum crucible and is intimately mixed with four grammes of a mixture of four parts of pure lime to one of anhydrous sodium carbonate. The crucible is completely filled with this lime-soda mixture, and a larger platinum crucible is then placed over the smaller one, mouth downward. The two crucibles are now inverted and the space between the two is filled with the same lime-soda mixture. The mouth of the larger crucible is then covered with a small square of thick asbestos board, and the whole is placed in a muffle furnace heated to bright redness. Distillation of the volatile portion of the coal occurs in about two minutes, and as soon as a flame appears round the asbestos board, this may be removed. To ensure complete oxidation of the carbon, the heating must be continued for two hours. The contents of the crucibles are then allowed to cool, brought into water, and the sulphides oxidized to sulphate by means of bromine. The solution is then made acid with hydrochloric acid, filtered, and the sulphur determined in the filtrate by precipitation with barium chloride in the usual way. The calculation of the percentage of sulphur in the fuel is made as before.

(To be continued.)

[1] Journal of the Society of Chemical Industry, December 15, 1905, p. 1213.

Electrical Spectacle at Baltimore, Md.

A feature of the Baltimore (Md.) jubilee week, beginning Monday evening, September 10, was the electrical illumination. The down-town section, including the city hall, court-house and other buildings, was brilliantly illuminated. The distribution of the lights was approximately as follows: city hall, 3,500; court-house, 4,000; streamers, 4,000; arch, Hopkins place and German street, 250; Wells and McComas monument, twenty-five; governor's reviewing stand, 100; markers outlining the burned district, 250; city hall reviewing stand, 200, making a total of 14,325 incandescent lamps.

The National Association of Cotton Manufacturers.

The semi-annual meeting of the National Association of Cotton Manufacturers was held at the Hotel Champlain, Champlain, Clinton county, N. Y., September 12 and 13. The programme included an address of welcome by the Hon. Julius M. Mayer, attorney-general of New York. James R. MacColl, of Providence, R. I., president of the association, delivered the annual address. Other papers and addresses were presented as follows: "Recent Progress in Textile Education in the United States," Christopher P. Brooks, New Bedford, Mass.; "Egyptian Cotton," Arthur A. Haserick, Boston, Mass.; "The Curtis Vertical Steam Turbine," C. B. Burleigh, Boston, Mass.; "Practical Experiences in Electrical Driving," John A. Fernley, New Bedford, Mass.; "Drawing-in of Warps by Machinery," Edgar F. Hathaway, Boston, Mass.; "Child Labor," Talcott Williams, LL. D., Philadelphia, Pa.; "Singeing," Edwin H. Marble, Worcester, Mass.; "Steel Boiler Insurance, a Conservor of Credit," Hugh Nelson, New York city. An address was also delivered by Harvie Jordan, president of the Southern Cotton Association, Atlanta, Ga.

Digitized by Google

ASPECTS OF THE INNER STRUCTURE OF METALS.[1]

BY J. A. EWING.

I intend to devote this address to considering in certain aspects the inner structure of metals and the manner in which they yield under strain. It will not be disputed that this is a primary concern of the engineer, who in all his problems of design is confronted by the limitations imposed on him by the strength and elasticity of the materials he employs. It is a leading aim with him to secure lightness and cheapness by giving to the parts such dimensions as are no larger than will secure safety, and hence it is of the first importance to know in each particular case how high a stress may be applied without risk of rupture or of permanent alteration in form. Again, the engineer recognizes the merit, for structural purposes, of plasticity as well as strength, and in many of his operations he makes direct use of that property, as in the drawing of wires and tubes or the flanging of plates. He is concerned, too, with the hardening effect that occurs in such processes when work is expended in permanently deforming a metal in the cold state, and also with the restoration to the normal condition of comparative softness which can be brought about by annealing. Nor can he afford to be indifferent to the phenomena of "fatigue" in metals, which manifest themselves when a piece is subjected to repeated alternations or variations of stress—fatigue of strength or fatigue of elasticity, which, like physiological fatigue, admits, under some conditions, of rest-cure, inasmuch as it tends to disappear with the lapse of time. No apology need be made in selecting for a presidential address to Section G a subject that touches so many points of direct practical interest to engineers. It is a subject which has for me the additional attraction of lying in the borderland between engineering and physics—a borderland in which I have often strayed, and still love to stray, and I enter it to-day even at the risk of wandering into regions which, to engineers, may seem a little remote from home, regions where the landscape has, perhaps, a suspicious likeness to that of the country over which the learned men of Section A hold rule.

To engineers, quite as much as to physicists and chemists, we owe in recent years an immense extension of knowledge regarding the structure of metals. This has come about mainly by the intelligent use of the microscope. Take any piece of metal, in the state in which an engineer makes use of it, polish and lightly etch its surface, and examine it under the microscope, and you find that it is a congeries of a multitude of grains, every one of which may be proved to be a crystal. It is true that the boundaries of each grain have none of the characteristics of geometrical regularity which one is apt to look for in a crystal; but the grain is a true crystal for all that. Its boundaries have been determined by the accident of its growth in relation to the simultaneous growth of neighboring grains—the grains have grown, crystal fashion, until they have met, and the surface of meeting, whatever shape it may happen to take, constitutes the boundary. But within each grain there is the true crystalline characteristic—a regular tactical formation of the little elements of which the crystal is built up. It is as if little fairy children had built the metal by piling brickbats in a nursery. Each child starts wherever it happens to be, placing its first brickbat at random, and then piling the others side by side with the first in geometrical regularity of orientation until the pile, or the branches it shoots out, meets the advancing pile of a neighbor; and so the structure goes on, until the whole space is entirely filled by a solid mass containing as many grains as there have been nuclei from which the growth began.

We now know that this process of crystal growth occurs not only in the solidification of a metal from the liquid state, but in many cases during cooling through a "critical" temperature when the metal is already solid. We know also that the process may in certain conditions go on slowly at very moderate temperatures. We know also that the process of annealing is essentially the raising of the metal to a temperature at which recrystallization may take place, though the metal remains solid while this internal rearrangement of its particles goes on. Whether crystallization occurs in solidifying from the liquid or during the cooling of an already solid piece, it results in the formation of an aggregate of grains, each one of which is a true crystal. Their size may be large or small—in general, quick cooling means that a crystallization starts from many nuclei, and the resulting grains are consequently small; with very slow cooling you get a gross structure made up of grains of a much larger size.

For simplicity of statement I shall ask you in what follows to confine your attention to simple metals, omitting any reference to alloys. Alloys present many complexities, into which we need not at present enter. With simple metals every crystalline grain is made of the same substance: the elementary brickbats are all exactly alike, though there may be the widest variation from grain to grain as regards the form of the grain, and also as regards the direction in which the elementary brickbats are piled. In any one grain they are piled with perfect regularity, all facing one way, like a regiment of perfectly similar soldiers formed up in rows, where each man is equidistant from his neighbors, before and behind, as well as to right and to left. Or, perhaps, I might compare them to the well-drilled flowers of an early Victorian wall-paper.

It was shown by Mr. Rosenhain and myself[1] that when a piece of metal is strained beyond its limit of elasticity, so that permanent set is produced, the yielding takes place by means of slips between one and another portion of each crystal grain. A part of each crystal slides over another part of the same crystal, as you might slide the cards in a pack. It is as if all the soldiers to one side of a given line were to take a step forward, those on the other side remaining as they were, or as if all the men in the front rows took a step to the left, while those in the rows behind kept their places. In other words, the plasticity which a metal possesses is due to the possibility of shear on certain planes in the crystal that are called "cleavage" or "gliding" planes. Plastic yielding is due to the occurrence of this shear; it may take place in three or more directions in a single grain, corresponding to the various possible planes of cleavage, and in each direction it may happen on few or many parallel planes, according to the extent of the strain to which the piece is subjected. Examine under the microscope the polished surface of a piece of metal which has been somewhat severely strained after polishing, and you will find that the occurrence of this shear or slip is manifested on the polished surface by the appearance of little steps, which show themselves as lines of narrow bands when looked at from above. To these we gave the name of slip-bands. Just as the piece of metal is an aggregate of crystal grains, the change of shape which is imposed upon it in straining is an aggregate effect of the multitude of little slips which occur in the grains of which it is made up.

1 Address to the engineering section of the British Association at the recent meeting in York.

1 Ewing and Rosenhain, "The Crystalline Structure of Metals." Bakerian lecture. *Philosophical Transactions, Royal Society*, vol. cxciii, A, 1899.

Digitized by Google

Each grain, of course, alters its form in the process.

Speaking broadly, this distortion of the form of any one grain by means of slips leaves it still a crystal. If part of the group of brickbats moves forward, keeping parallel to themselves and to the others, the formation remains regular, except that a step is formed on the outermost rows; the orientation of the elements continues the same throughout. Considerations which I shall mention presently lead to some qualifications of this statement. I now see reason to believe that in the process of slip there is a disturbance of the elementary portions, or brickbats adjoining the plane of slip, which may alter their setting, and thereby introduce to a small extent some local departure from the perfectly homogeneous orientation which is the characteristic of the true crystal. In very severe straining there may even be a wide departure from true crystalline character. We shall recur to this later; but meanwhile it will suffice to say that substantially the slip which is involved in a plastic strain of moderate amount is a bodily translation, parallel to themselves, of part of the group of elementary brickbats or molecules which build up the grain. If a crystal whose form has been altered, even largely, by such straining, is cut and polished and etched, it appears, under the microscope, to be to all extents and purposes as regular in the tactical grouping of its elements as any other crystal.

Further, in the process of straining we have, first, an elastic stage, extending through very small movements, in which there is no dissipation of energy and no permanent set. When this is exceeded, the slip occurs suddenly; the work do straining is dissipated; if the straining force is removed, a strain persists, forming a permanent "set"; if it continues to act it goes on (within certain limits) producing augmented strain. In general a large amount of strain may take place without the cohesion between the gliding surfaces being destroyed. Immediately after the strain has occurred there is marked fatigue, showing itself in a loss of perfect elasticity; but this will disappear with the lapse of time, and the piece will then be harder than at first. If, on the other hand, a process of alternate straining back and forth be many times repeated, the piece breaks.

These are now familiar facts. Can we attempt to explain them on the basis of a molecular theory which will at the same time offer a clue to the process of crystal-building as we find it in metals? I venture to make this address the occasion of inviting attention to some more or less speculative considerations which may be held to go some little way toward furnishing the material for such an explanation.

At the Leeds meeting of this association in 1890 it was my privilege to bring forward certain contributions to the molecular theory of magnetism, and to show a model which demonstrated that the rather complex phenomena of magnetization were explainable on the very simple assumption that the magnetic molecules are constrained by no other forces than those which they mutually exert on one another in consequence of their polarities.[1] From this were found to result all the chief phenomena of permeability and magnetic hysteresis. Let us attempt to-day to apply considerations of a similar character to another group of physical facts—namely, those that are associated with the crystalline structure of metals and with the manner of their yielding under strain. Just as in dealing with magnetic phenomena, I take as starting point the idea that the stability of the structure is due to mutual forces exerted on one another by its elementary parts or molecules, and that the clue to the phenomena is to be sought in the play of these mutual forces when displacement of the molecule occurs.

Iron and most of the useful metals crystallize in the cubic system; for simplicity we may limit what has to be said to them. Imagine a molecule possessing polarity equally in three directions, defined by rectangular axes. We need not for the present purpose enquire to what the polarity along the axes is due; it will suffice to assume that the molecule has six poles, three positive and three negative, and that these repel the like and attract the unlike poles of other molecules. We may make a model by using three magnetized rods fixed at right angles to one another at their middle points. I imagine, further, that the molecule has an envelope in the shape of a sphere, which touches the spherical envelopes of its neighbors, and assume that these spheres may turn on one another without friction.[2]

Think now of the process of crystal-building with a supply of such spherical molecules for brickbats. Starting with one molecule, let a second be brought up to it and allowed to take up its place under the action of the polar forces. It will have a position of sta bility when a positive pole in molecul A touches (or lies in juxtaposition to) negative pole in molecule B, with the co responding axes in line, and when the fu ther condition is satisfied that the axe in molecule B, whose poles are not touche by A, are stably situated with respect t the field of force exerted by the poles of A

In other words, we have this forma tion (Fig. 1):

For convenience of representation in th diagram the poles are distinguished b letters N and S, but it must not be assume that the polarities with which we are he concerned have anything to do with ma netism.

Suppose, now, that the crystal is bu up by the arrival of other molecules, ea of which in its turn assumes the positio of maximum stability consistent with fo mation in cubic or normal piling. T group in that case takes an arrangeme which is essentially a repetition of th quartette (Fig. 2).

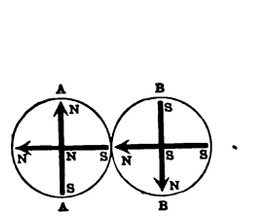


FIG. 1.

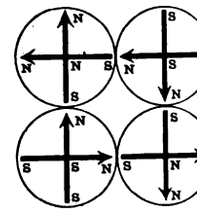


FIG. 2.

Along each row the polarity preser the same direction, but the polarity each row is opposite to that of each co tiguous parallel row. This description plies equally to all three axes. The wh group (Fig. 3) consists of the quartet of Fig. 2 piled alongside of, and also top of, one another. In this way we arr at what I take to be the simplest possi type of cubic crystal.

In this grouping each molecule has alignment giving maximum stability, it seems fair to assume that it will t that alignment when the crystal gr is formed under conditions of comp freedom, as in solidifying from the liq state. As a rule, the actual process crystal-building goes on dendritica branches shoot out, and from them ot branches proceed at right angles, leav interstices to be filled in later. We h therefore, to conceive of the molecule piling themselves preferably in rows ra than in blocks, though ultimately block form is arrived at. In this posi of maximum stability each molecule its six poles touching poles of cont name.

Now comes a point of particular

1 "Contributions to the Molecular Theory of Induced Magnetism," Proceedings of the Royal Society, vol. xlviii, June 19, 1890; or *Philosophical Magazine*, September, 1890.

2 Or, let the envelope be a shell of any form, inside of which the axes of polarity are free to turn as a rigid system.

Digitized by Google

portance. Imagine two neighboring molecules in the same block to be turned round, each through one right angle, in opposite senses. They will now each have five poles touching five poles of contrary name, but the sixth pole will touch a pole of the same name as itself. They are still stably situated, but much less stably than in the original configuration, and they will revert to that configuration if set swinging through an angle sufficient to exceed the limited range within which they are stable in the new position.

Similarly we may imagine a group of three, four or more molecules, each to be turned through a right angle, thereby constituting a small group with more or less stability, but always with less than would be found if the normal configuration had been preserved. The little group in question may be made up of molecules in a row, or it may be a quartette or block, or take such a form as a T or L. A sufficient

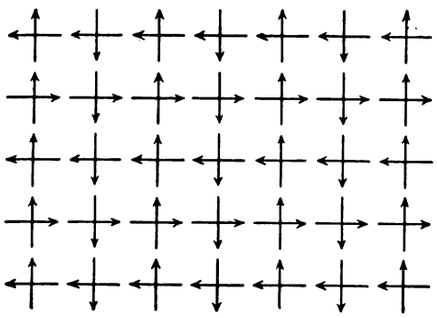


FIG. 3.

disturbance tends to resolve it into agreement with the normal tactics of the molecules which build up the rest of the grain.

It is conjecturally possible that small groups of this kind, possessing little stability, may be formed during the process of crystallization, so that here and there in the grain we may have a tiny patch of dissenters keeping harmony with their environment.

If this happens at all during crystallization, it would seem less likely to happen in free crystallization from a liquid state than in the more constrained process that occurs when a metal already in the solid state recrystallizes at a temperature far below its melting point. Though rare or absent in the first case, it might occur frequently in the second. There are differences in the appearance of crystal grains under the microscope in metal as cast and in metal as recrystallized in the solid state, of which this may be the explanation. It may also explain a difference pointed out by Rosenhain,[1] that the slip lines in cast metal are straight and regular, whereas in wrought iron and other metals, which have recrystallized in the solid, they rarely take a straight course across the crystal, but proceed in jagged, irregular steps. These may be due to the presence here and there of small planes of weakness, resulting from the existence of what I have called dissenting groups. Again, these groups, possessing, as they do, less stability than their normal neighbors, may be conjectured to differ from the normal parts of the grain in respect of electrolytic quality, and to be more readily attacked by an etching reagent. Hence, perhaps, the conspicuous isolated geometrical pits that appear on etching a polished surface of wrought iron.

It will help in making clear these points, and others that are to follow, if we study the action of a model formed by grouping a number of polarized "molecules" in one plane, supporting them on fixed centres, about which they are free to turn. In the model before you the centres are uniformly shaped in rectangular rows, and the "molecules" are +-shaped pieces of hardened steel, strongly magnetized along each of the crossed axes, each having, therefore, two north poles and two south poles. The third axis is omitted in the model, the movement to be studied with the help of the model being movement in one plane. On placing these molecules on their centres they readily take up the position already indicated in Fig. 3. Each one within the group has its four poles in close proximity to four poles of contrary name, and is, therefore, highly stable. If disturbed by being turned through a small angle, and let go, it swings back, transmitting a wave of vibration through the group, which is reflected from the edges, and is finally damped out in the model by pivot friction and air friction. We may assume some damping action (say by the induction of eddy currents) in the actual solid, of which the model may be taken as a very crude representation.

By turning two molecules carefully round together, each through one right angle in opposite senses, we set up a dissenting pair whose equilibrium has feeble stability. A slight displacement, such as might be produced by the transmission of a vibrational wave, breaks them up, and they swing back to the normal configuration, giving out energy, which is taken up by the rest, and is ultimately dissipated. By making the dissenting coterie consist of three or more we can give it additional strength.

An example is shown in Fig. 4, where the three molecules marked *a*, *b* and *c* are turned round in this way.

Notice that the normal molecule *d*, adjoining a line of such dissenters, is in a peculiar position. His neighbors present to him three north poles and one south pole. He has the choice of conforming to the majority, or of throwing in his lot with the dissenters; and he has a third possible position of equilibrium (very feeble equilibrium), which is reached when his two south poles are turned until the one neighboring south pole faces just between them. I have labored these points a little because they seem important when we come to speak of the effects of strain.

Consider now the straining action, which we may imitate in the model by sliding one part of the group past the other part. For this purpose the centres are cemented to two glass plates, which can slide parallel to one of the axes.

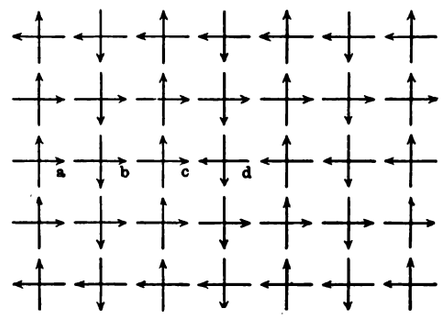


FIG. 4.

At first, when the displacement by sliding is exceedingly small, the strain is a purely elastic one. The molecules adjacent to the plane of sliding pull one another round a little, but without breaking bonds; and if in this stage the strain is removed, by letting the plate slide back to its original position, there is no dissipation of energy. The work done in displacing the molecules is recovered in the return movement. We have here a representation of what happens between each pair of adjoining rows in the elastic straining of a metal. So far the action is within the limit of elasticity; it leaves no permanent effect; it is completely reversible.

But now let the process of straining be carried further. The opposing molecules try to preserve their rows intact, but a stage is reached when their resistance is overcome; the bonds are broken, and they swing back, unable to exert further opposition to the slip. The limit of elasticity has now been passed. Energy is dissipated; set has been produced; the action

[1] Rosenhain, "The Plastic Yielding of Iron and Steel," *Journal of the Iron and Steel Institute*, No. 1, for 1904, page 335.

Digitized by Google

is now no longer reversible. The model shows well the general disturbance that is set up in molecules adjoining the plane of slip, which we may take to account for the work that is expended in a metal in producing plastic strain.

Moreover, when the slip on any plane stops and the molecules settle down again, the chances are much against their all taking up the normal orientation which they had before the disturbance. What I have called dissenting groups, or unstable coteries, are formed as a result of the disturbance. Here and there like poles are found in juxtaposition. Viewed as a whole, the molecular constitution of the metal in the region adjacent to the plane of slip is now uncertain and patchy. It includes parts whose stability is much less than normal. Individual molecules or small groups in it are very feebly stable; a touch would make them tumble into positions of greater stability.

Observe how all this agrees with what we know about the nature of plastic strain through experiments on iron or other metals. Its beginning is characteristically jerky. Once the critical force is reached, which is enough to start it, there is a big yield, which will not be stopped even by reducing the amount of the straining force.

Again, we know there is a slow creeping action that continues after the straining force has done its main work. I ascribe this to the gradual breaking up of the more unstable groups which have been formed during the subsidence of disturbance in the earlier stage of the slip.

Further, we know that overstrained iron is very imperfectly elastic until it has had a long rest, or until it has been raised for a short time to a temperature such as that of boiling water.[1] This is to be expected when we recognize the presence of unstable individuals or groups resulting from the overstrain. When the elasticity of the overstrained piece is tested by removing and reapplying the load, some of these tumble into new positions, making inversible movements, which dissipate energy and produce hysteresis in the relation of the strain to the stress although the strain is quasi-elastic. At ordinary temperatures these unstable groups are gradually becoming resolved, no doubt through the action of the molecular movements that are associated with heat, and hence the slow progressive recovery of perfect, or nearly perfect, elasticity shown by the experiments of Muir. Let the temperature be raised and they disappear much more quickly; in warm surroundings the rest-cure for elastic fatigue does not need to be nearly so long.

Rosenhain[1] has recently shown that after the slip-bands on the surface of an overstrained specimen have been obliterated by polishing, traces of them will reappear on etching if only a short interval of time is allowed to lapse since the overstraining; but if time is given for complete recovery no traces are found. This is in remarkable agreement with the view now put forward, that the layers contiguous to the surface of slip contain for a time conparatively unstable groups. They are consequently different from the normal metal until the unstable groups are resolved, and the temporary difference manifests itself on etching, provided that is done while the difference still exists.

From the engineer's point of view, a much more important matter than this fatigue of elasticity is in the fatigue of strength that causes fracture when a straining action is very frequently repeated. Experiments which I made with Mr. Humfrey[2] showed that this action begins with nothing more or less than slight slip on surfaces where the strain is locally sufficient to exceed the limit of elasticity. An alternating stress, which makes the surfaces slip backwards and forwards many thousands, or it may be millions, of times alternately, produces an effect which is seen on the polished surface as a development of the slip lines into actual cracks, and this soon leads to rupture.

We have, therefore, to look for an effect equivalent to an interruption of continuity across part or the whole of a surface of slip, an effect progressive in its character, becoming important after a few rubbings to and fro if the movement is violent, but only after very many rubbings if the movement is slight.

That there is a progressive action which spreads more or less into the substance of the grain on each side of the original surface of slip was clearly seen in the experiments referred to. It was found that a slip-band visible on the polished surface of the piece broadened out from a sharply defined line into a comparatively wide band with hazy edges, and this was traced to an actual heaping up of material on each side of the slip which constituted the original line.

I think this suggests that under alternating stresses which cause repeated backward and forward slips, these do not occur strictly on the same surface in the successive repetitions, and hence the disturbance spreads to some extent laterally. It may be conjectured that slip on any surface leaves a more or less defective alignment of the molecular centres; that is to say, the rows on one side of the plane of slip cease to lie strictly in line with those on the other side. If this occurs over neighboring surfaces, as a result of slips on a number of parallel planes very close together, the metal throughout the affected region loses its strictly crystalline character, and with it loses the cohesion which is due to strict alignment.

G. T. Beilby, in a very suggestive paper,[1] has advanced grounds for believing that portions of a metal may pass from a crystalline to an amorphous formation under the mechanical influence of severe strain, as in the hammering of gold leaf or the drawing of wire, and that this occurs in the polishing of a metallic surface, and also in the internal rubbing which takes place at a surface of slip within the grain. In both cases he suggests the formation of an altered layer. When a polished metal surface is etched, the altered layer is dissolved away, and the normal structure below it is revealed.

Without accepting all Mr. Beilby's conclusions, I think the idea of an altered and more or less amorphous layer is supported by the considerations I am now putting forward. We have assumed that in normal crystallization the intermolecular forces lead to a normal piling, in which each molecule touches six neighbors. But it may be conjectured that some of them may take up pyramidal piling (touching twelve others) under the compulsion of strong forces—such forces, for example, as act on the superficial molecules of a surface that is being polished.

If this also occurs at a surface of slip, it gives us a clue to several known facts. It at least assists in explaining the familiar result that metal is hardened by straining in the sense of being made less plastic. Again, it accounts for the general increase of density which is found to take place in such an operation as wire-drawing. Further, if a local increase of density occurs in the interior of a grain through piling of some molecules in the closer manner where repeated slips are going on, the concentration of material at one place requires it to be taken from another;

1 J. Muir, "On the Recovery of Iron from Overstrain," *Philosophical Transactions*, vol. cxcIII, A, 1900.

1 *Journal of the Iron and Steel Institute*, 1906.
2 Ewing and Humfrey, "The Fracture of Metals Under Repeated Alternations of Stress," *Philosophical Transactions*, vol. cc, A, 1902.

1 Beilby, "The Hard and Soft States in Metals," *Philosophical Magazine*, August, 1904.

Digitized by Google

in other words, the closer piling tends to produce a gap or crack in the neighborhood where it occurs. This is consistent with what we know of the development of cracks through repeated alternations of strain.

Recourse to the model shows that with pyramidal piling the polar axes point in so random a manner that the aggregate may fairly be called amorphous. To illustrate this a group is shown with centres fixed at the corners of equilateral triangles.

It is obvious that any pyramidal piling at a surface of slip tends to bar further slip at that particular surface. Hence, not only the augmented hardness due to strain, but the tendency in repeated alternations to lateral spreading of the region on which slip occurs. The hardness due to straining is, of course, removed when we raise the metal to such a temperature that complete recrystallization occurs, normal piling being then restored in the new grains.

Taking a previously unstrained piece, it is clear that the facility with which slip will occur at any particular surface of slip in any particular grain depends not only on the nature of the metal and on the orientation of the surface in question to the direction of the stress, but also on the amount of support the grain receives from its neighbors in resisting slip there. In other words, for a given orientation of surface the resistance to slip may be said to consist of two parts; one is inherent in the surface itself, and the other is derived from the position of the grain with reference to other grains.

To make this point clear, think of a grain (under stress) in which there is a gliding surface oriented in the most favorable direction for slipping. Slip on this surface can take place only when its yielding compels the neighbors (which are also under stress) to yield with it, and the surfaces in these on which slip is compelled to occur are, on the whole, less favorably situated. Hence the original grain can not yield until the stress is considerably in excess of that which would suffice to make it yield if it stood alone, or had neighbors equally favorably inclined.

Apply this consideration to the case of steel, where there are two classes of grain —the ferrite, which is simply iron, and the pearlite, which is a harder structure. Slip on any ferrite grain is resisted partly by the strength of the surface itself, and partly by the impossibility of its yielding without forcing slip to take place on neighboring (harder) grains. Now suppose the structure is a very gross one, such as Mr. Stead has shown may be found in steel that is seriously overheated. On the large grains of ferrite in overheated steel the resistance to slip will be but little greater than it would be in iron, and, consequently, under an alternating stress fatigue of strength, leading to rupture, may be produced by a very moderate amount of load. Mr. Stead[1] has shown how the effects of overheating can be removed by the simple expedient of raising the steel to a temperature sufficient to cause recrystallization — a homœopathic remedy that transforms the gross structure of the overheated metal into an ordinarily fine structure, where no ferrite grain can yield without compelling the yielding of many pearlite grains. Hence we find, as Rogers[2] has demonstrated by experiment, that steel cured by reheating from the grossness of structure previously produced by overheating has an immensely increased power to resist the deteriorating effects of often repeated stress.

I trust you will not feel I have abused the license of the chair in presenting contributions to molecular theory that are for the most part in the nature of speculative suggestions, thrown out in the hope that they may some time lead to fuller and more definite knowledge. Remote as they may seem to be from the concerns of the workaday engineer, they relate to the matter which it is his business to handle, and to the *rationale* of properties, without which that matter would be useless to serve him. We have attempted to penetrate into its very heart and substance in order the better to comprehend the qualities and functions on which the practical work of engineering relies. The man whose daily business leads him through familiar tracks in a forest does well to stray from time to time into the shady depths that lie on either hand. The eyes of his imagination will be opened. He will at least learn his own limitations, and, if he is fortunate, he may gain some clearing on a hilltop which commands a wider view than he has ever had before.

[1] See especially a paper by J. E. Stead and A. W. Richards on "The Restoration of Dangerously Crystalline Steel by Heat Treatment." *Journal of the Iron and Steel Institute*, No. 2, 1903.

[2] F. Rogers. "Heat Treatment and Fatigue of Steel." *Journal of the Iron and Steel Institute*, No. 1, 1905.

BOOK REVIEWS.

"Complete Examination, Questions and Answers, for Marine and Stationary Engineers." Calvin F. Swingle. Chicago. Frederick J. Drake & Company. Flexible leather. 368 pages. 4½ by 7 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.50.

This volume is put out as a complete engine operators' catechism, and it is the aim of the author to enable the careful student of it to obtain a certificate for operating marine engines. The subjects of heat and combustion are first taken up, followed by a consideration of the boiler and its appurtenances; a chapter is devoted to the care and operation of boilers, and finally engines and auxiliary machinery are discussed. While not all the explanations are put in a strictly scientific way, the manner of presentation is possibly one which will appeal to the class of readers sought.

"The Management of Electrical Machinery." Sixth edition. Francis B. Crocker and Schuyler S. Wheeler. New York. D. Van Nostrand Company. Cloth. 224 pages. 5 by 6½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.

For many years this little book was not only the standard, but the only, work of its kind available for men in charge of electrical machinery. It is so well known that there is no need, in calling attention to the new edition, to do more than state that this has been brought up to date. A large amount of new and amended material dealing with the management of alternating-current generators and motors, both single-phase and polyphase, and railway motors, has been added. Although the field to be covered is now much larger than when the book was first issued in 1892, by eliminating those parts dealing with machines no longer in use, the volume has been prevented from becoming bulky. For those whose business it is to keep a machine in order, and who have not had that training in theory which will assist in locating troubles, this book is invaluable; and, at the same time, it is of great assistance to those who have had book training, but whose experience with electrical machinery in actual service has been limited.

"Steam Turbines and Turbo-Compressors —Their Design and Construction." Frank Foster. Manchester, England. The Scientific Publishing Company. Cloth. 449 pages. 6 by 8¾ inches. Illustrated. Price, 10*s.*, 6*d.*, net.

An attempt has been made here to produce a book dealing with the intricate subject of steam turbine design, but which shall not be deeply involved in mathematics. The attaining of exceedingly high thermal efficiencies is not insisted upon, but rather is the practical and workable

Digitized by Google

type of machine considered. The author discusses clearly the different types of turbines, such as the action and reaction, and describes practically all the principal types that have been built. The various elements in design, such as the nozzles, blades, construction of rotor, methods of governing and bearing construction, are taken up in order, and the various actions coming into play during operation are explained and methods of providing for them suggested. A chapter on steam turbine performance gives some characteristic results and an analysis of the losses which take place. Both stationary and marine types of turbines are described.

"Wiring a House." Herbert Pratt. New York. The Derry-Collard Company. Paper. 21 pages. 5½ by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

This is one of a series of papers written for the practical man. The work takes up in detail the calculations involved in installing a simple two-wire or three-wire system for incandescent lighting. The familiar formulæ for calculating the carrying capacity and resistance of circuits are given, and there are several diagrams showing the layout for wiring a typical residence.

"Outlines of the Evolution of Weights and Measures and the Metric System." William Hallock and Herbert T. Wade. New York. The Macmillan Company. Cloth. 304 pages. 6 by 9 inches. Supplied by the ELECTRICAL REVIEW at $2.25.

A most interesting account is given here of the development and adoption of the metric system of weights and measures in Europe, and the progress which has been made in its use in various countries. While the authors are admittedly supporters of the metric propaganda, they have not taken up the subject in a controversial manner. They have prepared this book to serve as an introduction to metrological science and to make available an intelligent work dealing with the metric system. The metric system has resulted not from a sudden impulse, but is the growth of over a century of careful study and discussion. While it is very probable that it would not have been adopted by France as early as it was had it not been for the disturbing conditions of that country at the time, this fact does not in any way detract from the value of the work that has been given to this development. In fact, the original committee to whom was assigned the task of preparing a truly scientific system of metrology consisted of men in the first rank of science. The story of the difficulties encountered and the opposition they overcame in their work is exceedingly interesting. The book starts with a discussion of the beginnings of the science of metrology, describes the origin and development of the metric system and its extension throughout Europe and elsewhere, then takes up a discussion of the weights and measures in use in this country and the use of the metric system in commerce, engineering, pharmacy and science. It is a work which may be read with profit by all those who are interested in metrology, whether they be supporters or opponents of the metric system. To the book is added a useful appendix, giving tables of equivalents and a number of useful physical constants.

"The Elements of Electrical Engineering." Vol. I. William Suddards Franklin and William Esty. New York. The Macmillan Company. Cloth. 518 pages. 6 by 8¾ inches. 250 illustrations. Supplied by the ELECTRICAL REVIEW at $4.50

New text-books for students of electrical engineering have not been lacking of late, but seldom has the reviewer had the pleasure of examining one which seems so well fitted to meet the requirements of teaching in our technical schools. The demands made on the various engineering departments at these schools are various in order to meet the requirements of the different classes of students. The problem of obtaining a text-book, or even a set of text-books, that will supply the needs at an expense not prohibitive is difficult. The authors of this book, realizing from a long experience in teaching the needs and difficulties, have decided to lay the greatest stress upon the fundamental principles, and only pass to details when this will assist in the understanding. With this idea in view the first part of the book explains the fundamental laws of electricity and magnetism and how these are applied in the dynamo and motor. The characteristic behavior of these various machines is discussed, as well as their performance as energy converters. The methods of rating machines are carefully explained and some instructions given for the care and operation of dynamos and motors. This is the ground covered by the book proper. The discussions are clear and satisfactory and not at all mathematical, so that this part is suitable for the use of students who are not making a specialty of electrical engineering, as well as being excellently adapted to serve as an introduction for the electrical student. To carry the latter further there is a number of appendices, one on electromagnetism, in which the theory is gone into fully. Another deals with characteristic curves, those tools which are so useful to the electrical engineer. A third appendix makes a study of armature windings, and a fourth gives over 100 practical and instructive examples to be worked out by the student as he progresses through the book. This brief outline will, perhaps, indicate in a way the method of treatment adopted by the authors. As said before, the aim is to instil principles, and not confuse the mind with a mass of so-called practical information. Too many books err in trying to give too much so-called practical data and in trying to catalogue too many types of machines. In the opinion of the reviewer this practice is wrong. Electrical engineering is becoming so broad and practice is advancing so rapidly that it is disheartening to attempt—in fact, it is impossible—to keep up with all advances. What should therefore be done, and what is done here, is a driving home of the fundamental principles upon which electrical engineering is based.

The Adirondack Murray Memorial Association.

Quite a number of electrical men have become interested in the recently organized Adirondack Murray Memorial Association, which provides for the perpetuation of the memory of Adirondack Murray. The objects of the association will be to erect a suitable monument at his burial place, to preserve the homestead at Guilford, Ct., to assist in the education of his daughters, and to promote the sale of his books.

The trustees of the association are: W. H. Merrill, of the Boston *Herald;* Colonel A. A. Pope, Hartford, Ct.; Rev. Newell Dwight L. Hillis, Brooklyn, N. Y.; Hon. Edward Griswold and C. H. Scholey, Guilford, Ct.; Hon. M. J. Hapgood, Peru, Vt.; James H. Cutler, Washington, D. C.; Harry V. Radford, of *Woods and Waters,* and M. F. Westover, Schenectady.

The officers of the association are: Edward Griswold, a classmate and lifelong friend of Mr. Murray, president; M. J. Hapgood, treasurer; M. F. Westover, secretary.

The constitution provides that the membership in the association shall be permanent without annual dues, and that members may be either "regular," "special" or "patron." Any person may become a regular member upon the payment of $2, a special member upon the payment of $5, and a patron member upon the payment of $26, or such larger sum as he may be disposed to give.

The number of rubber trees of all ages in the Federated Malay States is put at six or seven millions. The rubber production of 1905 is estimated to have been 300,000 pounds.

Digitized by Google

The Meeting of the Electrical Jobbers at Niagara Falls.

As reported in the issue of the ELECTRICAL REVIEW for September 15, a meeting of electrical jobbers and manufacturers was held at the International Hotel, Niagara Falls, N. Y., September 11-14. The business programme included division meetings on September 11, both morning and afternoon, and a morning session on September 12. Executive committee meetings were held on the afternoon of September 12, on the morning and afternoon of September 13, and on the morning and afternoon of September 14.

The entertainment programme included a ladies' informal reception in the parlors of the International Hotel, a smoker for the jobbers and manufacturers at the Cataract Hotel, and a rejuvenation of the Sons of Jove, following the smoker at the Cataract Hotel, on September 11. On the morning of September 12 a tug-of-war was indulged in between teams representing the Atlantic and Central divisions of the jobbers, and the ladies and manufacturers were given a carriage drive. In the evening there was a trolley ride to the rapids of Niagara Gorge, and later an informal dance in the ballroom of the Cataract Hotel.

On the morning of September 13 a baseball game was held between the manufacturers and the jobbers. In the evening there was a progressive euchre for the ladies in the parlors of the International Hotel, and a banquet of jobbers and manufacturers in the dining hall of the International Hotel.

On September 14, in the morning, there were sight-seeing trips to various points of interest. At one o'clock a picnic was given at Brock's Monument, Queenstown Heights, overlooking Lake Ontario. It was unfortunate that the rain kept a good many from attending this picnic.

In addition to those mentioned in last week's issue of the ELECTRICAL REVIEW, the following attendants and guests arrived late: W. J. Phelps, Frank Stout, E. Ward Wilkins, A. T. Appleton, Norman Marshall, E. A. Jenkins, H. B. Crouse, Thomas Walsh, E. H. Haughton, F. S. Terry, Harry Hart, A. N. Palmer and H. C. Hoovens. The attendance was markedly representative of the jobbing and manufacturing sides of the electrical industry.

The baseball game was the means of creating considerable amusement, and was really one of the most enjoyable features. Counsel Thomas M. Debevoise officiated as umpire, armed with a pistol and a golfer's guide. The line-up was as follows:

Electrical manufacturers—Waterman, 1st base; Hart, catcher; Gray, pitcher; Wilkins, 2d base; Gray, 3d base; Walsh, shortstop; Grier, centre field; Crockett, left field; DeVeau, right field.

Electrical jobbers—Wayman, shortstop; Hopkins, centre field; Turner, left field; Hodge, 3d base; Fletcher, catcher; Hall, 1st base; Hughie, pitcher; Adams, 2d base; Jones, right field.

Of the many banquets held by electrical men during the last few years it was conceded that the affair attended by the electrical jobbers on Thursday, September 13, at the International Hotel, was beyond others in the matter of its genial spirit and good-fellowship and the enthusiasm inspired by the toasts, and especially by the toastmaster, Counsel Thomas M. Debevoise. The toasts were as follows: "Hospitality," W. W. Low; "Wire-Pulling," Albert H. Elliott; "Sand," Hon. Daniel Hemingray; "The Old Apple Tree," A. D. Page; "Timely Sentiments," J. C. Fish; "A New Broom," Harry E. Hart; "The Jobbers," E. W. Rockafellow; "Trade Ideas," E. Irving.

The menu served was as follows:

Dry Martinis
Littleneck Clams
Bisque of Lobster — Croutons Souffle
Salted Almonds — Cheese Straws
Stuffed Olives — Celery
SAUTERNE
Fillet Sole, White Wine Sauce
Potatoes Saint Anna
Broiled Squab — Chicken on Toast
German String Beans
CLARET
PUNCH AU KIRSCH
Braised Saddle of Southdown Mutton
Currant Jelly
CHAMPAGNE
Potato Croquettes
Salad Victoria
Frozen Nesselrode Pudding
Fancy Assorted Cakes
Fromage de Cataract
CIGARS
Saltines
CIGARETTES
Demi Tasse Coffee

The peculiar success of this dinner was largely due to the indefatigable efforts of the committee in charge, consisting of Messrs. Robertson, Sibley and Bosley.

Johns Hopkins University Offers Graduate Courses in Applied Science.

The Johns Hopkins University is offering as a part of its regular curriculum advanced courses in applied science. These aim to present the most recent advances of the several sciences from the point of view of theory and in their special bearing on industrial applications, and are designed to meet the present demand for a specialized scientific equipment exceeding that indicated by the usual collegiate or engineering degree. Particular attention in these courses is paid to the results of research and to improvements in methods as reported in current scientific literature. Complete laboratory facilities are offered to engineers and others who desire to prosecute research along particular lines.

These courses are adapted to students who have graduated in engineering or science, to engineers desirous of knowing the present state of research in their subjects, and to those wishing to prosecute some special experimental research. Courses having special bearing on applied science are now offered in biology, chemistry, physics, applied electricity, geology and mechanical drawing. Under physics and allied subjects, courses are given in electrical measurements, applied electricity, photography, theoretical mechanics, the design of instruments and mechanical drawing.

Meeting of the American Institute of Electrical Engineers.

The 209th meeting of the American Institute of Electrical Engineers will be held in the auditorium of the New York Edison Building, 44 West Twenty-seventh street, on Friday, September 28, at 8.15 P. M. Dr. Samuel Sheldon, recently elected president of the Institute, will be officially conducted into office at this meeting. Dr. Sheldon will read his inaugural address, entitled "The Work of the Institute."

The following papers will be presented:

"The Effect of Iron in Distorting Alternating-Current Wave-Form," by Professor Frederick Bedell and Elbert B. Tuttle, Cornell University, Ithaca, N. Y.

"The Current Transformer," by Kenneth L. Curtis, Leland Stanford, Jr., University, Palo Alto, Cal.

New York Electrical Society.

The New York Electrical Society will open its season for 1906-1907 with an interesting meeting, on the evening of September 26, at the exhibition offices, 1414 Broadway, New York city, introducing to the electrical public one of the notable inventions of recent years, the Cahill Dynamophone and Telharmonium System. Oscar T. Crosby, the well-known electrical engineer, who is associated with Dr. Thaddeus Cahill in the enterprise, will deliver an address on the subject of the apparatus. An excellent programme of music of all kinds will be presented.

The new president, George Herbert Condict, will be in the chair. Each member will be at liberty to bring one lady on presentation of the card of admission.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Carbon Brushes versus Copper.

Although giving carbon brushes full credit for the assistance they have given in developing electrical apparatus, E. Austin raises the question whether it will not be possible, and perhaps desirable, to return to copper to-day. Although a few years ago carbon was indispensable to prevent sparking, much advance in machine design has since taken place, and the use of commutating poles and other similar devices should enable us to return to copper, the advantage being the lower electrical resistance and the decreased friction, and hence a more efficient and cooler machine. The advantage of doing this will be much greater with the high-speed machines to which we are returning in order to take advantage of the steam turbine, and it is a rather curious fact that continuous-current machines driven by turbines are now run with copper brushes, although, on account of the high-reactance voltage of the armature, they are the ones to which carbon brushes would seem to be the most necessary. The conductivity of carbon is only one-tenth that of copper, and its friction coefficient is 0.3, as against 0.2 for copper. It has been estimated that the efficiency of a fair-sized machine can be raised from two to two and one-half per cent by substituting copper for carbon brushes. Better results can be obtained by using carbon coated with copper or carbon which contains a large percentage of copper; but the efficiency of a machine can always be increased an amount well worth consideration with pure copper alone.—*Abstracted from the Electrical Engineer (London), August 31.*

An Experiment in Industrial Training.

The apprenticeship course of the General Electric Company at West Lynn, Mass., is described here by M. W. Alexander. The object of this course is to train young men as skilled journeymen and to furnish a supply of such men from which foremen and assistant superintendents may be picked. Under this system boys of at least sixteen years of age with a grammar school education are indentured as apprentices in one of the many trades practiced at the West Lynn works. The applicants have to serve a trial period from one to two months, and unless they give promise of becoming good artisans during this period they are not allowed to sign the regular apprenticeship agreement. This agreement provides for a service of four years, during which time the apprentices are paid fair wages along a progressive schedule, and are given every opportunity to learn the arts of the particular trade to which they are indentured. The wage schedule is set so that each boy can be self-supporting from the beginning, even during the trial period. In addition to the work in the shops the apprentices attend school twice a week, each session lasting two and one-half hours. These sessions take place during the working period, and the boys are paid for this time at the regular rate. For this instruction a small shop has been set aside in a large factory which is devoted entirely to the preliminary instruction of apprentices. He serves in this shop for about two years, and is then sent into the regular shop, where he secures still greater skill and accuracy on a greater variety of work. It is said that this school has proved most successful since its inception early in 1902.—*Abstracted from Machinery (New York), September.*

The Nature and Origin of Volcanic Heat.

Exception is taken here by T. J. J. See to the recently propounded theory of the origin of volcanic heat, due to Professor Elihu Thomson, an abstract of which appeared in the issue of the ELECTRICAL REVIEW for August 25. Dr. Thomson says a truly solid interior seems to be demanded by the accepted great rigidity of the body of the earth. While the author had frequently expressed this view in his writings, he thinks he has since proved conclusively that a fluid substratum underlies the earth's crust. Rigidity really does not disprove internal fluidity, and the geological evidence of the existence of a fluid substratum is overwhelming. He has shown that the required rigidity could be given by a fluid interior, if it were under sufficiently great pressure. He agrees with Dr. Thomson in pronouncing against radium as a source of volcanic action, for, were this the cause, abundant eruptions should be expected to occur in all countries underlaid with granite, which is contrary to observation. R. J. Strutt, from his radium investigations, concludes that the internal temperature of the moon exceeds that of the earth, but the observed temperature of the lunar surface contradicts this hypothesis. From this we must be very cautious about ascribing too much to radium. The best experimental evidence available is that radium is a temporary form of matter the energy of which must be renewed from other sources at intervals of 20,000 years, and thus it may play an inappreciable part in the physics of the universe. There is no evidence that it is an important cosmical agency. The great forces which have most profoundly modified the world will be found to be familiar ones which are overlooked mainly because they are so simple and so near at hand.—*Abstracted from Science (New York), September 7.*

Practical Notes on Underground Substations.

Some notes dealing with the construction of underground substations, referring particularly to English practice, are given here by W. Pleasance. These substations are intended for the large transformers which take the place of a number of smaller transformers placed on poles. Two general types are recognized—single and double-compartment vaults. As a measure of precaution against possible flooding, it is best to use the type of transformer designed to be placed in a watertight tank. This is bulkier than the unenclosed type for the same output and necessitates a larger chamber. In the single-compartment type of chamber it is necessary to leave a passageway for the inspector. This calls for a somewhat larger chamber. Space may be saved by making a recess in the chamber by which entrance is effected. The chamber should not be less than seven feet high from floor to ceiling. One of the most important features in its construction is to provide watertight walls and floor. This is best done by laying down a foundation of nine inches of concrete with a slope toward one

Digitized by Google

end of one inch in four feet. On this floor a fourteen-inch brick wall is erected. The floor and walls are then waterproofed either with cement, lead sheathing, or asphalt, and over the waterproofing is laid three inches of concrete, also sloping toward a sump where water may collect. A nine-inch wall is then built against the waterproofing, and the beams for supporting the roof laid upon this. The roof is covered with the same waterproofing, and over that is put a second layer of concrete. The waterproofing should be carried well up and turned under the top course of brick. The roof beams must be selected to stand heavy loads, at least that of a loaded cart. Ventilation must be provided, otherwise the walls and apparatus will sweat; and it is advisable to install a small fan to circulate the air for the first few months. The opening of the duct into the chamber must be carefully finished. White-enameled bullnose bricks are preferable. When they can not be used the wall should be bell-mouthed with a wide sweep. —*Abstracted from the Electrical Review (London), August 31.*

The Sudden Short-Circuiting of Alternators.

A study is made here by F. Punga of the factors that effect the difference between a gradual short-circuit and a sudden short-circuit. As the matter is rather complicated, an exact solution of the problem seems quite impossible, but a rough approximation may be made. If the generator be short-circuited, the flux in the armature, as well as in the pole, has to be changed; and it is this change of flux which changes many of the phenomena observed on the occasion of a sudden short-circuit. During the time this change is taking place a larger flux is entering from the pole shoes into the armature than at the end of the change, and therefore a higher electromotive force is also produced. The maximum short-circuit current may reach a value twenty times larger than the full-load current, and, owing to the change of flux induced in the field-winding acting in the same sense as the exciter voltage, the exciting current is increased. If the generator were standing still the change in field flux would induce the same effect in the armature-winding as in the field-winding. As, however, the field is rotating, the current induced in the armature circuit due to the change of flux is displaced by nearly ninety degrees. In case the armature circuit has a considerable resistance a component of the current induced will have a demagnetizing effect, but, in general, this may be neglected. The armature current at short-circuit does not immediately reach the value corresponding to the induced electromotive force, requiring about one-quarter of the period to grow from zero to its maximum. An analytical examination of the conditions existing at short-circuit leads to the following conclusions: After a sudden short-circuit the field current increases within a quarter of a period to a maximum value. The number of magnetic lines that would be linked with the field circuit if the generator were gradually short-circuited with the preceding maximum value as excitation would be just as large as with normal excitation before the short-circuit. The effect of a sudden short-circuit may be briefly summarized as follows: The excitation current is increased, the exciter is overloaded momentarily to a considerable extent, the armature current reaches a value considerably higher than the normal short-circuit current, and, as a consequence of the high armature current, a considerable force is produced on the spool heads. Even though the armature have a comparatively large ohmic resistance or the short-circuit occur at a distance from the generator, the armature current may still become considerably higher than the normal short-circuit current, and the copper losses may represent a dangerous overload on the generator. The author then gives the results of an investigation of sudden short-circuits on a 5,000-kilowatt alternator. It was found that after a sudden short-circuit the exciting current rose to six times its normal value, while the flux fell to about one-half its normal value. In order to determine the value of the sudden current rush a dead-beat ammeter and a hot-wire ammeter were used, but in either case the readings are merely indications, and are not accurate. It was found that the ammeter in the field circuit at the moment of short-circuit gave maximum deflections about three and one-half times the normal exciting current, while the hot-wire instrument showed that the current rush in the armature was nearly double that taking place on a normal short-circuit. The results point to the advisability of clamping the field spools firmly and of using mechanically strong insulation on the armature. It has been suggested that one method of protecting a generator against such unexpected loads would be to insert an overload switch in the field circuit.—*Abstracted from the Electrician (London), August 31.*

The Measurement of Phase Differences.

Methods of measuring phase differences are divided by Dr. C. V. Drysdale into three classes — measurements at high power-factor, measurements at low power-factor, measurements of small differences of phase. For ordinary commercial testing the usual method is to determine the power by means of a wattmeter and to divide this by the product of the effective volts and amperes. This method suffers from two defects. At high power-factors, although the inductive errors due to the wattmeter may be small, a small error in reading any of the instruments makes a large error in the phase angle. At low power-factors this error is less, but the inductive reactions in the wattmeter have their maximum effect. With a moderately good wattmeter this is perhaps the best method of measuring low power-factors. For measuring high power-factors the author replaces the non-inductive resistance in his pressure coil by a condenser, thus shifting the phase of the pressure current by about ninety degrees. While the actual shifting can never be quite through a quadrant, the angle of error is easily obtained by taking readings on non-inductive circuits, so that the correction factor may be determined. An objection to this method is that the condenser tends to magnify harmonics in the potential wave, but since all commercial circuits are approximately sinusoidal the error here may, in general, be neglected. Where a two-phase supply is available the pressure coil of the wattmeter may be connected across one phase, the current coil being placed in the other. It is frequently important to determine small phase differences at any power-factor, such as are introduced by a transformer or shunt. For this purpose the best method is to employ a wattmeter, arranging some means so that the currents in the two coils are approximately in quadrature. This may be done by condensers, inductances or a phase-shifting transformer. This arrangement serves for measuring differences of phases of voltages and also of currents, if it is permissible to introduce non-inductive resistances in series with the circuits over which the drop can be taken. When such resistances can not be introduced, the main coil of the wattmeter can be changed over from one circuit to the other; but to provide for this case, wattmeters having two coils may be used.—*Abstracted from the Electrician (London), August 24.*

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

BEST METHODS TO INCREASE BUSINESS APPLIED TO A VILLAGE OR SMALL CITY, WHERE THE POPULATION IS NOT INCREASING.[1]

BY SAMUEL RUST, GREENVILLE, OHIO.

This subject is a very interesting one to every electric light manager or superintendent, and while it is not the writer's intention to try to cover all of the ground, he will give some of his personal experiences and ideas in trying to secure and maintain a business in a small town or city where the field for new business is limited and where it has been intelligently worked for many years.

In the first place, you will all agree that we must give good service, and in order to do this the manager or superintendent must have reliable men—men who take pride in their work and who make the company's interest their interest. They must be men that are trustworthy, and if any of them have to deal with the customers (and they all do more or less), they should be courteous at all times.

I believe that the central stations should take care of all construction work, such as wiring, etc., for the customers; at least, the company should see to it that the contractor does not charge prices that will tend to prevent prospective customers from installing the wiring; in fact, any work of this class should be installed by the lighting company at nearly cost. In doing this the company should of course use nothing but the very best material and workmanship. The manager or superintendent should make it his duty to convince the customers that the company is giving them value received for everything done for them, that it is his earnest endeavor to favor them as far as possible, and never under any circumstance misrepresent anything. It is far better for your business if you never secure a man for a customer than to get him and lose him because he finds that you have misrepresented something.

I believe that every central station should furnish free renewals, no matter how small the town. It has a pleasing effect on the customer and I believe it a paying business for the company, for the reason that if the customer is compelled to pay for his renewals, you will find him taking lamps from places that are little used, leaving the sockets open, and when he has occasion to use light in these places, he does without. This works two hardships on the company; first, the loss of the current consumed; second, the dissatisfied customer, because he has to use some other kind of light, and perhaps go to some inconvenience in order to accomplish his purpose; whereas, had there been an electric lamp there, he would have turned it on and been pleased with the result.

The successful superintendent in a small town, must, of necessity, be a very busy man. He must be in touch with everything, from the coal pile to the lamp. Must know where his men are, what they are doing at all times, be with them as much as possible, and know that the work along every line of the business is being done in the most economical and best way possible. He should make a study of his customers, know their peculiarities, and see that they are taken care of in a way that will satisfy each individual. It is a deplorable fact that almost every public service company has the reputation of overcharging and mistreating their customers. This feeling may be, and should be eliminated, and I believe that this duty falls upon the shoulders of the superintendent, perhaps, more than any other officer of the company, and by hard and continuous work, by meeting the customers from time to time, listening to their grievances, whether they be real or imaginary, conceding to their whims as far as possible, and constantly bringing before them and impressing on them the fact that their interests are your interests, you can convince them that you are their friends, and that you are serving them rather than trying to overcharge them, and whenever you succeed in gaining their confidence, you will have a friend as long as you prove worthy of their friendship, and that customer will do you more good in getting new business than any one you might hire.

Another grave mistake that is made by many small plants, is the arbitrary way they have adopted of furnishing service. Some have certain hours to run, starting at a given hour and shutting down at a certain hour. Others are controlled by the weather, starting when it gets dark and stopping as soon as they think it is light enough to do so. I have found that these things are very annoying and unsatisfactory to the customer. He may have a dark store and will need light, when the majority do not need it and you may shut off the light just at the time when the consumer may have an important customer. Now, put yourself in the same place and see how long you will put up with that kind of service. The current should be kept on the lines as much as possible. You may not make anything in dollars and cents; in fact, you may lose something in operating during the day, but I am sure that the satisfaction will more than recompense you for any outlay that you may make in this direction. The revenue derived from this service may not look like a paying proposition; in fact, it may appear that you are losing by operating your plant at times, but the fact that you are giving satisfaction and that your customer can have what he wants and at the time he wants it, will more than repay for the seeming loss in operating. This kind of service opens up a field for many little things that are a convenience to the customer and incidentally a source of revenue for the company. It gives you a chance to install sewing-machine motors, flat-irons, chafing-dishes and a great many other things that are fully appreciated by your customers.

Another thing that is in favor of the continuous operation of your plant is the fact that you may educate the public to use more light. If they know that they can use it at any time, they will learn to use it at times when ordinarily they have been getting along without it. The fact that they know that they can have the use of the current will tend to have a pleasing effect upon the customer and you all know what that means, not only more revenue from these parties but their influence toward securing other and new business from their friends and this is the end for which we should all be working. The satisfied and enthusiastic customers are the best advertising mediums that a company can secure.

The inducements of good service

[1] Read before the Ohio Electric Light Association, at its twelfth annual convention, held at Put-in-Bay Island, Ohio, August 21, 22 and 23, 1906.

Digitized by Google

courteous treatment, free renewals and day current will do much to solve the difficulty of slow business, but where this does not bring in the necessary amount of increase desired by a company, special inducements may be employed in some cases to good advantage. Where the company has a day current, and I believe that no company should operate without furnishing a day current, special inducements can be offered that will attract residence customers especially. I have always found that where you could enlist the interests of the ladies in your business you had a strong aid if the inducements were such as to appeal to their ideas of good housekeeping and labor-saving devices. With a day current flat-irons can be made to prove a profitable investment, not supplied free because I have always found that what costs nothing is usually but little appreciated, but supplied at actual cost installed without further cost than the iron. The best method of introducing the flat-iron problem is to order plenty, get consent to install on trial, say nothing about price or cost until they have had a chance to get acquainted with their use. Where irons are furnished at cost, it will be found that less than five per cent will come back to the plant when the time comes to close the contract or remove the irons.

The same rule holds good as to water-heaters, sewing-machine motors, small radiators for bedroom service and other like appliances costing little but adding greatly to the convenience of the household.

One hard problem I have found in pushing residence business has been the immediate cost of wiring in houses that are already occupied. I have not tried collecting for wiring in instalments, but I believe that such inducements will be profitable. Where parties are absolutely good I have found it to an advantage to give all reasonable time asked for in paying for wiring. Another inducement is to offer free a nice portable lamp in each residence wired. This does not partake of free wiring but is merely an evidence of good will on the part of the company to induce the customer to stand the inconvenience of having the house wired. I believe that the companies could advertise this as a special inducement for certain months and it would bring in much more than the cost of the lamp. With business houses I have found that furnishing the newest and best method of lighting is an inducement that is always good. In the plant with which I am connected, we would have lost three very desirable department store customers had we not been able to please them with the high-efficiency lamp, and, while they paid for the first installation, all lamp renewals are furnished under the contract. This was sufficient inducement in these cases. I have also found that in small stores where they were dissatisfied with a small installation of lamps or with the use of gas, the installation without cost of one high efficiency would bring about satisfaction, or a change of gas to electricity. No matter how small the town or how unprogressive the business man, if he sees his competitor well lighted and drawing custom for that reason he will listen to inducements for his own lighting.

As I before stated the necessity for the superintendent or business manager of the plant in a small city or town to know and have a business acquaintance with all light consumers is an absolute necessity. Five minutes, two or three times each month, spent in the store of a man who does not use your product with inducements of better light, will eventually get his business.

One of the greatest mistakes some of the smaller central stations are making and perhaps the primary cause of many plants not proving a financial success, is the system of selling current on a flat-rate basis. Many times a superintendent in order to secure business will listen to a prospective customer as to how much current he will use and the hours that he he will use it, and basing his calculations on the customer's statement makes a price too low and in a short time finds the same customer using fully double the current he had contracted for. In this case you have no recourse other than to shut him off, making an enemy who will knock your business afterward, or letting him continue at a loss. If there is a superintendent here laboring under such unfavorable conditions, I would say do not sleep after you return home until you put all your customers upon meters, for this is your only salvation. You may hesitate fearing you will lose some business; you may but the probabilities are you will not lose any if they are properly handled; even if you should lose a few, don't worry, as the ones you lose will be the ones that you can not afford to keep on your lines. The first thing to do is to find out as nearly as possible what your current costs to produce and then add to that a fair profit, bearing in mind that you are to now get paid for all you put out, and make your rate as favorable as possible to the customer and never lose sight of the fact that your rate must be one that the consumer can afford to use the current, not as they have been using it but as they need it and as it should be used. If you have the confidence of your people it is not a hard proposition to convince the average business man that you are giving him all that you can afford. With this change you will find that the gross earnings of your plant will increase very materially, and at the same time your output and operating expenses will decrease. I am not giving you theory, but experience. The plant with which I am now connected has within the last two or three years gone through this same experience, and while I was not with the company during the greater part of this change, I know it was a most satisfactory change to both company and customers. In making the change to meters, the company adopted the two-rate system for stores and commercial use, giving the customer the option of the two-rate or straight-meter system. The company went into the question of the cost of production and fixed expenses very thoroughly in order to arrive at the best price that it could give the consumer. It then went to its customers, giving them the reasons for the change and courteously but firmly informing them that the flat-rate system was to be a thing of the past and current would only be sold by meter, and that they might have their option of either current at a nine-cent rate, including the discount or two-rate system with a fixed charge of $3 per kilowatt per month and current at a four-cent rate, or the company would be compelled to discontinue service. No attempt was made to withhold anything from the customer, and the whole matter was dealt with by a heart-to-heart business talk on the injustice of the flat-rate system and the necessity for the meter rate, which would be fair to both parties to the contract. In a city of 7,000 people not a single customer was lost in changing over, and the results have been better satisfied customers, more light used, larger receipts for the company, less operating expenses and more actual profit from the business done.

I do not believe that our company or our city is differently situated from any other company or town or city in the state, and that the same results could be obtained and a sure profitable business had as against a poor business at an unsatisfactory rate under the old flat-rate system.

To recapitulate, I would say that the following will increase business in any town:

Digitized by Google

Reasonable meter rates, good service, courteous treatment, good wiring at or near cost, free renewals, continuous service, attention to small details, cultivation of acquaintance, careful attention to plant, allow wiring to be paid for in instalments or on reasonably long time, offer such little inducements in the way of labor-saving and comfort-giving appliances as will enlist the interest of the ladies, and at all times work to convince the people that the company is working to their interests and will do everything possible to render the business relations between the company and the consumer pleasant, agreeable and profitable to both.

— —

From time to time, in various articles devoted to the general subject of methods of getting new business, the fact has been pointed out that one of the best forms of publicity is in the use of space in the local daily newspapers. Several writers have claimed that no better utilization of an advertising appropriation can be made than to make use of the daily newspapers, and this apparently applies either to large cities or small towns. The Cleveland Electric Railway Company, Cleveland, Ohio, has for some time been publishing a notable series of advertisements in the Cleveland daily papers. The illustration herewith is a fair example of the style of advertising which this company has had in vogue for some time. There can be little doubt of the utility of this method in putting the company's case clearly before its customers. What makes the matter of pertinent interest in connection with this particular advertisement is that there appears on the page immediately following that upon which the advertisement is printed an editorial dealing with municipal ownership, the sentiment of which is obviously in favor of public operation, whether it is called municipal or political.

NOTE—Each day you will find here something new on the street railway situation. Read it, and if you disagree or care to make any suggestions concerning it, we shall be glad to hear from you.

THE CLEVELAND ELECTRIC RAILWAY COMPANY.
By HORACE E. ANDREWS, President.

STREET RAILWAY TALKS

No. 17

DO YOU WANT CHICAGO CONDITIONS?

This little story happens to be true.

The day after E. F. Dunne was elected mayor of Chicago, upon a platform of "immediate municipal ownership," three men boarded a street car on their way to work.

The conductor asked for their fares.

They refused to pay. When the conductor demanded their reason for refusing they replied:

"We've got municipal ownership now. Mayor Dunne's elected. We own the street cars as much as anybody else does. We don't have to pay fares any more."

When the conductor attempted to expostulate with them, they interrupted, saying: "No, you can't fool us. We know we don't have to pay any more. MAYOR DUNNE'S SPEECH-MAKERS TOLD US SO!"

To make a long story short, it ended in a riot in which the conductor was pummeled and thrown off the car.

You may remember that about the same thing happened in Cleveland the day after Mayor Johnson's first election — the passenger thinking he had the right to ride for three cents.

In both cases the people had been fooled into believing that they would get something in return for their votes.

The present situation in Cleveland is almost identical. Certain men are promising you three-cent fares, eight years from now, with absolutely no certainty that they can carry out their promises.

If they succeed in pulling the wool over your eyes, as was done in Chicago, you will be a sadder but wiser man eight years from now.

We don't ask you to wait eight years or eight days. We will give you 3½-cent fares THE VERY DAY YOU EXTEND OUR RIGHTS TO SERVE YOU TO SUCH A LENGTH OF TIME THAT WE CAN AFFORD TO DO IT

D. W. Low, of the Alliance Gas and Electric Company, stated to the Ohio Electric Light Association at the recent convention that when electric flat-irons came into use he thought it best not to commit his company to any special make, not being convinced which was the best, and he accordingly adopted the policy of letting the supply dealers send samples out on two weeks' trial, which he persuaded them to do, and at the end of the trial period if the party decides to keep the iron and will sign a certificate evidencing that they will purchase same, the lighting company will allow this certificate to be applied as a credit on the light bill to the extent of one dollar. By this method the lighting company does not in any way have to guarantee the irons. Mr. Low concluded by exhorting all managers in smaller places to keep before the public favorably, and if in their places of business in the evenings to make the same a rendezvous for those who may want some little accommodation, such as postage stamps after the post-office is closed, use of telephone, or information such as where a house can be found vacant to be rented, etc.; to be ready, in other words, to at all times accommodate patrons in every reasonable way. In connection with this paper the writer prints blank forms of circular announcements of gas stoves, also blank agreement of purchase, etc.

Digitized by Google

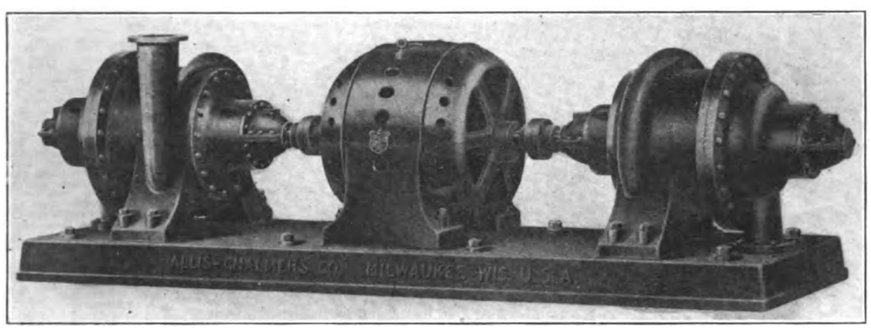
INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Allis-Chalmers Motor-Driven Centrifugal Pumps.

The general use of the centrifugal pumps in this country has, until recently, been confined to installations where a low lift was required, but the multi-stage centrifugal pump, for heads ranging as high as 2,500 feet or more, is rapidly coming into general favor.

Among the numerous features that recommend pumps of this type are their low first cost, the small space which they occupy, the light foundations needed, and the limited amount of attention that they require. They are safe to operate, because they will produce no more than approximately the maximum pressure for which they are designed, even if the delivery is almost or entirely stopped by the closing of the valves in the discharge pipe. They are also able to handle gritty waters, and, when made of acid resisting materials, to handle acidulous, corrosive or viscous fluids to good advantage.



INDUCTION MOTOR DRIVING THREE-STAGE CENTRIFUGAL PUMP.

The Allis-Chalmers Company, of Milwaukee, one of whose small units is illustrated herewith, designs these pumps for any capacity and conditions of service within the range of their adaptability, and the construction of each is planned with careful reference to the requirements of the service for which it is intended. They may be used in mining operations, for irrigation work, for auxiliary pumping stations in cities, for municipal fire service, for feeding boilers, or for any other service of a similar nature.

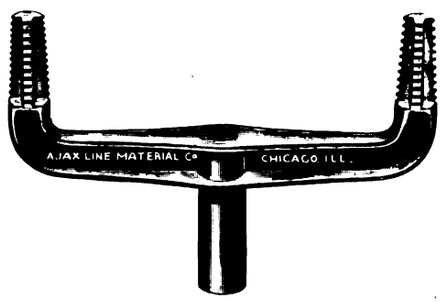
The pumps are built with as many runners as there are stages through which the water is required to be handled, each stage raising the total required quantity of water through its proportion of the total net head. The runners are designed after the well-known "enclosed" type, the water entering and leaving each runner axially. All of the runners are mounted on a common shaft. A stationary guide wheel is introduced between each runner, the function of this wheel being to take the water from the tips of the vanes of one runner and conduct it through suitably designed passages to the inlet side of the succeeding or next runner. After the water has passed through the last runner it is guided into the volute-shaped casing. Particular attention is given to securing for these pumps' casings of smooth surface, free from irregularities, in order to reduce the hydraulic friction to a minimum; and of those portions of the interior of the pump casing and runners through which the water passes at high velocity all accessible parts are machined. The waterways are of relatively large area, and the contour of the vanes is such as to produce the best results for the particular service required. The pump remains in lateral balance under varying loads and conditions. When properly adjusted, those pumps will run smoothly, without undue jar or vibration, and care has been taken in their design to secure the highest possible efficiency, strength, durability and accessibility.

The pumps may be driven either by induction or direct-current motors. Both pump and motor are mounted on a common bedplate.

The electrically driven pump has a number of important advantages. One of these is that, on account of the high rotative speed, less work needs to be done for each revolution, thus reducing the size of the unit. Pumps directly connected to electric motors are also flexible in their operation. As the speed is constant, the power and output are in inverse ratio to the head pumped against, so that the efficiency remains practically constant within the limits of which the pump is designed. Then, too, the speed necessary for operating under high heads can be obtained without increasing the impeller diameter of the pump to such an extent as to render its construction impracticable. Further, it sometimes becomes necessary to erect pumping machinery at a distance from the source of power, and in such cases the use of electric current greatly simplifies the problem of construction.

New Cleats and Break-Arms.

Believing that there is room for improvement even in quite familiar types of electric line material, the Ajax Line Material Company, of Chicago, Ill., is supplementing its line of original insulators and fixtures with improved types of older devices. Two of these are pictured herewith, both showing how neater forms can be obtained without sacrificing strength or increasing the cost. The "Cast Pin Break-Arm" has the usual twelve-inch spread, while the Ajax cleat has a nine-inch length (an inch more than usual) and hence will take a greater length of hoisting rope. Besides, it has a curved back, so that it will not rock on the pole, while the galvanized finish makes it extra durable.



CAST PIN BREAK-ARM.

NEW LINE CLEAT.

Digitized by Google

A New Line of Alternators.

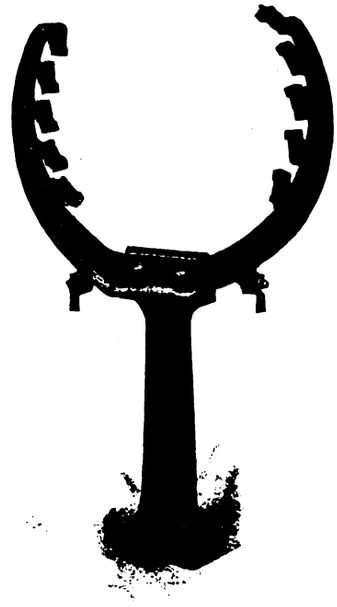
The first and simplest form of electric generator, a single coil rotating between two magnetic poles of opposite polarity, was essentially an alternator. As the chemical generator, or battery, preceded the mechanical generator, or dynamo, the early conception was of a unidirectional current. Hence, the commutator was added to the early dynamo, and little use was found for alternating current. The modern trend of electric development, however, toward distant transmission and higher voltages has made the alternating current, with its advantages of transformation, greater simplicity in generating apparatus, and greater ease in insulating the stationary generator coils, a prevailing form in which electrical energy is now transmitted when any great distance is to be covered.

"R" Design, Engine-Type Alternator.

The Western Electric Company, in addition to its already developed line of direct-current apparatus, has just completed the design of a line of alternating-current generators. A number of machines have been installed during the past year and are giving the best of satisfaction.

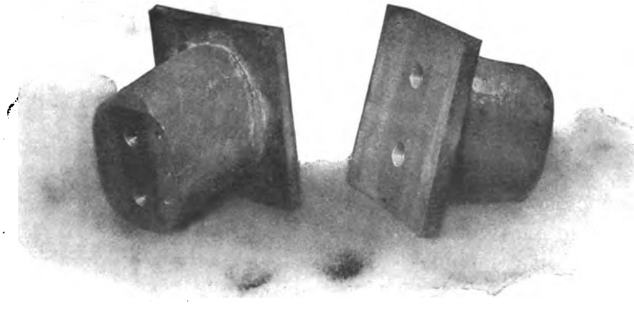
The position of a company with the facilities and experience of the Western Electric Company in taking up the manufacture of alternators at this time is particularly fortunate. The stage of development during which all sorts of alternator designs were evolved and placed upon the market is past, and now a standard form of alternator, having a stationary armature and an internal revolving field separately excited by direct current, has come to be the generally accepted type. After carefully studying the conditions which prevail in the high-voltage alternating-current apparatus, this company is now producing and installing a line of alternators in all of the standard types, speeds and frequencies which it confidently believes to be of the best design and construction. With no old and obsolete patterns and dies to hamper the design, and with a general knowledge of the present-day class of machines, a complete line has been laid out in which each part is the best that can be produced under any conditions, and the best adapted to its particular function.

From the standpoint of the purchaser,



Brush Rigging for Revolving Field

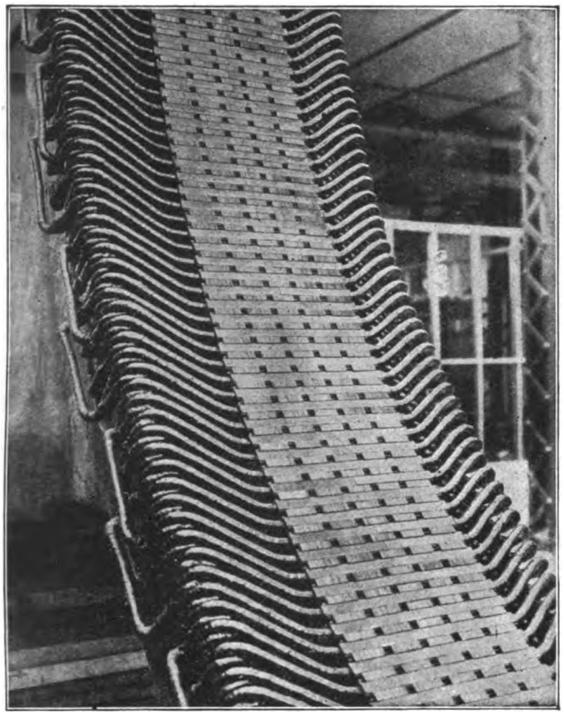
Type of Pole-Piece Used in the Larger Machines of the "R" Design.



Type of Pole-Piece Core Used in the Smaller Machines of the "R" Design

Digitized by Google

the three most important features considered in selecting an alternator are heating, regulation and efficiency. These features are given especial consideration in the design and manufacture of Western Electric alternators.



STATOR OR ARMATURE WINDING, SHOWING VENTILATING SPACES.

The heating is kept low by a generous design of those parts developing heat. The working densities are low and the radiating surfaces large. All coils are so constructed as to have unusually good heat-conducting properties, and an open construction ensures excellent ventilation.

Specially good regulation is obtained by so proportioning the parts of the machines as to reduce the two quantities which tend to cause poor regulation. The local self-induction of the armature circuit, and the back and cross-magnetizing tendency of the armature current, are reduced to a minimum. Self-induction is reduced to a minimum by the use of windings as widely distributed as possible, shallow open armature slots, and such a form of armature connection as will minimize the local leakage. The back and cross-magnetization of the armature current is also reduced by this distribution of the windings and by the form of end connections. Large running clearance is used, thus improving the regulation by reason of a greater excitation being required, and a consequent stiffer field. The efficiencies of these alternators are high. Depending as they do upon the copper and iron losses in the engine type, and the copper, iron and frictional losses in other types, a careful proportioning of these losses has produced machines with high efficiencies. While good ventilation is a feature, in no case is this taken advantage of to reduce the active material so as to impair efficiencies.

The result of the prevailing methods of alternator drive has been the placing on the market of three types of machines: the belted type, the water-wheel type and the engine type.

In the Western Electric Company's belted type, of the smaller capacities, the armature or stator is mounted in a cast-iron frame made of unusual width and stiffness, in order to carry the bearing brackets and resist the twisting moment due to the belt pull. Slide-rails and adjusting screws are provided for belt adjustment. The bearings are supported by brackets attached to the lower half of the armature frame only. Light removable shields are fastened to the upper part of the frame. This construction permits of easy access to the machine and easy removal of the bearing caps.

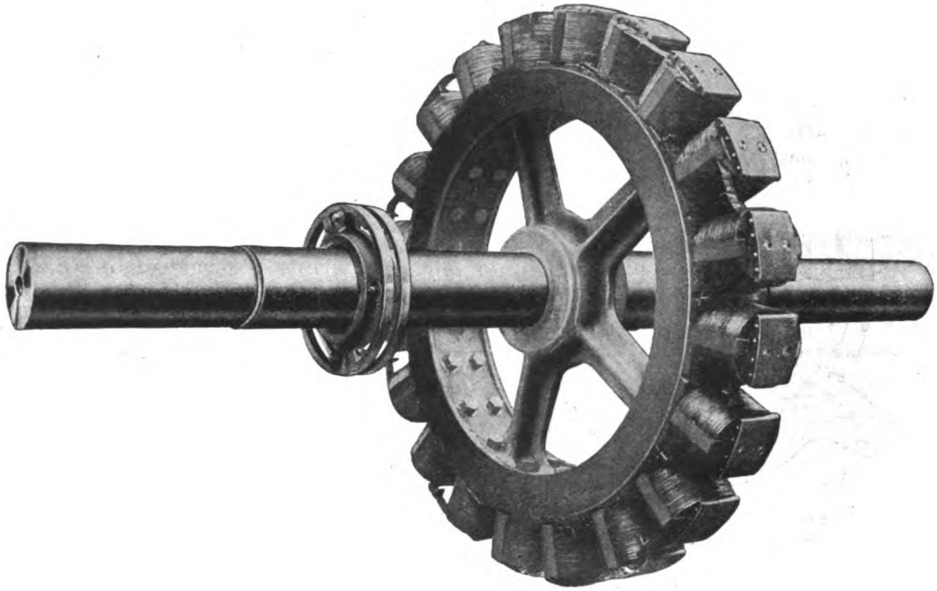
For larger sizes, the belted type is built with separate base and pedestal bearings; in most cases using three bearings. Slide-rails, similar to those of the bracket type, are used.

The smaller water-wheel type is similar to the smaller belted type. The larger capacity is built with separate base and two pedestal bearings. The shaft at one end receives the water-wheel coupling, and at the other end an exciter pulley if such is used.

In the engine-type machine the armature is supported in a cast-iron frame of the deep box girder section. This frame rests at each side on a sole-plate and subbase. When it is required to slide the armature parallel to the engine shaft, this subbase is made sufficiently long, and suitable jack-screws are furnished. When the shifting of the frame is not required, the sole-plate is omitted, and the frame rests directly upon the subbase, which is then made shorter. The rotor, in this type, is mounted directly upon the engine shaft.

Throughout the several types, in constructional details, those types which have been found by experience to be most desirable have been adopted, and, in some cases, new or improved ones introduced.

The cast-iron armature frames are made in one piece for the belted and medium-sized machines; for the larger engine-type machines they are divided horizontally, being secured at the joints by heavy eye-bolts and keys or dowels.

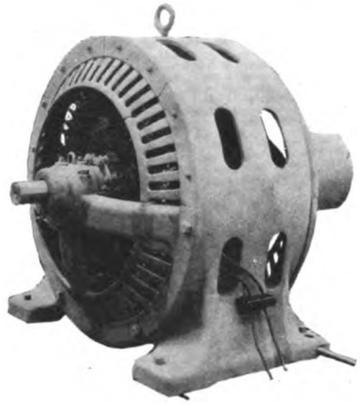


COMPLETE ROTOR WITH LAMINATED POLE PIECES THIS CONSTRUCTION IS USED ON THE SMALLER MACHINES OF THE "R" DESIGN.

In some of the larger diameter of engine-type machines the armature is divided into quarters, preferably at forty-five degrees from the horizontal or vertical line. Special attention is given in the design of

Digitized by Google

armature frames, to allow for free circulation of air in and around the armature coils and core. In the larger diameters, stiffness is insured by a deep section and large amount of inertia, so that the de-

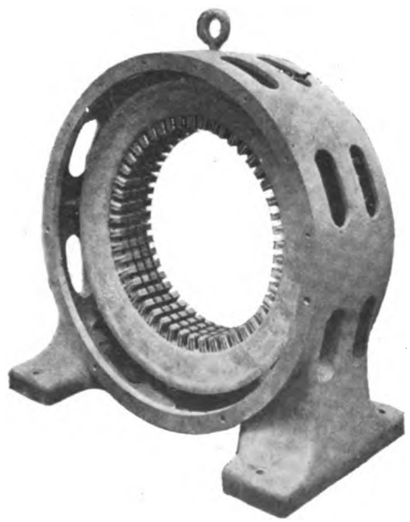


"S" Design, Belted Type Induction Motor.

flection of the frame, either from its own weight or the unbalanced magnetic pull of an eccentric armature, can not occur.

On the larger machines a copper-strip field is used. The strip is wound on edge and exposes its outer surface to the air, bringing the flat surface of the strip into the best position to resist the strains to which it is subjected.

The rotor construction on the belted and high-speed water-wheel machines is entirely of laminated steel. The poles are built up of thin sheets, in order to minimize the iron losses due to the armature slots. The pole-face is curved to produce a widening gap from the centre of the



"S" Design, Belted Type Induction Motor.

pole-face outward to distribute the magnetic field so as to generate a sinusoidal electromotive-force wave. The inner end of the pole forms a dovetail or "T" projection which is held in a corresponding slot in the laminated centre by means of double tapered keys. This construction permits of easy removal of the poles for repairs. The field centre is built of heavy laminations, and is homogeneous in structure, and insures uniform strength and good running balance. In the medium-speed machines of the larger sizes the field centre is made of one steel casting, and the laminated poles are dovetailed and keyed in place.

The rotor of the slow-speed and engine-type machines consists of a centre or spider of cast steel, and poles of cast steel bolted to the rim. The pole tips are laminated, and secured by a dovetail to the pole core. The pole-face is curved, the same as mentioned above. The rotor spiders are made solid, and pressed on the shaft in smaller machines of this type, and in the larger capacity the fields may be split.

Carbon brushes are used, several to each collector ring. The collector rings are of a special grade of cast iron.

In the belted and water-wheel machines the shaft is a solid-steel forging, and of large diameter to carry the weight of the revolving field, and resist possible magnetic pull, due to the eccentric wearing of the bearings.

The journals are of ample design for cool running, and are carefully turned and fitted. Special oil grooves are provided in the shaft to prevent creeping and oil throwing, so common in high-speed machines. The bearings are lined with the best quality of babbitt metal, and have from two to four oil rings, according to the size. Large oil wells are provided.

Another Electric Motor Conquest.

New industries are constantly joining the ranks of those operated by electricity. The adaptability, economy and general efficiency of this form of machine driving have led to its installation not only in the more ordinary manufactories but in the less known fields of various classes of work. One of the most recent establishments to adopt this method of drive, is the Archer Daniels Linseed Company, of Minneapolis, Minn. The process of making linseed oil and cake from the raw material is very interesting and the induction motor has been found to adapt itself perfectly to the cycle of operations.

The first step in the process in which the motor has been adopted is at the storage bins. The raw material, flax-seed, is elevated by a thirty horse-power induction motor to the cleaning room. Here, the seed is freed from dust and dirt by motor driven fans, the refuse being sucked up and carried to the waste-bins by exhaust fans driven by the same means. The flax-seed then goes to the grinding mill, the elevator and conveyers being motor driven. The grinder is operated by a sixty horse-power 2,300-volt induction motor, and the seed is reduced to meal of about the fineness of graham flour. The flour is then cooked about an hour and a half in steam jacketed kettles, and the oil is expressed by hydraulic presses, the pumps for which are driven by induction motors. From the presses the oil is pumped first to large vats, then filtered to tanks on a lower level, and again pumped to storage tanks. All these various pumps are driven by induction motors.

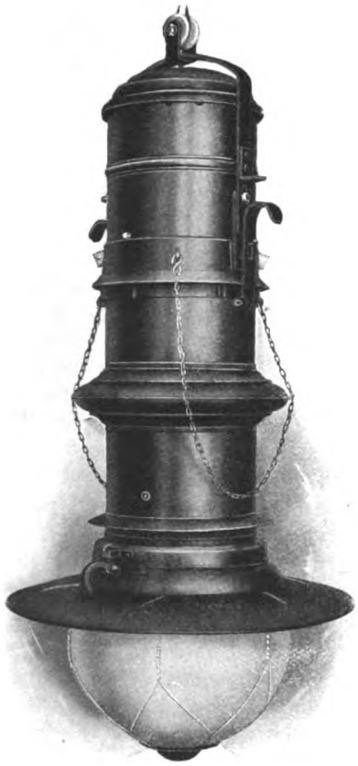
The switching and wiring arrangements in this establishment are very complete. All the motors of thirty-five horse-power and over are operated directly at 2,300 volts, the connections being made through three-phase lead-covered cable in iron conduit. Each motor has a controlling panel, and these are grouped on the different floors so that all the motors in one department can be controlled from one point. The central controlling panel is located in the basement which receives the power from the transmission lines at 2,300 volts and distributes it through non-automatic oil switches and expulsion fuses to the various motors in the building. In an annex outside the main building a fifty-six kilowatt, three-phase transformer is installed for supplying current to the 200-volt induction motors of small power. In this same transformer house there is also a twenty-kilowatt single-pole transformer arranged for lighting the building. The current for the transformers is first brought to the main switchboard and then distributed to them through oil switches. From the transformers the wires run directly to the small motor and lighting panels. The complete electrical equipment of this unique plant was furnished by the General Electric Company.

The Derby Gas Company, Derby, Ct., through its engineers, W. S. Barstow & Company, has recently purchased from the General Electric Company two mercury arc rectifier sets. These sets are to be used with the present enclosed direct-current arc lamps, but are so designed that later on they can be used with magnetite arc lamps. Mr. Barstow arranged some time ago with the General Electric Company for a complete installation of mercury arc reteifiers and 1,200 magnetite lamps for the Portland General Electric Company, and these are now in operation.

Digitized by Google

New Flame Arc Lamps.

The Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., has recently placed on the market a flame arc lamp known as the Stanley-G. I. "Brilliant." These lamps are made for either alternating-current or direct-current circuits, both types being of the converging carbon construction, *i.e.*, both carbons feed downward toward each other so as to focus the arc at the same point; thereby eliminating shadows and preventing the



STANLEY-G. I. FLAME ARC LAMP.

formation of non-conducting slag at the carbon tips.

The mechanism of the direct-current lamp is of the differential magnet type, while that of the alternating-current lamp is of the differential disc motor type; the carbons in both cases being regulated by chain feed. Both types are designed, adjusted and carried in stock to burn two in series on 110-volt circuits—standard resistance being furnished with the direct-current and a reactance coil with the alternating-current lamps. All lamps are adjusted for twelve amperes, and an arc voltage of forty-five. Both golden yellow and white light carbons can be used on the direct-current lamps, but golden yellow only will be furnished for the alternating-current lamps.

The weatherproof steel castings, finished in bright japan, are the same for either lamp and are interchangeable. The feeding mechanism is contained in a separate compartment of the case, so carefully partitioned off from the arc that it is unaffected by the heat or loose slag.

Homer Commutators.

The Homer Commutator Company, Cleveland, Ohio, has equipped a complete factory devoted exclusively to the manufacturing of commutators. The company states that this is the only factory in the world devoted exclusively to this line of material. The Homer commutators are manufactured under modern shop methods from pure Lake Superior copper, and of the best insulation that the world's source of supply can furnish. These commutators are the subject of specialized workmanship. Only expert commutator builders who know how to build commutators that are right and stay right, and who have served long years of apprenticeship, are allowed to build the Homer commutators.

The heart of a perfect commutator is the manner in which it fits the shell. An imperfectly fitting commutator is never tight, wears only a short time, and causes all kinds of motor troubles. The Homer commutators, the company claims, are made under the only correct system, by which every commutator must fit the shell for which it is intended. When once placed in a motor it is seldom removed until the commutator is worn out. These commutators have a great length of life, as is demonstrated by their use by street railway companies throughout the country.

The Homer factory is equipped to build anything in the commutator line, from small fan motor commutators to the largest direct-current generator commutators.

The company's sales department is mailing to every street railway in the United States and Canada a monthly commutator bulletin giving valuable information to purchasing agents. Besides quoting prices on all standard street railway motor commutators, it gives the weights and diameters of the wiring surface on all assembled commutators. A large stock is constantly carried, so that immediate shipments are available. The company recently booked an order for an assembled commutator for a Walker 400-kilowatt generator that is over sixty inches in diameter, delivery to be effected in less than three weeks. In addition to this the factory is crowded with orders for commutators for street railway motors, making it necessary to ship over 200 commutators every week.

Copper Production—Increase in the United States.

A table giving an estimate of the production of copper in the various sections of this country compared with the government report of production in 1905 has recently been published. According to these returns the production during the current year will show an increase of about eleven per cent over the 1905 output, but the increase in production over the rate of output during the last few months of 1905 is small, if any. The developments of the next few months may change the estimate in the table given herewith.

UNITED STATES PRODUCTION.

Source.	1906.	1905.	Source.	1906.	1905.
	Pounds.	Pounds.		Pounds.	Pounds.
Montana	340,000,000	314,750,612	Colorado	10,000,000	9,404,830
Arizona	300,000,000	236,627,535	Wyoming, Idaho, etc.	7,000,000	5,944,180
Lake Superior	230,000,000	230,287,992	Alaska	5,000,000	5,000,853
Utah	65,000,000	63,947,261			
California	30,000,000	15,367,106	Total	1,005,000,000	901,630,998
Tennessee and South.	18,000,000	14,655,504			

COPPER IMPORTS, 1906.

		Pounds.
Mexico		120,000,000
Canada		40,000,000
Other Countries		65,000,000
Total		225,000,000
Mexico output		160,000,000
United States production, 1906		1,005,000,000
Imports, 1906		225,000,000
Total supplies, 1906		1,230,000,000
	Pounds.	
Domestic consumption	720,000,000	
Exports	500,000,000	
Total consumption		1,220,000,000
Reserves, January 1, 1907		10,000,000

To which must be added residual supply held on January 1, 1906

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

MILLION-DOLLAR MICHIGAN ELECTRIC LINE—Articles of incorporation of the Jackson, Ann Arbor & Detroit Electric Railway Company have been filed, the authorized capital being put at $1,900,000, and the company being empowered to secure by purchase or construction a line of railway from Jackson to Detroit, a distance of ninety miles. The incorporators are: W. A. Boland and N. S. Potter, of Jackson; H. R. Corse and Charles W. Osborne, of New York city, and C. M. Booth, of East Orange, N. J.

NEW WISCONSIN ELECTRIC ROAD—D. McAllister, ex-president of the Metropolitan Elevated, of Chicago, Ill., is head of a syndicate that is projecting an interurban electric road from Chicago to Madison, Wis. H. H. Clough is associated with Mr. McAllister in the enterprise. Business men of Madison have been assured that the new line will be completed from Janesville to Madison *via* Stroughton as soon as material and labor can be secured, the financing of the Wisconsin section having been arranged for.

ANOTHER NEW YORK ELECTRIC LINE—The Essex County Traction Company has been incorporated at Albany, N. Y., with a capital of $1,500,000, to construct an electric road forty-one miles long from Westport, on Lake Champlain, to Newman, Essex county, running through Elizabethtown. The principal office is at Ausable Forks. The directors are: Albert L. Washburn, Norman C. Spencer, Wilbur T. Holliday, E. S. Goodrich, of Hartford, Ct.; William L. Miley and Thomas D. Trumbull, of Glens Falls, and R. L. Trumbull, of Ausable Forks.

POWER PLANT FOR THE ST. JOSEPH RIVER, ST. JOSEPH, MICH.—A franchise has been granted to Charles A. Chapin, Chicago, Ill., by the St. Joseph (Mich.) board of supervisors for the construction of a dam across the St. Joseph river near Berrien Springs. The work will cost $750,000, and a force of 200 men will be employed for two years to complete the construction. Operations will begin this fall. The Chapin interests are pioneers in water-power business on the St. Joseph river. The company now owns dams and power stations at Penn Island and at Niles and Buchanan.

ORGANIZATION OF THE TWIN STATE GAS AND ELECTRIC COMPANY—The Twin State Gas and Electric Company has been incorporated at Hartford, Ct., with a capitalization of $1,750,000. This company will be controlled by the National Light, Heat and Power Company, of New York. The company has been organized for the specific purpose of taking over and operating twelve electric light companies and railroad plants. These plants are located at Dover, Rochester, Somersworth, Salmon Falls and Hinsdale, in New Hampshire; Berwick, North Berwick, South Berwick and Lebanon, in Maine, and Brattleboro, Vt.

WYOMING POWER ENTERPRISE—The Asmus Boysen Mining Company has been granted a permit to divert the water of the Big Horn river at Thermopolis, Wyo., for power purposes. The company will erect a reenforced concrete dam which, it is expected, will develop at least 4,000 horse-power. The power is to be used in working the company's mines, which were taken up under special act of Congress opening the Shoshone reservation. It is expected that power will also be furnished to mines owned by other companies on Copper Mountain. The company is considering the advisability of a trolley line from Thermopolis to a connection with the Northwestern Railroad, probably at Shoshone.

NEW ENGLAND INVESTMENT AND SECURITY COMPANY—It is anounced that the New England Investment and Security Company, which has taken over the greater part of the trolley roads in Massachusetts formerly owned by the Consolidated Railway Company, a subsidiary company of the New York, New Haven & Hartford Railroad Company, has issued to the Consolidated Railway Company, in payment for its properties, promissory notes and all its preferred and common stock, the outstanding stock issue amounting to $10,000,000 preferred and $10,000,000 common. The Consolidated Railway Company has guaranteed four per cent dividends on the preferred stock and $105 per share in case of liquidation. Under the agreement with the bankers the Consolidated Railway Company, it is stated, will receive the proceeds of the sale of the common shares in consideration of its affixing its guarantee to the preferred shares.

THE COMMERCIAL CABLE COMPANY, OF CUBA—The certificate of incorporation of the Commercial Cable Company, of Cuba, has been filed at Albany, N. Y. The names of the incorporators are: Clarence H. Mackay, William W. Cook, Albert B. Chandler, Dumont Clarke, Samuel S. Dickenson, George Clapperton and Albert Beck. These men are also the directors. The Commercial Cable Company, of Cuba, has been organized by the Mackay Companies to lay two cables from the United States to Cuba. The monopoly which the Spanish government granted to the Western Union Telegraph Company, forty years ago, expires on December 6, 1906. The plan is to lay two cables from Havana to Key West and thence from Key West to Florida, and to provide special wires from Florida to New York city. The new line will be operated in connection with the Postal Telegraph and Commercial cables, and it is expected that the system will be open for business early in December of this year.

EDUCATIONAL NOTE.

EVENING COURSES AT DREXEL INSTITUTE, PHILADELPHIA—Drexel Institute, Philadelphia, Pa., has prepared a special announcement circular of evening courses in engineering subjects. The institute is endeavoring to meet the needs of young men who can not, for various reasons, undertake a complete day course in engineering. During the coming season complete engineering courses covering four consecutive winters of work are offered. A number of groups have been planned, from which to make selection, each of which leads to a formal certificate granted by the faculty of engineering. The evening courses include engineering drawing, mechanics and heat, elements of chemistry, engineering electricity, advanced engineering electricity, strength of materials and machine design, advanced strength of materials and machine design, thermodynamics and steam engineering, plain surveying, advanced surveying, applied electricity, elementary mechanical engineering, telephony and advanced telephony. The registrar or the director, Arthur J. Rowland, will be pleased to give full information to any one interested in this matter.

DATES AHEAD.

American Electrochemical Society. New York city, October 8 and 9.

American Institute of Electrical Engineers. New York city, September 28.

American Society of Municipal Improvements. Birmingham, Ala., October 2-4.

American Street and Interurban Railway Engineering Association; American Street and Interurban Railway Association. Columbus, Ohio, October 15-19.

Empire State Gas and Electrical Association. New York city, October 12.

Kansas Gas, Water and Electric Light Association. Lawrence, Kan., October 16-17.

Michigan State Electric Association. Grand Rapids, Mich., October 10-12.

National Machine Tool Builders' Association. New York city, October 23-24.

Old Time Telegraphers' and Historical Society. Washington, D. C., October 9, 10 and 11.

Railway Signal Association. Annual meeting, Washington, D. C., New Willard, October 16, 17 and 18.

Digitized by Google

ELECTRIC RAILWAYS.

WEBSTER CITY, IOWA—The city council has granted a franchise to the Boone, Webster City & Interurban Company, giving a tax exemption of five years.

CONEMAUGH, PA.—The Conemaugh council has granted to the Conemaugh Valley Railroad Company a franchise to lay tracks and erect wires on certain of the town streets.

PEORIA, ILL.—The Alton, Jacksonville & Peoria Railway Company has increased its capital stock from $10,000 to $300,000, notice of increase being filed in both Pekin and Peoria.

WALLA WALLA, WASH.—It is announced that the Walla Walla-Milton interurban electric line will be in operation between Walla Walla and Milton, eleven miles, by December 1.

KANSAS CITY, MO.—The power-house of the Kansas City & Leavenworth Electric Railway, at Wolcott, Kan., burned September 3 with all its machinery. The loss is $300,000.

DAVENPORT, WASH.—A. W. Turner, of Davenport, announces that the line of the Big Bend Transit Company from Spokane into the Big Bend country will be in operation the coming year.

FAYETTEVILLE, W. VA.—The Fayette & Fayetteville Electric Railway Company has closed a contract with T. E. Martin for the erection of an electric power-house at Fayetteville for a proposed railway, at a cost of $26,700.

OGDEN, UTAH—A contract has been closed between the Ogden Rapid Transit Company and the Utah Light and Railway Company whereby the latter company furnishes motive power to the transit company for a period of seven years.

FAYETTEVILLE, N. C.—Application has been made to the board of aldermen for a franchise to construct and operate a street-railway system in Fayetteville. The grantees named are: W. D. McNeill, J. H. Anderson, John F. Harrison and W. E. Kindley.

SPOKANE, WASH.—D. L. Huntington, general manager of the Washington Water Power Company, has placed an order with the J. G. Brill Company, Philadelphia, for seventeen cars for the Medical Lake and city lines. Delivery is expected the coming fall.

HATTIESBURG, MISS.—President H. L. Camp, of Hattiesburg Light and Traction Company, which company is about to lay a street railway line in Hattiesburg, has given out the route that will be followed by the road. About five miles of track will be put down at once.

FORT ERIE, N. Y.—The Toronto, Niagara & Buffalo Electric Railway has made application to the Fort Erie council for a franchise through the village, the road to be completed in six months. The railway will run to Niagara-on-the-Lake, connecting also with the road to Hamilton and Toronto.

MARTINEZ, CAL.—An electric railroad to connect the town of Black Diamond with the Bowers Rubber Works and the railway stations is the latest project contemplated by C. A. Hooper & Company, of Black Diamond. It is proposed to extend the line from the Bowers plant and the Redwood Manufacturing Company's mill to the town.

GREENVILLE, MISS.—The Greenville & Leland Railroad Company has filed official notice of organization with the authorities of Mississippi. The company plans to build an interurban electric road between Greenville and Leland, and it is said that financial arrangements have already been completed. The company will have $300,000 capital stock.

LOWELL, MASS.—The Lowell & Woburn Street Railway Company has petitioned the Massachusetts railroad commissioners to issue $90,000 additional capital stock to take an equal amount of mortgage bonds of the Lowell & Boston Street Railway Company, the predecessor of this company. The new company's capital stock at present outstanding is $53,200.

PORTSMOUTH, N. H.—The Atlantic Shore Line contemplates building a new electric railroad from South Berwick through North Berwick village, Bauneg Beg to Sanford. A survey has been made, and construction will be commenced as soon as the line from York to Kennebunk is completed. The new road will open up a large territory, including Bauneg Beg Lake.

BATON ROUGE, LA.—M. Osgood Orton, chief engineer and promoter, and H. V. Mielly, right-of-way agent, both representing the Baton Rouge-New Orleans Electric Railway Company, are making final preparations for the commencement of work on the proposed line between this city and New Orleans. It is the purpose of the company to begin work about the first of November.

LIMA, OHIO—The Western Ohio Railway Company will take over the Lima, Findlay & Toledo Traction Company, issuing $400,000 six per cent cumulative preferred stock in exchange for the same amount of preferred of the Lima & Findlay line outstanding. The Western Ohio has for some time owned all the common stock of the other company, and the change will result in an absolute merger.

CUMBERLAND, MD.—The Meyersdale council has revoked the franchise of the Meyersdale & Salisbury Street Railway Company and has granted a franchise to the Maryland & Pennsylvania Street Railway Company, in which C. H. Jennings, of Jennings, Garrett county, Md., is prominently interested. It is proposed to build a line connecting Meyersdale, Somerset, Frostburg, Md., and points in the Meyersdale coal region.

JACKSON, MISS.—Official notice has been received of the organization of the Greenville & Leeland Railroad Company, an electric line that is to traverse a dozen or more miles of Washington county. The road is capitalized at $300,000, and the directors are: J. R. Robertshaw, W. H. Hunt, Henry Crittenden, Arthur Hider, Alfred Shields, E. A. Dalton, Morris Rosenstock, Edward Holland, John L. Hebron, Nathan Goldstein and W. A. Everman.

WHEELING, W. VA.—The organization of the new Rapid Transit Railway has been perfected, and plans decided upon in regard to the securing of right of way and franchises in order that work may be started this fall and pushed through to completion. Albert Shenck, of F. Shenck & Sons, has been elected president, with A. S. List, vice-president, and George Folmar, secretary-treasurer. The directors are: Albert Shenck, A. S. List, George Folmar, Otto Shenck and J. V. Braden.

MUSCATINE, IOWA—The City Railway and Light Company, of Muscatine, has been sold to Child, Hulswit & Company, of Grand Rapids, Mich. The price paid for the exchange of the properties has not been given out, but it is estimated to be in the neighborhood of $500,000. The interests were formerly owned by the Western Gas and Development Company, of Chicago, of which H. W. Huttig, of Muscatine, is president. No local capital will be interested in the new company, Mr. Huttig retiring absolutely.

MACON, GA.—The Macon Railway and Light Company has installed $100,000 worth of new machinery. The apparatus consists of a 2,500-horse-power turbine, a 1,000-horse-power boiler, pumps, condensers and switchboards for controlling the distribution of the current, and the accessories that go with the apparatus mentioned. It is understood that the additional equipment will furnish power enough to run the cars and the lights for years, the expected increase in business being taken into consideration.

ARKANSAS CITY, KAN.—The Kansas-Oklahoma interurban railway, which was to have been built by eastern capitalists, is being revived. The concern which started out to finance the road dropped it because of a lack of funds. Now another company of capitalists has begun buying up the right of way which had been secured by the former concern. Options have also been secured on the present street-car lines in Arkansas City and Winfield. The proposed line extends from Arkansas City to Winfield, Geuda Springs and Chilocco.

LEXINGTON, KY.—A party of local capitalists, interested in the building of electric roads to connect Lexington with the smaller towns in central Kentucky, recently made a tour of the proposed route to North Middletown, Bourbon county. It is proposed to build a line by way of Clintonville, and as the citizens of both points are anxious to have the road built, it is likely surveyors will be put to work in the near future. The party was composed of County Judge Bullock, Mayor Combs, John Skain, M. C. Alford,

Digitized by Google

Major P. P. Johnston, J. W. Rodes, D. F. Frazee, J. W. Porter and Magistrate Skinner.

ISLIP, N. Y.—James T. Wood, as president of the Cross-Island Traction Company, has filed with the town board an application for a franchise to build and operate an electric road, east from the Brookhaven line, through Bayport and Sayville and north to Lakeland and the village of Ronkonkoma. The route is a very circuitous one, and the application asks for permission to make connection at any and all points. The company offers to put up a $10,000 bond to render the town harmless while the road is being constructed, and also agrees to strengthen all bridges over which the road passes and pay one-third of the cost of maintaining the same.

RADFORD, VA.—Pearisburg is to have an electric railway and electric lights. The stock has all been subscribed, and the following officers have been elected: Charles T. Painter, president; T. J. Pearson, vice-president; M. P. Farrier, secretary and treasurer; directors, C. T. Painter, T. J. Pearson, M. F. Farrier, Martin Williams, John W. Williams, Barnard Mason and J. H. Woodrum. The company will erect a large stone dam at the mouth of Walker's creek, near Pearisburg, which will furnish many thousand horsepower for railway, lights and manufacturing establishments. The electric railway will extend from the Norfolk & Western station to the town.

BUFFALO, N. Y.—According to announcements Buffalo and Angola will be connected by trolley this fall. J. C. Calish, manager of the proposed line, states that the contract for construction has been let to L. E. Myers, of Chicago, and that the link will cost between $300,000 and $500,000. The road, which will be controlled by the Sheehan-Mayer interests, will be built along the Hamburg turnpike, and will touch all the important intermediate towns. The Hamburg line will be a portion of the road. Directly after the close of the Chautauqua County Fair the work of improving the Dunkirk & Fredonia road and constructing the Dunkirk Belt Line will be commenced.

FREDERICK, MD.—Construction of a trolley line between Braddock Heights and Jefferson has been begun by the Braddock Heights & Jefferson Railroad Company. The new line will be three and one-half miles long and will run along the summit of the Catoctin Mountain, through a rich section of Frederick county. Westinghouse, Church, Kerr & Company are building the road, and its completion is expected by the first of the year. It is the ultimate intention to extend the road on from Jefferson to Brunswick, where it will intersect the Baltimore & Ohio Railroad, but this latter extension largely depends upon the attitude of the citizens of Brunswick toward the new road.

BOONE, IOWA—The organization of a company to build an interurban railway from Boone to Webster City, connecting with the line from Des Moines to Boone, has been completed, and the new company will spend about $500,000 in building and equipping the line. The company is to be known as the Boone-Webster City Interurban Railway Company. The president is E. E. Hughes, who built the Davenport, Rock Island & Northwestern and the Ozark & Cherokee railroads. John C. Regan, of Des Moines, is vice-president; John S. Crooks, who secured the right of way for the Newton & Northwestern, is secretary, and J. H. Herman, cashier of the First National Bank, of Boone, is treasurer.

EASTON, MD.—The directors of the Peninsula Traction Company, of Talbot county, which was chartered last fall, have organized by electing Ernest P. Fink, of Philadelphia, president; General Joseph B. Seth, of Easton, vice-president; Robert A. Orbison, of Philadelphia, treasurer; Charles R. Wooters, of Easton, secretary. The secretary was authorized to open the books for subscriptions to stock, which is limited to $1,000,000. The first branch of the road to be constructed will be from a point on Tilghman's Island bordering on the Chesapeake bay through the principal towns and villages in Talbot, Caroline, Dorchester, Wicomico and Worcester counties, with a terminus at Ocean City, Md. At the time this road is being constructed a branch will be built, beginning at Cambridge ferry, on the Choptank river, opposite Cambridge, and running from there through Trappe, Hambleton and other places connecting with the main line at Easton. After the construction of these lines a line will be built running from Easton to Longwood. Wye Mills, Skipton, Centreville, Chestertown and other towns north of Easton in Talbot, Queen Anne's and Kent counties, and thence to the cities of Philadelphia and Baltimore.

DENVER, COL.—The Colorado & Southern Railway is considering the purchase of a reservoir site in Estes park to be utilized in creating electric power for the operation of some of the proposed electric lines in northern Colorado. Power for the Denver-Boulder line will be purchased from the Northern Colorado Power Company, but for the present the Colorado & Southern will make no more contracts with the concern, but will try to obtain power from a plant of its own. The Colorado & Southern contemplates the construction of electric lines as far north as Fort Collins, with branch lines to Estes park and other points where business is increasing. All the agricultural sections within a radius of twenty miles of Denver will soon be tapped by electric lines built by the Colorado & Southern.

AUGUSTA, ME.—Announcement has been made at the office of the board of railroad commissioners of the granting by the board of the petition of the Eastern Traction Company, asking the approval by the board of the location, distances and boundaries of a proposed street railway from Bangor to Dexter. The proposed road will run from the city of Bangor through the towns of Hermon, Levant, Stetson, Exeter, Garland and into the town of Dexter, and the length of the road will be thirty-five miles. The capital stock of the corporation is $180,000, divided into 1,800 shares, the par value of the shares being $100 each. The stockholders, each of whom owns 300 shares of stock, are as follows: Forest J. Martin, of Bangor; Charles W. Mullen, of Bangor; Fred T. Dow, of Bangor; H. Franklin Bailey, of Old Town; Edgar B. Weeks, of Old Town, and William H. Whitehouse, of Old Town. The directors are: Forest J. Martin, Fred T. Dow, H. Franklin Bailey and Charles W. Mullen.

PORTLAND, ME.—Stock has been subscribed for the proposed electric road from Cumberland Mills to Bridgton *via* Naples, and a petition for a charter is now in the hands of the commissioners. The road is to be known as the Portland & Northern Railroad, and will engage in a general passenger and freight-carrying business. The plan is to start the road on Foster street at Cumberland Mills, near the Maine Central Railroad, running thence to Duck Pond, Westbrook and then to Windham Centre up the Meadow road to Casco village and thence to Naples village and Bridgton, covering a route of between thirty and thirty-eight miles. It is proposed to issue 1,200 shares of stock of the par value of $100, which has already been subscribed and the majority of it paid into the treasury. The stock has been taken by prominent citizens in the towns through which the road is to run, a portion of the money being furnished by merchants in Portland. The association as it now exists consists of Sumner O. Hancock, of Casco; Richard Cook, of Casco; County Commissioner Edward M. Mason, of Raymond; Ephraim B. Jillson, of Otisfield; Henry W. Evans, of Denmark; Walter W. Hamlin, of Otisfield, and John L. Meserve, of Naples, as directors; Sumner O. Hancock serving as chairman and John L. Meserve as secretary and treasurer until the corporation is perfected and duly chartered under the laws of Maine.

NEW PUBLICATIONS.

PROCEEDINGS OF THE ELEVENTH ANNUAL CONVENTION OF THE NATIONAL ASSOCIATION OF MANUFACTURERS OF THE UNITED STATES—The proceedings of the eleventh annual convention of the National Association of Manufacturers of the United States have been published. This volume contains the report of the meeting held in New York city May 14, 15 and 16 of this year.

THE BALANCED DRAUGHT GAS-PRODUCER FURNACE—Embury McLean, New York city, has published, in pamphlet form, a paper entitled "The Balanced Draught Gas-Produeer Furnace as Applied to Steam Boilers," which was read by him recently before the Brooklyn (N. Y.) Engineers' Club. In this paper the author describes apparatus designed to produce a perfect combustion of fuel under boilers and gives some figures showing the economies which may thereby be effected.

Digitized by Google

PERSONAL MENTION.

MR. H. J. CLARK, who has been superintendent for some time of the Fort Dodge Light and Power Company, Fort Dodge, Iowa, has succeeded Mr. H. E. Morton as manager of the company.

MR. W. J. JONES, formerly superintendent of the Newport (R. I.) Street Railway Company, has assumed the duties of general manager of the Austin (Tex.) Electric Railway Company.

MR. JOHN W. MAJOR, inspector at St. Joseph, Mich., for the Northern Indiana Electric Railway Company, has been promoted to the office of assistant superintendent of all the company's lines.

MR. L. F. WESTERLAND has been elected superintendent of the Orangeburg (S. C.) light and water plant. Mr. Westerland conducted an electrical supply business in Chester, S. C., for several years.

MR. W. T. SPRANLEY, of the Spranley & Reed Company, New Orleans, La., was in attendance at the Niagara Falls (N. Y.) convention of the electrical jobbers. Mr. Spranley spent some time in New York city last week.

MR. CHARLES W. McDANIEL, Kansas City, Mo., superintendent of the Missouri & Kansas Telephone Company, was a New York visitor during the present week. Mr. McDaniel has a very large telephone territory under his control.

MR. J. SIDNEY CORBY, the well-known salesman with the Bryan-Marsh Company, Chicago, Ill., has been appointed special representative to look after the sales of Bryan-Marsh tantalum and metallized filament lamps. Mr. Corby has been designated as "High-Efficiency Corby." His many friends will be pleased to hear of his promotion.

MR. E. W. MOORE, president of the Electric Cable Company, Bridgeport, Ct., is a contributor to the September issue of *System*, writing on the subject "Starting a Manufacturing Business." The article is illustrated by a full-page portrait of Mr. Moore and also by exterior and interior views of the Electric Cable Company's plant, showing the system observed in shipping products and the labor-saving machinery used in this connection.

MR. T. H. KELLY, night chief operator of the New Orleans (La.) office of the Western Union Telegraph Company, has been promoted to the position of chief operator in place of E. E. Cord, who has resigned to accept a responsible position with the American Telephone and Telegraph Company. Mr. Cord had been in the service of the Western Union since 1880. Mr. Kelly, the new chief operator, is a native of Whistler, Ala., and entered the telegraph business as an operator on the Mobile & Ohio Railroad in 1883.

ELECTRICAL SECURITIES.

While there were many good net gains made in stock market prices last week, it is apparent that there is coming about a diminution in interest generally. The operators who are in favor of a continued rise in prices will welcome a renewed interest on the part of the speculating public and will do everything possible to stimulate this renewed interest and to encourage developments which will bring about a greater confidence. It is said that despite the recent gradual easing of the money market there is little hope in bank circles that really easy rates are ahead. It is pretty generally conceded that money firmness will be the order of the day until after the end of the year. As far as the general industrial situation is concerned, reports indicate that, if anything, there is an expansion in all directions. This is especially true of the railroad, iron and steel and copper industries.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 15.

New York:	*Closing.*
Allis-Chalmers common	18⅛
Allis-Chalmers preferred	44
Brooklyn Rapid Transit	79⅞
Consolidated Gas	139½
General Electric	165¼
Interborough-Metropolitan common	38½
Interborough-Metropolitan preferred	77¾
Kings County Electric	160
Mackay Companies (Postal Telegraph and Cables) common	73
Mackay Companies (Postal Telegraph and Cables) preferred	71¼
Manhattan Elevated	145
Metropolitan Street Railway	107
New York & New Jersey Telephone	125
Western Union	90
Westinghouse Manufacturing Company	155

The New York City Railway Company reports for the year ended June 30 as follows: gross, $17,425,660; expenses, $9,576,511; net, $7,849,149; other income, $1,089,938, a total of $8,939,087; charges, $11,225,403, leaving a deficit of $2,286,315.

A gain of $75,000 was made in the gross earnings of the Brooklyn Rapid Transit system during the first eight days of September. The average daily increase was about $9,000, a record gain. The present rate of increase follows daily gains of $2,000 in July and $4,000 in August.

The board of directors of the Western Union Telegraph Company has declared a quarterly dividend of 1¼ per cent upon the capital stock of the company, payable at the office of the treasurer on and after the fifteenth day of October next, to shareholders of record at the close of the transfer books on the twentieth day of September. A special meeting of the stockholders of the company is called for October 10 to authorize an issue of $25,000,000 of redeemable 4 per cent convertible bonds. The bonds will be convertible into stock at not less than par. Of such proposed issue it is intended, subject to the consent of the stockholders, now to issue $10,000,000 of bonds which are to be convertible as mentioned and first to offer the $10,000,000 bonds to the stockholders for subscription pro rata on such terms as may be determined by the board of directors or executive committee. The proceeds of the proposed issue are to provide funds for the construction of new lines and wires and for the purchase of new property. Since the general consolidation of 1881 and down to June 30, 1905, the company has expended for such purpose the sum of $39,074,066. For the purpose of the special meeting and the annual meeting to be held on the same day the books closed September 20 and will reopen October 12. The quarterly statement of the Western Union Company for three months ending September 30 (partly estimated) is as follows: net revenue, $2,000,000; bond interest, $332,688, leaving a balance of $1,667,312; dividends, $1,217,022; surplus, $450,290, which, added to the previous surplus of $16,848,728, gives a total surplus of $17,299,018.

Boston:	*Closing.*
American Telephone and Telegraph	136½
Edison Electric Illuminating	235
Massachusetts Electric	73
New England Telephone	129
Western Telephone and Telegraph preferred	85

Massachusetts Electric issues have been generally firm. It is reported that the buying of both preferred and common stocks has been of the very best character for several months.

Philadelphia:	*Closing.*
Electric Company of America	11⅜
Electric Storage Battery common	69
Electric Storage Battery preferred	69
Philadelphia Electric	8⅜
Philadelphia Rapid Transit	29¾
United Gas Improvement	85½

The directors of the United Gas Improvement Company have declared a regular quarterly dividend of 2 per cent ($1 per share), payable October 15 to stockholders of record September 29. Books do not close.

John M. Mack has sold his Philadelphia Rapid Transit holdings, amounting to about 55,000 shares, to Widener interests. The syndicate which bought the stock is composed of George A. Huhn and his associates.

Electric Company of America interests say the earnings continue favorable so far this year, showing some increase.

Chicago:	*Closing.*
Chicago Telephone	119
Chicago Edison Light	140
Metropolitan Elevated preferred	66½
National Carbon common	85
National Carbon preferred	118
Union Traction common	5
Union Traction preferred	20

The South Side Elevated reports for the year ended June 30, 1906, as follows: gross, $1,771,989; expenses, $1,023,810; net, $748,179; other income, $7,485, a total of $755,664; charges and taxes, $128,441; surplus, $627,223; depreciation, $50,000; balance, $577,223; dividends, $412,952, making the surplus for the year $164,271, which is equal to 5.59 per cent on the $10,323,800 capital stock. The surplus for 1905 was $121,473, and that for the preceding year, $166,664.

Digitized by Google

TELEPHONE AND TELEGRAPH.

ALBANY, N. Y.—The Hudson River Telephone Company has begun the work of placing its remaining cables under ground.

PARSONS, KAN.—The council passed an ordinance granting the Missouri & Kansas Telephone Company a franchise for twenty years.

CAMDEN, N. J.—After a year's delay the street committee of the Camden city council has decided to accept the proposition of the Bell Telephone Company to place its wires underground.

BELLEVILLE, ILL.—Articles of incorporation of the New Athens & Hecker Telephone Company have been filed at Belleville. Incorporators: William Lischer, John A. Barthel and Philip Wenner.

WATERVILLE, WASH.—The Entiat Telephone and Telegraph Company has been incorporated at Waterville by Frank E. Knapp, D. M. Farris and P. M. Martin, of Entiat, Wash., west of Spokane. The company will operate in the Big Bend country.

NEW YORK, N. Y.—The New York Telephone Company has opened a new building for its Tremont exchange at 178th street and Webster avenue. The telephones in subscribers' stations will at once be changed to the common battery type.

LAWRENCE, MASS.—The Lawrence Automatic Telephone Company has accepted the franchise which was granted by the board of aldermen in July. The promoters of the company say that the work of installing the new system will be started next spring. The surveys will be made this fall.

TEMPLE, TEX.—The Southwestern Telephone Company has a large force of men reconstructing the entire system in Temple. All of the old instruments are being replaced with new ones to be operated under the central energy system. It is estimated that the improvements will cost $50,000.

SPOKANE, WASH.—C. A. Hoag, of Waterville, Wash., and a party of Chelan men have secured a franchise for the construction of a telephone line from Chelan Falls to Lakeside, twenty-five miles west from Spokane. The line will also be built up the Columbia river and will have long-distance connection with the Pacific States line.

CHICAGO, ILL.—By bisecting the Lake View and the West districts, the Chicago Telephone Company is arranging two new districts. On the new stations $500,000 is being spent. The present Lake View district is to be divided at Lawrence avenue to make a new district to be called Edgewater, in which there will be 3,500 telephones. West district will be divided at California avenue.

MONTREAL, CANADA—The system of the Bell Telephone Company is being extended in all directions in the vicinity of Montreal. New metallic lines have recently been completed from Ste. Agathe to Lac Manitou, Trout Lake and Val Morin. A line has been erected from Lachute to Cushing, and St. Therese has been brought into closer touch with Rosemere by the building of a line between these two points.

FERGUS FALLS, MINN.—A deal has been closed by the Great Western Telephone Company, which owns the exchanges at Wahpeton, Milnor, Lisbon, Hankinson, Forman and Fairmount, N. D., and at Breckenridge and Campbell, Minn., together with intermediate and branch toll lines, selling its entire system to the Northwestern Telephone Company. The controlling interest in the Great Western was held by Fergus Falls men.

ALBANY, N. Y.—The Upper Hudson Telephone Company, with principal offices at Castleton and with a capital stock of $10,000, has been incorporated. The directors are: Andrew A. Gardiner, of Schodack Landing; Clifford C. Hastings, of West Sand Lake; Wakeley Best, Harrie McK. Curtis and Albert Baker, of Coxsackie; Phillip S. Parks, of Multzeskill, and Martin A. Springsteed, of Castleton. The company proposes to operate a line connecting the various places embraced in the territory that the directors reside in.

BROOKLYN, N. Y.—Eleven miles of ducts are being laid in the village of Jamaica by the New York & New Jersey Telephone Company for the purpose of bringing all the trunk lines in the new five-story central building on Hardenbrook avenue. This will allow the trunk lines to come into the Jamaica central office without interruption from outside lines and will greatly improve the service in all parts of the old town of Jamaica and more than double the number of connections between Jamaica village and outside points. The work is now being pushed vigorously and it is expected that it will be completed by the middle of October.

OBITUARY NOTES.

MR. CLINTON MANNING BALL died at Rockaway, N. J., on September 10 from paralysis, after a brief illness. He was born October 28, 1843, in Hoosick Falls, N. Y., and was educated in the public schools and at Hamilton College. In his junior year illness compelled him to give up his college career and to travel for a time in Europe. On his return to this country he settled in Utica, N. Y., where he remained until 1870, when he removed to Troy, N. Y., and formed with his brother, John C. Ball, the firm of Ball Brothers, shirt manufacturers. He remained in the firm until 1887, when he went into the electrical business, which he continued until his death. In 1878 he applied for a patent, in the specifications of which he showed all the conditions of the current in the electric arc. Through a faulty claim this invention was thrown out. It is said that at the time of his death Mr. Ball was one of the best authorities on magnetic ores in the world.

MR. DANIEL O'DAY, a well-known financier connected with several important electrical enterprises, died in Rouen, France, at the home of one of his daughters, Mrs. S. Triana, last week. Mr. O'Day was born in Kildysart, a small town in Ireland, on February 6, 1844. When very young he came to the United States with his parents, locating in Buffalo, N. Y., where he received his early education, and where he worked until 1865, when he left Buffalo for the oil fields of Pennsylvania. Mr. O'Day was put in charge of the first pipe line for the transporting of oil and petroleum operated by Mr. John D. Rockefeller, who had taken over the South Improvement Company into the Standard Oil Company. Mr. O'Day's rise in the executive department of the Standard Oil Company was rapid from this time forward, and about 1880 he became manager of the company. Mr. O'Day was a member of the New York Athletic Club, the Lotos, Lawyers', Colonial and Catholic clubs. He was connected with the following companies: Atlantic Coast Railroad, president and director; Buffalo General Electric Company, president and director; Buffalo Natural Gas Company, president and director. He was also director in the Buffalo, Thousand Islands & Portland Railroad, the Cataract Power and Conduit Company, Federal Trust Company, of Newark; International Railway Company, International Steam Pump Company, Niagara Falls Power Company, Oil City Boiler Works, People's Bank, the Buffalo Seaboard National Bank and the Venango Traction and Power Company. He was a trustee of the Colonial Trust Company, the New York Produce Exchange, the Safe Deposit and Storage Company and the Northwestern Ohio Natural Gas Company, of which he was also vice-president, and the National Transit Company.

ENGINEERING SOCIETY.

SCHENECTADY BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—A meeting of the Schenectady (N. Y.) branch of the American Institute of Electrical Engineers was held at the Alpha Delta Phi fraternity house, Union College campus, on Saturday evening, September 8. The meeting was in the nature of an informal smoker, and plans for the coming season were discussed. Dr. C. P. Steinmetz was the speaker of the evening. There is a promise of great activity, both educationally and socially, among the electrical workers in Schenectady. In addition to the address by Dr. Steinmetz, David B. Rushmore, chairman of the Schenectady branch, made an address and reviewed the prospects for development. A prospectus has been prepared outlining the lecture course for the coming winter. In order to stimulate the interest in these meetings, free trips to New York to attend the monthly meetings of the national association will be given to those who take a conspicuous part in the discussions at the branch meetings. E. B. Merriam, of the General Electric Company, is chairman of the membership committee. A special membership with dues one-half the regular branch dues is proposed for all men in the General Electric Company's testing department, the American Locomotive Works' testing department, Union College and the Rensselaer Polytechnic, of Troy.

Digitized by Google

ELECTRIC LIGHTING.

McEWEN, TENN.—A contract has been closed for an electric light plant for McEwen.

CALUMET, MICH.—The electric light plant at Ontonagon has been placed in operation.

FRANKLIN, MASS.—Local capitalists are considering the establishment of an electric lighting plant.

BATON ROUGE, LA.—The town council at Jonesville proposes to establish a municipal electric lighting plant.

PARIS, ILL.—A new electric light system is to be installed to replace the old one, which has become inadequate.

EMMETT, IDA.—A dam is being constructed at Horseshoe Bend to increase the power output of the electric light plant.

FRANKLIN, N. Y.—Contracts have been let and work will be begun promptly for the electric light system for Franklin.

TOPEKA, KAN.—Oberlin is installing an electric light plant in connection with the city waterworks at a cost of $10,000.

LOWELL, MASS.—The board of selectmen of Dracut has under consideration the proposition to light the town by electricity.

FREMONT, NEB.—The issue of bonds for the new municipal electric light station has been sold to S. C. Hayes & Son, of Cleveland, Ohio.

MUNCIE, IND.—Under the contract recently entered into with the Muncie Electric Light Company, 250 new arc lamps have been installed on the city streets.

ROCHESTER, N. Y.—Charlotte will engage one or more experts to investigate its electric light and water systems before deciding on the question of new plants.

FRANKFORT, N. Y.—The board of trustees has granted the Hudson River Electric Power Company permission to construct a transmission line through the village.

WATERTOWN, TENN.—At a recent meeting of the board of mayor and aldermen a franchise was granted to H. H. Weir and W. L. Goodhart to erect an electric light plant in Watertown.

OTTAWA, OHIO—After considerable figures from the Ottawa Electric Light Company for the lighting of Waterworks Park, the village council has decided to install its own lighting plant at the park.

MILO, ME.—F. W. Bolster has taken the contract to build the new power station for the Milo Electric Light and Power Company. Work has begun on the foundation and will be hurried forward as fast as possible.

FLINT, MICH.—The new power plant of the recently organized Oak Park Power Company, which will furnish current for the Weston-Mott and Buick factories, is practically completed, and boilers, engines and generators are installed.

UNION CITY, TENN.—The municipal electric plant at Union City is to be enlarged. Contracts have been let for a new dynamo and engine at a cost of $4,000. The enlargement has been made necessary on account of the increasing demand for service.

BRONSON, MICH.—The new electric light plant being built to replace the one recently destroyed by fire is nearly completed. The structure is fifty-two by sixty-four feet, two stories high and constructed of cement blocks. The roof will be of slate, and the whole building practically fireproof.

EAST TEMPLETON, MASS.—The electric light commissioners have decided to let the contract for the municipal electric lighting plant for the town of Templeton to E. E. Ley & Company, of Springfield, who were the lowest bidders. The work will be started as soon as the material can be procured.

LYNDON, KAN.—Specifications have been issued for the municipal electric light plant to be installed by the city of Lyndon. Bids will be received up to 6 P. M., September 27. Copies of the specifications may be had by addressing City Clerk J. H. Yearout, Lyndon, or the consulting engineer, M. Dunsworth, Emporia, Kan.

BIRMINGHAM, ALA.—At a meeting of the directors of the Coosa River Power Company the following officers were unanimously elected: Roswell H. Cobb, Anniston, Ala., president and manager; Robert R. Zell, Birmingham, vice-president; Robert D. Johnston, Birmingham, treasurer; Cyrus K. Hartzell, Pittsburg, Pa., secretary.

MEMPHIS, TENN.—The Merchants' Power Company, according to L. G. Van Ness, general superintendent and constructing engineer, will be ready to furnish lights in the up-town district by November 1, and the entire city by next January. Eleven car-loads of machinery, representing about one-third of the equipment, have arrived. This shipment includes two engines of 2,000 horse-power each, and two 500-horse-power boilers.

MOBILE, ALA.—A mortgage for $3,000,000 has been filed in the Probate Court, given by the Mobile Electric Company to the American Trust and Savings Bank, of Chicago. It is a forty-year mortgage, bearing five per cent interest. The mortgage covers all the holdings of the company, together with all real estate owned by the concern. The filing of the mortgage is the last act in the consolidation of the lighting interests of Mobile.

WOODBURY, PA.—On November 6 the voters of this city will vote on the question whether or not the city shall construct, maintain and operate a municipal light, heat and power plant. The Public Service Corporation is now furnishing the city with light, and owns an unused plant here. The question of buying this will come up later, if the vote is favorable to the new move. Councilmen believe that there will be a great saving to the taxpayers if they own their plant. Paulsboro will vote on a similar project.

CORTLAND, N. Y.—The terms for a new lighting contract for five years have been decided upon by the common council and the Cortland County Traction Company. The lamps are to be lighted every night in the year and all night. The contract price is to be twenty-four cents per night per arc, while the price to private consumers is dropped from twelve cents a kilowatt-hour to eleven cents. The price of arc lights under the present contract is twenty-eight and one-half cents per night. Aside from the drop in prices, the traction company is to install new arc lights of the enclosed type.

ROCHESTER, N. Y.—The board of contract at a special meeting awarded the new lighting contract to the Rochester Railway and Light Company. The contract is for five years and under the bid the city will make a saving of more than $305,000 on the old lighting prices. The new contract takes effect July 1 of next year. The bid was at the rate of $57.95 a year for the class of lamps most used. The city is now paying $78.50 a year for these lamps. For double arc lamps on iron poles the company bid $62.96 a year each under the new contract, and for single arc lamps on iron poles $68 a year per lamp.

DETROIT, MICH.—Desiring to confine to Wayne county the operations of the Peninsular Electric Light Company, now controlled by the Detroit Edison interests, these interests have formed a new company for the extension of the business of furnishing light and power through the counties of Macomb and St. Clair. The new company will have plants at Royal Oak, and its operations will take in the territory on the Clinton river and in the Anchor Bay territory, possibly extending to the Flats. The new concern is to be known as the St. Clair Edison Company and will have a capital stock of $100,000. The incorporators are Alexander Dow, Hoyt Post and J. V. Oxtorby.

LITTLE FALLS, N. Y.—The contract to light the streets of Little Falls for a period of five years, commencing January 1, has been awarded by the common council to the Herkimer County Light and Power Company. This is the company that is at present lighting the city at the rate of $85 per lamp per year. The Hudson River Electric Power Company was, however, the low bidder. The Herkimer company's bid was as follows: One hundred and twenty-five incandescent lamps, $12 per year, and as many more at the same price as desired. Arc lighting, alternating current: for a period of five years, $35 per lamp per year for 125 arc lights, or as many more as desired.

Digitized by Google

NEW INCORPORATIONS.

LANSING, MICH.—Lewis Electric Company, Grand Rapids. $6,000.

INDIANAPOLIS, IND.—Evansville & Cannelton Traction Company. $10,500. To operate between the two places.

CHILI, ILL.—Chili Mutual Telephone Company, Chili. $10,800. Incorporators: David G. Toff, John O. Carlin and D. H. Carlin.

WEIR, TEX.—Welber-Weir Telephone Company, of Weir. $2,000. Incorporators: Frank Doering, A. M. Nalley, J. W. Long and others.

JACKSON, MISS.—The Starkville Street Railway Company, Starkville. $30,000. Incorporators: F. L. Hogan, W. H. Sudduth and others.

KENNEY, ILL.—Kenney Electric Company, Kenney. $4,800. Incorporators: Andrew Harkyard, William E. Cooper and Louis O. Williams.

AUSTIN, TEX.—Falfurrias Telephone Company, of Falfurrias. $5,000. Incorporators: Frank S. Rachal, John S. Donohoe, B. Temple Henry, Richard C. Miller and D. H. Dashiell.

TOPEKA, KAN.—Lawrence Street Motor Company; $20,000; to extend lines to suburban points. Southwestern Interurban Railway; to build lines connecting Arkansas City, Parsons and Coffeyville.

GUTHRIE, OKLA.—The Hobart Light and Power Company, of Purcell, I. T. $550,000. Incorporators: Frederick A. Gale, of Chicago; George S. Selden, of Erie, Pa.; Dorset Carter, of Purcell; James R. Tolbert, of Hobart, Oklahoma agent.

COLUMBUS, OHIO—The Oak Point & Elyria Railway. $3,000. To build a line from Elyria to Amherst and thence to Oak Point. Incorporators: E. S. Cook, F. S. McGowan, A. R. Manning, Jr., M. Dickey, Jr., and M. L. Fowles, all of Cleveland.

SPRINGFIELD, ILL.—The East St. Louis, Columbia & Waterloo Railway. To be constructed from East St. Louis, Ill., to Waterloo, Monroe county, Ill., principal office at Columbia, Ill. Incorporators and first directors: Joseph W. Rickert, J. J. Koenigsmark, Waterloo, Ill.; J. W. Warhock, E. F. Schoening, H. Reichenbach, Columbia, Ill.

SPRINGFIELD, ILL.—De Kalb-Sycamore Interurban Traction Company. $100,000. To build a line connecting De Kalb, Sycamore, Belvidere, Boone county; Aurora, in Kane county, and Sandwich, Directors: J. G. Michael, William Jarvis, C. K. Minary, Henning Chambers, H. S. Gray, S. E. Bradt, John Glidden, D. A. Syme and F. B. Townsend.

SPRINGFIELD, ILL.—Belleville & Pinckneyville Traction Company. $100,000. To construct a line from Belleville to Pinckneyville, Ill; principal office at Belleville. Incorporators: Lucius D. Turner, Belleville; John Hamilton, Marissa, Ill.; William Stevenson, Tilden, Ill.; W. T. Armstrong, Coulterville, Ill.; George F. Mead, Pinckneyville.

LOUISVILLE, KY.—The Henry County Light and Power Company. $40,000. Organized to take over the defunct Eminence Electric Light Company. Incorporators: C. B. Hole, of W. N. Coler & Company, New York, 200 shares; J. J. Borger, Eminence, three shares; C. C. Hieatt, H. M. Johnson, of the firm of Johnson & Hieatt, Louisville, and C. Y. Hieatt, three shares each.

HARRISBURG, PA.—Lawrenceville Street Railway Company, Pittsburg; $12,000; to build a line from the Pittsburg subway line at Neville street to Hatfield street, Pittsburg; directors, Edwin K. Morse, Warner Marshall, Horace W. Baker, Coleman Audel, Pittsburg, and Harrison M. Williamson, Allegheny. Rebecca Street Railway Company; to build line from Neville street to South Highland avenue, Pittsburg; same capital and directors.

NEW MANUFACTURING COMPANY.

LOS ANGELES, CAL.—The Electric Heating and Manufacturing Company has purchased land near Dolgeville upon which to erect a plant for the manufacture of heating, lighting and cooking appliances.

INDUSTRIAL ITEMS.

C. H. THORDARSON, 153-159 South Jefferson street, Chicago, Ill., has ready for distribution a new series of literature describing electrical laboratory apparatus.

THE McROY CLAY WORKS, Brazil, Ind., has issued a September blotter bearing a neat calendar card and two verses entitled "The Game of Baseball in Old England."

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., will be pleased to send full information concerning the A. E. G. "Brilliant" flaming arc lamps.

THE NOVELTY INCANDESCENT LAMP COMPANY, St. Marys, Pa., has moved its office to its new lamp factory at Emporium, Pa., where all correspondence, telegrams, etc., should be sent.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., is calling attention to the "P. & S." No. 157 standard brass sockets. The company will be pleased to send descriptive literature upon request.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburg, Pa., announces that its northwestern office, which until recently was located at Spokane, Wash., has been moved to the Pacific Block, Seattle, Wash., with F. E. Hoar in charge.

THE W. S. HILL ELECTRIC COMPANY, New Bedford, Mass., has ready for distribution a new catalogue descriptive and illustrative of knife switches, cutouts, tablet boards and panelboards. This catalogue will be sent to any one interested upon request.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., is distributing a neat set of blotters calling attention to floor and wall outlet boxes, water-tight outlet boxes, the new riveted-frame-type induction motor and new type "K" arc lamps.

H. M. BYLLESBY & COMPANY, Chicago, Ill., have been retained as consulting, designing and supervising engineers for the modern gas plant being built by the Indiana Steel Company at Gary, Ind. This is the city the United States Steel Corporation is founding for the location of its new works.

THE ELECTRIC CABLE COMPANY, 17 Battery place, New York city, announces that the Kilburne & Clark Company, Seattle, Wash., has recently placed a large order for "Voltax" compound, to be used as a waterproof compound for the protection of railway bridges which this company has in course of construction on the Pacific coast.

W. S. BARSTOW & COMPANY, New York, has recently completed an extensive electrolytic survey for the Chester Traction Company, Chester, Pa., and the Trenton Street Railway Company, Trenton, N. J. Under their direction several modifications have been made which bring the track return systems of these two companies up to date.

THE L. B. ALLEN COMPANY, INCORPORATED, Chicago, Ill., is calling attention to the Allen soldering stick, soldering paste, soldering salts and commutator lubricant. This material is endorsed by the Underwriters' National Electrical Association. The company is in possession of many testimonials commendatory of the utility and reliability of its products.

THE PRINGLE ELECTRICAL MANUFACTURING COMPANY, 1906 North Sixth street, Philadelphia, Pa., has ready for distribution a new handbook describing and illustrating its electrical products. These include high-grade switches, panel-boards, switchboards, receptacles and specialties. The book has been carefully arranged and is tabulated, so that reference may be made to any classification with great facility.

JAMES L. ROBERTSON & SONS, INCORPORATED, New York city, have ready for distribution some attractive literature calling attention to "Eureka" service packings. The company will also be pleased to send full information concerning its return copper-coil feed-water heater, indicator piping, lubricators, indicators, planimeters, reducing wheels, damper regulators, exhaust heads, oil filters and flue cleaners. The company announces the removal of the sales department of the Eureka Packing Company to 48 Warren street.

THE PORTLAND COMPANY, Portland, Me., manufacturer of the "W. H. C." voltage regulator, described in a recent issue of the

Digitized by Google

ELECTRICAL REVIEW, has ready for distribution a series of bulletins describing the engineering and mechanical apparatus manufactured by the company. This includes steam boilers, digesters, stand-pipes, absorbing systems, electric neutralizers for printing companies, marine boilers, rocking and dumping grates, elevators, propelling machinery, iron shears and electric generating sets. Any of this literature may be secured upon request.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., has issued new literature as follows: bulletin No. 618 describing Stanley-G. I. short-arc lamps. These lamps measure fifteen and one-half inches overall in height and are particularly desirable for use with low ceilings. Circular No. 795 describes Stanley-G. I. sixty-cycle, single-phase induction motors. These motors are built in various sizes from one-quarter horse-power to fifteen horse-power. Circular No. 781 describes the G. I. type "J" primary fuse box or transformer cutout. This device is made up to thirty amperes, 2,500 volts capacity.

THE DE LA VERGNE MACHINE COMPANY, foot East 138th street, New York city, reports the following among other recent orders received for "Hornsby-Akroyd" oil engines: Central New England Railway Company, Hartford, Ct., seven horse-power, geared to pump; F. J. Stokes Machine Company, Philadelphia, Pa., twenty-five-horse-power; the Hastings Pavement Company, New York city, sixteen-horse-power; the W. F. Norman Sheet Metal Company, Nevada, Mo., fifty-horse-power; Union Ballast Company, New York city, one twenty-horse-power and one thirty-two-horse-power; D. P. Forst & Company, Trenton, N. J., thirteen-horse-power; Webb Wire Works, New Brunswick, N. J., thirty-two-horse-power; J. W. Lippincott, S. P. Scott and Max Meyer, Little Rock, Ark., fifty-horse-power engine to drive a De La Vergne ice-machine.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has ready for distribution a new series of advertising literature. This includes July indexes to price lists, pamphlets, supply catalogues, descriptive catalogues and fliers. Supply catalogue No. 7,600 gives details concerning controller contact fingers and handles. Price list No. 5,153 gives data concerning Edison "Gem" filament street series incandescent lamps. Flier No. 2,191 describes and illustrates reversing motor-starting rheostats, type RS. Bulletin No. 4,451 describes and illustrates the GE tantalum incandescent lamp; No. 4,452, direct-current series enclosed arc lamps, forms 10 and 11; bulletin No. 4,453, Edison "Gem" high-efficiency incandescent and meridian units; No. 4,454, the GE-90 railway motor; No. 4,455, single-phase motors, type IS, form KG.

Record of Electrical Patents.

Week of September 11.

830,497. CIRCUIT-CLOSING DEVICE FOR SPEED INDICATORS. Hans Dahl, Berlin, Germany. Filed June 20, 1901. The circuit is closed at a predetermined speed by centrifugal force.

830,501. PROTECTING BUSHING FOR ELECTRIC CIRCUIT WIRES. John H. Goehst, Chicago, Ill., assignor to Federal Electric Company, Chicago, Ill. Filed February 16, 1905. A bushing threaded at the bottom for taking a washer.

830,537. TIME-ELEMENT DEVICE. John G. Statter, Birmingham, England, assignor to William Maxwell Scott, Philadelphia, Pa. Filed July 31, 1905. The circuit-breaker's movement is retarded by a sucker.

830,568. TROLLEY-CONTROLLING APPARATUS. Frank E. Case, Schenectady, N. Y., assignor to General Electric Company. Filed March 10, 1905. A pneumatic device for raising and lowering the trolley.

830,572. CLAMP FOR ELECTRICAL CONDUCTORS. Scott C. Cutter, Oswego, Ill. Filed July 3, 1905. The jaws are pierced by conical holes, allowing them free movement.

830,575. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed December 6, 1901. A central battery system, the signals being controlled by a polarized relay.

830,583. COMBINATION TELEPHONE TRANSMITTER AND RECEIVER. Charles C. Gilchrest, New York, N. Y., assignor to Western Electric Company, Chicago, Ill. Filed October 12, 1905. The receiver and transmitter are mounted on one handle, constructed to avoid transmission of vibrations from one to the other.

830,585. INSULATOR FOR TELEGRAPH AND TELEPHONE WIRES. Salathiel V. Graves and Samuel H. McDaniel, McFall, Mo. Filed November 14, 1905. The insulator proper is mounted in a metal box.

830,598. INCANDESCENT LAMP. Gottlob Klumpp and Henry F. Herman, Brooklyn, N. Y.; assigned to Klumpp. Filed September 9, 1905. A regulating resistance, controlled by turning the lamp, is mounted within an enlarged base.

830,628. SWITCH FOR ELECTRIC CIRCUITS. Eddy R. Whitney, Lynn, Mass., assignor to General Electric Company. Filed June 2, 1904. A controller for variable-speed motor which prevents too rapid reversals.

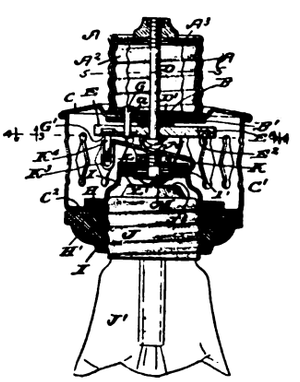
830,629. SEMAPHORE. Jean F. Webb, Jr., Denver, Col., assignor to the Electric Signagraph and Semaphore Company. Filed November 11, 1905. A motor-operated semaphore.

830,639. PROCESS FOR THE ELECTROLYTIC PRODUCTION OF COPPER. Johannes A. W. Borchers, Aachen; Paul R. Franke, Eisleben, and Franz E. Günther, Aachen, Germany. Filed September 21, 1905. A copper mat with a richness of from seventy-two to eighty per cent is employed as anode in an acid electrolyte of copper sulphate.

830,653. TELEPHONE PAY STATION DEVICE AND SYSTEM. Alfred H. Dyson, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Filed December 30, 1904. The coin is automatically deposited by the called subscriber.

830,654. TELEPHONY. Alfred H. Dyson, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Filed April 3, 1905. An automatic system in which the person called releases the coin-collecting device.

830,674. MACHINE FOR ELECTRICALLY WELDING. Louis S. Rolland, Brussels, Belgium. Filed September 28, 1905. A device for clamping and adjusting parts for welding.



830,598. INCANDESCENT LAMP.

830,675. ATTACHMENT FOR TELEPHONE TEST SETS. George L. Rosenberger, Manassas, Va. Filed September 12, 1905. A testing clamp for different sizes of wire.

830,686. TROLLEY-POLE CONTROLLER. John J. Tartt, Los Angeles, Cal., assignor of one-half to David E. Spangler, Los Angeles, Cal. Filed December 28, 1903. The compression of the trolley base spring is adjusted by a solenoid.

830,696. TELEPHONE SWITCH HOOK. James A. Wotton, Atlanta, Ga., assignor to Electric Manufacturing and Equipment Company. Filed June 17, 1905. A switch hook stamped out from one piece.

830,698. ELECTRIC LAMP. Albert Ackerman, Pittsburg, Pa., assignor, by mesne assignments, to Nernst Lamp Company, Pittsburg, Pa. Filed October 4, 1899. A glower of the Nernst type enclosed in an exhausted globe and started by a carbon filament.

Digitized by Google

830,708. COMBINED CANDLE BASE AND SOCKET FOR MINIATURE ELECTRIC LAMPS. John H. Goehst, Chicago, Ill., assignor to Federal Electric Company, Chicago, Ill. Filed April 11, 1904. An adapter, in the shape of a candle, for standard sockets.

830,718. APPLIANCE FOR TRACING COURSES ON CHARTS. Harold E. S. Holt, Farnborough, England. Filed November 26, 1904. The record is made by two independent driving mechanisms operating at right angles, the motions of which are controlled by the speed and the direction of the vessel.

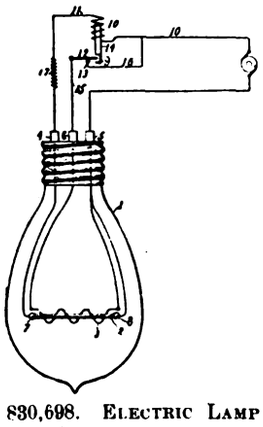
830,767. HEADLIGHT. Frank Buchanan, Dayton, Ohio. Filed October 26, 1903. An arc headlight with carbons set at an angle.

830,770. AUTOMATIC RESETTING SWITCH. Samuel H. Couch, Boston, Mass. Filed October 2, 1905. For an intercommunicating telephone system.

830,780. CIRCUIT CLOSER FOR LOCKS. Anthony Glass, Cleveland, Ohio. Filed January 31, 1906. The movement of the lock opens and closes the circuit.

830,800. GAME AND TOY. Charles G. Mortimer, Jr., New York, N. Y., assignor to Howard Miniature Lamp Company. Filed July 26, 1905. A motor of the coil-and-plunger type arranged as a vertical engine.

830,801. GAME AND TOY. Charles G. Mortimer, Jr., New York, N. Y., assignor to Howard Miniature Lamp Company. Filed January 16, 1906. A motor of the interrupted-current type arranged as an engine.



830,698. ELECTRIC LAMP

830,812. PROTECTIVE APPARATUS FOR COMPENSATOR DYNAMOS. Henry H. Walt, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. Filed January 18, 1904. Apparatus for use on three-wire or similar distributing systems for automatically cutting out series field-windings.

830,830. GEAR-CASE FOR RAILWAY MOTORS AND MEANS FOR MOUNTING THE SAME. Alexandre Grammont, Pont-de-Cherry, France. Filed March 21, 1905. A method of constructing a hermetically closed gear-case.

830,849. DYNAMOELECTRIC MACHINE. Willard F. Richards, Buffalo, and William A. Turbayne, Lancaster, N. Y., assignors to Gould Coupler Company, New York, N. Y. Filed August 12, 1905. The end-plates of the main generator may be removed over an auxiliary generator on the same shaft without detaching the latter.

830,862. ELECTRICAL CEILING-SWITCH. Joseph G. Swallow, New York, N. Y., assignor of one-half to Hubert Krantz, Brooklyn, N. Y. Filed April 29, 1905. A rotary snap-switch reset by gravity.

830,898. GAS-ENGINE SPARKER. Stephen A. Hasbrouck, Yonkers, N. Y., assignor to Anna M. Hasbrouck, Yonkers, N. Y. Filed August 26, 1903. Renewed February 10, 1906. A method of construction.

830,918. ANODE. John Nelson, Peru, Ill. Filed June 28, 1906. Pockets are formed of porous envelopes for holding the anode materials.

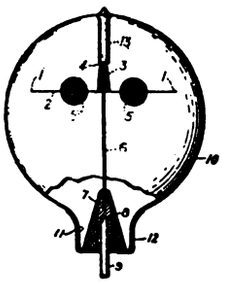
830,919. DEVICE FOR IGNITING AND EXTINGUISHING GAS. Richard N. Oakman, New York, N. Y. Filed June 2, 1905. An electric igniter.

830,921. MEANS FOR TRANSMITTING ELECTRICAL IMPULSES. Francis L. Orr, Thurman, Iowa. Filed July 19, 1905. Alternating currents are produced by armature extensions rotated about the poles of an induction coil.

830,923. PRESSWORK RECORDER. Walter F. Palmer and John Winnacott, New York, N. Y. Filed July 7, 1905. An electrically operated recorder for a printing-press.

830,924. CURRENT RECTIFIER. Franz Pawlowski, Vienna, Austria-Hungary. Filed November 14, 1904. The electrolyte of the rectifier is a hemisulphide of copper.

830,938. POTENTIAL INDICATOR. John B. Taylor, Schenectady, N. Y., assignor to General Electric Company. Filed January 3, 1905. Point discharges drive a rotating indicator enclosed in a glass globe.



830,938. POTENTIAL INDICATOR.

830,947. MEANS FOR STARTING ALTERNATING-CURRENT MACHINES. Obed F. Whitehurst, Schenectady, N. Y., assignor to General Electric Company. Filed January 28, 1905. An auto-starter providing two starting voltages.

830,971. ELECTRIC CLOCK. Ulysses L. Collins, St. Louis, Mo. Filed September 18, 1905. A spring-driven, magnetically wound clock.

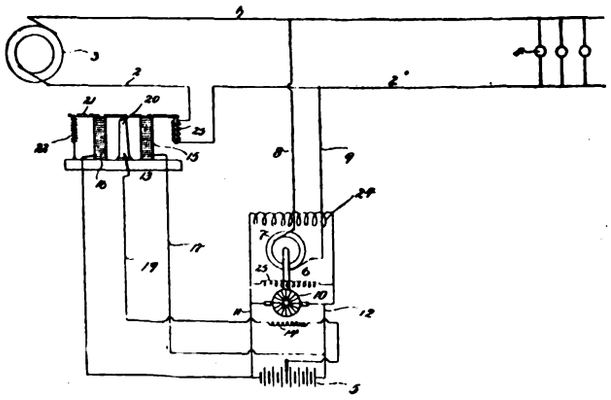
830,975. APPARATUS FOR PRODUCING HIGHLY OZONIZED AIR OR OXYGEN. Auguste Déchaux, Paris, France, assignor to Wilhelm Mallmann, Ruremonde, Holland. Filed April 28, 1904. The electrode is formed of an inner conducting tube, an intermediate non-conducting and an outer conducting tube, air spaces separating the three.

830,981. TELEPHONE SYSTEM. Alfred H. Dyson, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Filed April 17, 1905. Automatic means are provided at a calling substation for connecting any subscriber with the central exchange.

830,982 SYSTEM OF ELECTRICAL DISTRIBUTION. Justus B. Entz, Philadelphia, Pa. Filed March 28, 1905. A regulator automatically controlling a rotary converter, enabling a storage battery to equalize the load on an alternating-current system.

831,001. RECEIVER HOOK FOR TELEPHONES. Denis Howard, Binghamton, N. Y. Filed January 16, 1906. A number of contacts on the receiver hook indicate the station calling.

831,013. DISTANT-ACTING ELECTRICAL GAS-IGNITER. Georg Lentschat, Hohen-Schönhausen, near Berlin, Germany, assignor of one-half to Wenzel I. Drahonowsky, Miröschau, Austria-Hungary. Filed July 24, 1906. Electromagnetic device for turning on and off and igniting gas.



830,982. SYSTEM OF ELECTRICAL DISTRIBUTION.

831,016. ELECTRIC DOOR-STRIKE. George N. Parker, Boston, Mass. Filed July 9, 1904. A magnetically controlled door opener.

831,025. LOCOMOTIVE ENGINEERS' ALARM. Edward McClintock, Merriam Park, Minn., assignor to the McClintock Manufacturing Company, St. Paul, Minn. Filed May 16, 1904. Auxiliary rails divided into insulated blocks enable lamp signals to be shown on the locomotive.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 13. NEW YORK, SATURDAY, SEPTEMBER 29, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON
NEW ENGLAND OFFICE, M. W. BARBER, Mgr., DELTA BLDG., 10 Post Office Sq.

LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
The Fire-proof Dynamo..... 489
Color Difficulties in Photometry..... 490
High-Efficiency Radiators..... 491
Our Cities of Evil Smells..... 491
Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw..... 492
A Letter from Manchuria..... 497
Electric Operation of the Telt ow Canal, by Frank C. Perkins..... 498
Color Phenomena in Photometry, by J. S. Dow..... 501
Length of Wave and Speed of Propagation of Electrical Phenomena..... 506
The Relation of the Alternating-Current Motor to Central-Station Power Business, by E. W. Lloyd..... 506
Montreal Light, Heat and Power Company's Soulanges Canal Power Station 508
Convention of the Illinois Electrical Association..... 509
The Opening of the Camden-Atlantic City Line of the West Jersey and Seashore Railroad..... 509
Meeting of the Colorado Electric Light, Power and Railway Association..... 509
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE..... 510
METHODS OF GETTING NEW BUSINESS..... 512
An Interesting Emergency Application of Electricity 516
The Electrical Trades Exposition Company..... 516
Staff Additions for Sanderson & Porter..... 516
Illuminating Tests..... 516
The Association of Edison Illuminating Companies..... 516
INDUSTRIAL SECTION:
The Balanced-Draft Gas-Producer Furnace..... 517
The Improved "Dow" Adjuster..... 518
New Electrical Engineering Company..... 518
Sturgess Water-Wheel Governor..... 518
An Improved Type of Lever Switch..... 519
The Dean Hook Switch..... 520
Crude and Fuel Oil Generator Sets..... 521
Electric Equipment for the Hudson Company's Tunnels..... 521
Automatic Motor-Controlling Devices..... 521
Vacuum Drying and Impregnating Apparatus..... 522
CURRENT ELECTRICAL NEWS..... 523
Record of Electrical Patents..... 529

Copyright, 1906, by Electrical Review Publishing Co.

THE FIRE-PROOF DYNAMO.

The weak point in electrical machinery is almost always the insulation. It is true that the direct-current dynamo is somewhat handicapped by its commutator, but improved design has reduced the troubles at this point very greatly, and the commutator itself may be constructed so as to withstand a great deal of hard service. But both alternating and direct-current machines must employ some insulating material, and this is generally of necessity of such a character that it is seriously damaged, if not destroyed, by overheating. The commonest insulating materials are cotton and flax, which become carbonized at temperatures not much above that of boiling water, and they thus lose the very property for which they are used. In larger machines or those constructed for excessively high voltages the cotton insulation may be supplemented or even replaced by other materials such as tubes of fibre or of mica. But fibre and even the cement used for building up tubes of small pieces of mica can not withstand indefinitely high temperatures, so that a form of construction which does not become too hot must be adopted. By means of various devices, such as ventilating systems or ways of arranging the materials of the machine, it is possible to dissipate a great deal more energy from a given weight of material or from a given surface than we could a few years ago. In this way we have succeeded in decreasing the weight and the cost of our apparatus, but we are not yet independent of temperature, for an overloaded machine will still become dangerously hot.

The difficulty encountered in insulating electrical machinery lies in the fact that a good electric insulator is also a good heat insulator, and the very process of construction employed to prevent the current from taking undesired paths is one well calculated to prevent the dissipation of heat, and therefore the inner layers of a winding of insulated wire in which energy is being dissipated as heat will be at a temperature considerably higher than that of the outer layers. One of the most successful means of combating this difficulty is the use of ventilating ducts, which cause a circulation of air through the machine. Another, of more recent date, also of very great importance in the construction of machines, is the use of strip windings. By this means a coil having a sufficient number of turns, with a conductor of the proper cross-section, may be made but one layer deep; and when this conductor is bare, as is very frequently the case, every foot of it is exposed to the air. This solution may be compared with the lamination of the armature core. A good path for heat conduction is provided, but a poor path for electrical conduction across from layer to layer, just as in the

Digitized by Google

armature the laminations provide good magnetic paths in one direction, but poor electrical paths in another.

Other attempts have been made to render coils less liable to injury from overheating. The coils, after being wound, may be saturated with some insulating material and baked so as to convert them into a solid mass. This method of treatment has been employed in various ways, but has not come into general use for windings, and though of considerable value, this method would not make a machine entirely fire-proof, for the insulation of the wire will eventually break down under the continued high heat, resulting possibly in a short-circuit.

Another method of insulation more recently tried makes use of the insulating property of aluminum oxide. This metal is used instead of copper, and is treated so as to take on a coating of oxide. The wire thus treated—otherwise bare—is wound up in coils without any other provision being made for insulation. For high voltage some precautions are necessary to secure a sufficiently thick coating of the oxide, but for ordinary voltages no treatment at all is required. The advantage of this method, beyond the reduction in cost which is said to result from it, will lie in the fact that the insulating coating is thin, and there is but little space not filled by the metal. If square wire be employed, as suggested, in some cases, the coil becomes almost a solid mass of metal and oxide. Such a coil is not only able to withstand fairly high temperatures, but should be a fairly good dissipator of heat, for although the insulating coating is itself a non-conductor, the fact that there is but little air space left between adjacent wires would facilitate the conduction and dissipation of heat. It is a question whether a coil wound in this way could stand very high temperatures, such, for example, as would drive off the water of crystallization of the oxide coating. Even should this happen, the pure oxide might be a fairly satisfactory insulator. The ideal construction is one which would enable the coils to be used even if red hot, although, of course, other considerations make it undesirable to work at such temperatures. The question of efficiency is an important one, and this is bound up in that of temperature.

COLOR DIFFICULTIES IN PHOTOMETRY.

The work of the photometrist is not easy, for he has many difficulties to contend with, yet the one which occasionally gives the most trouble is that involved in making a satisfactory comparison between two sources of light which differ in color. Given two lights of the same kind and satisfactory apparatus, almost any one can make some sort of comparison, though, for consistent results, practice and skill are required. But when a comparison is sought between two lights differing considerably in color, even the most expert photometrist has difficulty. An interesting article on this subject by Mr. J. S. Dow appears on another page of this issue. Mr. Dow has made a somewhat extended investigation of the matter and has produced some valuable results to which attention may well be called.

The investigation was divided into four parts, according to the cause of the uncertainty. These were: the difficulty experienced in forming a judgment in the case of differently colored lights and the possibility that the judgments of different people may not be the same; the fact that the apparent relative brightness of two surfaces illuminated by light of different colors depends upon the part of the retina on which the image of them is received; the Purkinje phenomena; and the possibility that when mirrors are made use of the coefficient of reflection may not be the same for differently colored lights.

Taking up these points in the reverse order it is found that although there is probably some difference in the coefficient of reflection of the mirrors, that this, with the mirrors used in the investigation, was of little importance. For mirrors made in other ways it might, however, be a source of considerable error.

The Purkinje effect, it was found, may give rise to considerable error if low intensities of illumination be employed. This is that peculiar phenomenon which causes a surface of one color to appear brighter than that of another when both are brightly lighted by the same source, while the second will appear brighter than the first when the intensity of illumination is diminished This effect is exceedingly complicated, and errors due to it may be avoided by maintaining a good illumination of the surfaces compared.

The second source of error investigated is one which may become troublesome. In a comparison of two lights of different color different results may be obtained if the images of the two surfaces are formed on different parts of the retina. In fact, it was found that a considerable error may be introduced merely by moving the eye nearer to or further away from the photometer screen, thus increasing or decreasing the size of the image on the retina.

The first source of difficulty—that one involving a difference of judgment with different persons—is perhaps the most important. There would seem to be no way of getting around it. Although it was found that one observer, after some training, could obtain fairly consistent results when working straight ahead, even he was apt to judge differently if he allowed time to intervene between his readings.

The whole problem, like some other problems in photometry, seems to be due to an attempt to do something next to impossible. In the question of rating lamps no satisfactory decision has been made—satisfactory, that is, to every one—because those manufacturers making highly efficient lamps want a rating which will bring out this desirable quality, and those who make a feature of a peculiar distribution of illumination want this phase emphasized.

But the comparison of lights of different color involves a more fundamental difficulty. Who is to say whether a green light is brighter than a red, and what is meant by brightness? It is only a comparative term. Many persons are so color blind that it would be impossible for them to make any fair comparison, and possibly all of us are somewhat affected in this way. If some test were employed involving the amount of illumination necessary for vision there might be some meaning in

Digitized by Google

a comparison, but it is doubtful if even such a test would give consistent results, for the physical condition of the eye, whether fresh or tired, would have much to do with it. If a comparison could be made satisfactorily between lights having different colors this would be exceedingly useful, but it is questionable whether there is much value in such comparisons as they are now made. One might as well try to judge between the relative goodness of an apple and a peach. If either of the two is very bad there is no difficulty in making a choice, but when both are good, who is to say which is the better? Every one, according to his preference, will take the apple or the peach; and, according to his eyes, will find the reddish or the greenish light more satisfactory.

HIGH-EFFICIENCY RADIATORS.

Although a number of explanations have been given for the apparent greater efficiency as radiators of light of certain bodies, no one of these has received unquestioned support. One which is frequently given is that these bodies have the property of selective radiation; that when heated they radiate a larger proportion of the energy given off in certain wave-lengths than do other bodies heated to the same temperature. Another suggestion is that by some sort of catalytic action the temperature of the source of heat is raised by the presence of the radiator. Other ideas have been expressed, such as unstable oxidation or luminescence, or other vague phrases, which, since they go no farther, are not explanations.

This subject was discussed in an interesting manner by Mr. James Swinburne at the recent meeting of the British Association for the Advancement of Science, who sought for an explanation of the great luminous efficiency of gas mantles. Mr. Swinburne touched upon the various explanations which have been offered, dissenting from all but one, which is that the blue Bunsen flame employed for heating the mantle is really very much hotter than is generally supposed, and therefore the mantle is really raised to a higher temperature than would be suspected. This idea is attributed to Ram, and to support it it is said that temperature indications of the Bunsen flame made by thermometers or pyrometers can not be depended upon, because these bodies are radiating, and must, therefore, be absorbing heat from the flame, and, as a consequence, are at a lower temperature than the flame. The gas mantle is, however, a white body and should, therefore, be a poor radiator, and, as a consequence, should come more nearly to the normal temperature of the flame. The efficiency of the luminous radiator increases enormously with the temperature, so that this explanation, if supported by facts, might be sufficient to account for the efficiency of the mantles; but, as is pointed out, it has not yet been shown that the radiator is a white body at the temperature of the flame. The mantle is formed in general of two substances —thoria and ceria. The former is used to produce the radiation, and the latter because it is permanent at high temperatures. In fact, where two or more materials are used in constructing the mantles the perplexity of the problem increases considerably, for changing their proportions will change considerably, and perhaps unexpectedly, the amount of light emitted. If the mantle be a poor radiator it will be at a high temperature, but will radiate little energy. On the other hand, if it be a good radiator it will necessarily be at a lower temperature, but may radiate more energy. In the first case, of the energy radiated the proportion which is luminous will be greater than in the second, but the total amount of luminous energy may be greater in the second case, and while it may be less efficient as a radiator it may be more efficient as a mantle—that is to say, it may convert into luminous rays a greater proportion of the heat developed by the flame.

It would seem that the subject might be studied with greater ease by means of the electrically-heated radiators of this kind, such, for example, as the Nernst glower. In this case the supply of energy to the glower may be made independent of its temperature, and may be controlled at will. With the gas mantle, on the other hand, the actual condition of the mantle itself determines not only the amount of energy which it gives out, but the amount of energy which it takes from the flame; so that an investigation made under such conditions would naturally be difficult. A number of investigations with the electrically-heated glower have been carried on, one of which was referred to not long since, it being at attempt to determine the temperature; and the investigator, Mr. L. W. Hartman was much surprised to find that it was apparently considerably lower than previous work had indicated. These results do not agree with Ram's explanation, as they point rather to some sort of selective radiation; but, as Mr. Swinburne says, though simple explanations appeal to him, "very simple explanations are very often wrong."

OUR CITIES OF EVIL SMELLS.

What a pity it is that with all our progress in building up cities and developing means of transportation and distributing power that we can not get away from certain old nuisances, and have brought about some new ones almost as bad! One can hardly make a long trip through a large city without finding some street badly torn up and the air for blocks around almost unbreathable from the horrible stench of gas. We have been afflicted with this nuisance for over half a century.

Another annoyance of a less violent type, but perhaps as bad because it is more widespread, is the disgusting trail left behind by the gasolene automobile. There is no need of a blood-hound to track the course of one of these modern vehicles through a city. Every one may do so for himself, though if his olfactory nerves are at all sensitive he is more apt to seek a different route. Why can not the automobile makers do something to mitigate this annoyance?

These are only two of the various offending odors which seem to be inseparable from urban life. Many of us, perhaps, have noses which have become so deadened through constant exposure that we no longer notice them, but those who are fortunate enough to be able to live where the air is purer suffer from the plague of smells every time they enter a city. We are agitating for clearer air, and we have given some attention to reducing noise. Let us also give some thought to securing sweeter air to breathe.

Digitized by Google

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW.

III—The Calorific Valuation of Fuels.

The laboratory calorific valuation of fuels is carried out by burning a weighed quantity of the dry fuel in a confined space surrounded by a known volume or weight of water, and by noting the increase in temperature of the latter, due to the combustion of the fuel. A very large number of calorimeters have been designed and employed in the laboratory for carrying out this test, but all of these may be brought into three classes, according to the character and method of supplying the necessary oxygen.

Either the oxygen is brought to the fuel in the form of a chemical compound, or in the free state; and calorimeters using gaseous oxygen for combustion of the fuel are differentiated by the pressure at which this oxygen gas is supplied, the Fischer and Mahler bomb calorimeters being the leading representatives of these two different types. In the following pages one calorimeter only of each class will be described, and the method of use will be explained in considerable detail.

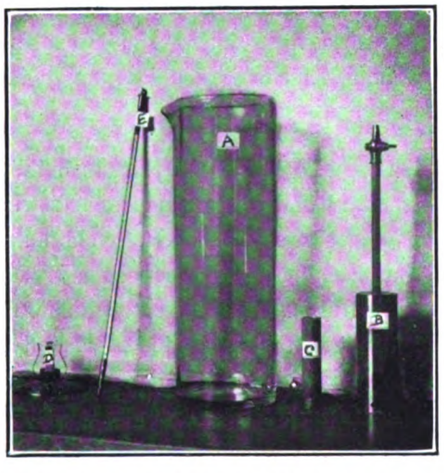


Fig. 9.—Lewis Thompson Calorimeter.

Of Class i, the Lewis Thompson calorimeter has been selected. Although the results obtained by this calorimeter has been often discredited, when used with the modifications suggested by the author it yields concordant results with certain classes of fuel.[2]

Of calorimeters using oxygen gas at normal pressure, the "Darling" calorimeter has been described; while of Class iii, the Mahler-Donkin bomb calorimeter has been dealt with.

[1] All rights of reproduction and translation are reserved. Copyright, 1906, by John B. C. Kershaw.

[2] Scheurer Kestner's tests with this form of calorimeter confirm this opinion.

In each case the descriptions and details are based upon lengthy trials in the author's own laboratory.

General Regulations for Calorimetric Work.

Wherever possible a room heated by hot water pipes or by hot air, and kept

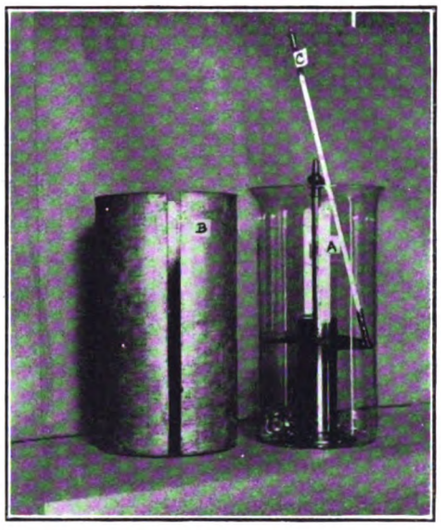


Fig. 10.—Modified Form of the Lewis Thompson Calorimeter.

at the same temperature day and night, should be used for calorimetric work. Rooms heated by open fires vary greatly in temperature at different times of the day, and this difference in temperature of the air causes difficulties in the calorimetric work. The whole of the calorimetric apparatus should be kept under cover in the same room, and it should be thoroughly cleaned and dried after each test. The water used in the tests should be drawn at least twenty-four hours before required, and stored in large bottles in the calorimeter room, so that both the apparatus and water may be at the air temperature of the room when required for use. Direct sunlight must not be allowed to fall on the apparatus during the tests; and when choice is possible a room with a north or east aspect is preferable to one facing south or west. Temperatures should be taken with standardized mercury thermometers read off with a magnifying glass. All temperatures taken during the tests should be noted down on paper with the time at which they were recorded; omission to form this habit will generally lead to spoiled tests at some later date.

In the winter months in laboratories heated by open grates, the tap water, if the other supply has failed, is often many degrees colder than the air of the laboratory. In such cases it will be found that the large volume of water required for filling the calorimeter can be speedily raised in temperature by the radiated heat from a coal fire. The water is placed in large pale green glass bottles eighteen inches from the bars of the grate, and the bottles are turned round at intervals of fifteen minutes. This method is less troublesome and less likely to lead to breakage than heating over the fire in a kettle or over the lamp in beakers.

When working with only half a gramme of fuel, radiation losses can be ignored, and water at the laboratory temperature may always be employed.

The Lewis Thompson Calorimeter.

Fig. 9 shows the separate portions of the Lewis Thompson calorimeter, as usually employed. A is a large glass cylinder holding 2,000 cubic centimetres of water—when filled to the mark; B is a copper cylinder open below and closed above by the copper pipe and tap—through which the final gases of the combustion are allowed to escape; C is a small copper cylinder in which the com-

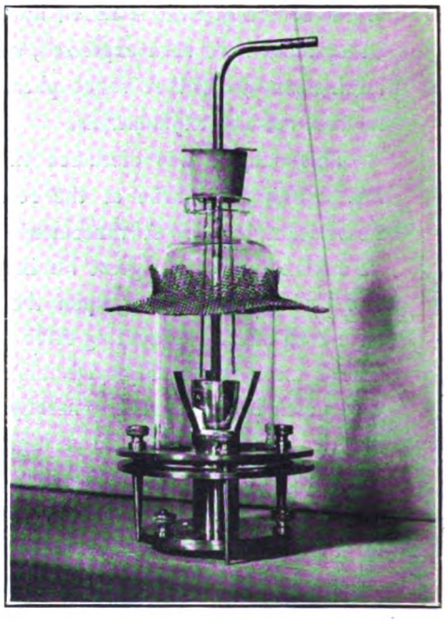


Fig. 11.—Darling Calorimeter.

bustion of the fuel actually occurs; D is the holder for the same; and E is a mercury thermometer, graduated in tenths, and reading from zero to forty-five degrees centigrade.

The method of use is as follows: Two grammes of the finely powdered and dried sample of coal, prepared as described in Article ii, are weighed out and intimately mixed with twenty-two grammes of the oxygen mixture.[1] This mixing is best carried out upon a sheet

[1] This mixture contains three parts of potassium nitrate to one of potassium chlorate, and must be quite dry.

Digitized by Google

of glazed white paper, and must be continued until no black specks are visible, and the mixture is of a uniform gray color. The mixture is now transferred to the copper cylinder C, with the aid of a dry funnel having its leg cut off, and is pressed down by means of a glass rod having a flattened glass button on its end.[1] When the whole of the mixture has been transferred to C, this is placed in the holder D, a few strands of fuse are embedded in the top of the mixture, the projecting free ends are ignited, and after quickly covering with the copper cylinder B, the whole is placed in the vessel A, containing 2,000 grammes of water, the temperature of which has been most carefully noted. If the ignition and combustion are successful, the test is now nearly completed, for after the whole of the combustion gases have bubbled up through the water in A, it is only requisite to open the tap at the top end of B, allow the water access to the cylinder C, and to thoroughly mix the water in A by plunging the cylinder up and down in it, to obtain the final

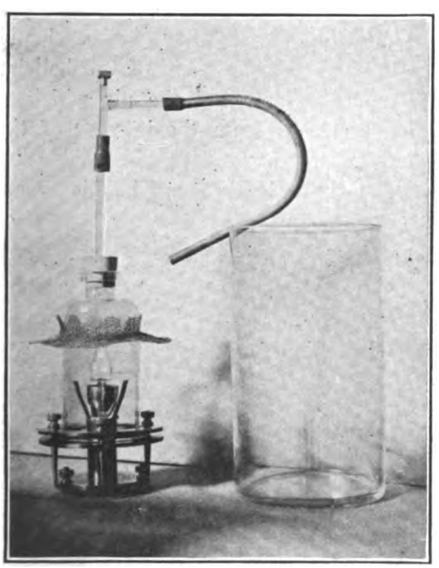


FIG. 12.—ANOTHER FORM OF THE DARLING CALORIMETER.

reading of the thermometer which gives the increase in heat due to the combustion of the two grammes of fuel.

The calculation which yields the calorific value of the fuel is then simply obtained by use of the equation $C = \frac{(2{,}000 + x)\ t}{2}$ in which C = calorific value; x = the water equivalent of the apparatus in centigrade units and t = the gain in temperature. The value of x for this apparatus, and in fact for all forms of calorimeter, is best obtained by testing a standard sample of fuel or pure cellulose, of known calorific value, and by using x as the unknown in the above equation in place of C, the value of which can then be inserted.

The improvements in the Lewis

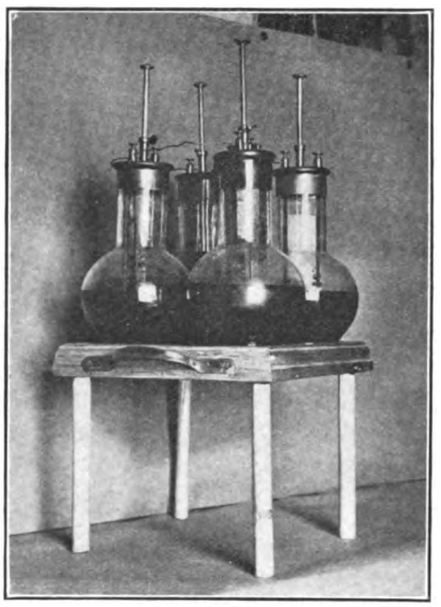


FIG. 13.—BATTERY OF BICHROMATE CELLS FOR FUEL IGNITION PURPOSES.

Thompson calorimeter, and method of use devised by the author, are as follows:

1. The weight of water used for each test is increased to 3,000 grammes by use of a larger vessel; see A, Fig. 10.

A thin Jena glass beaker replaces the thick vessel shown in Fig. 9. This change lessens the rise in temperature and thus diminishes radiation losses.

2. Radiation losses are further minimized by use of the tin cylindrical shield B in Fig. 10 which surrounds the beaker, and provides a non-conducting air jacket between the water and the outside air.

3. A copper gauze ring is provided to fit on to the copper cylinder and nearly touch the beaker at all points. This breaks up the bubbles that pass through the water on making a test, and causes the waste gases to be better cooled.

4. The usual thermometer is replaced by one which allows the temperature to be read one one-hundredth of a degree centigrade. This improvement in reading off the increase in temperature must, of course, be accompanied by increased care in the weighing, mixing and measuring operations. A one-litre flask is used for measuring the water used for the test.

5. The oxygen mixture is dried before use, one hour at 110 degrees centigrade for each test) and the amount to be employed is calculated from the combustible actually present in the fuel. The formula used for this calculation is $W = \frac{100-x}{4}$ in which W = the weight of oxygen mixture required for two grammes of the fuel, and x = the percentage of ash in the dry sample.

6. The mixing of the oxygen compound with the two grammes of fuel and charging of the copper cylinder with the same are most carefully carried out, and no loss of fuel is allowed to occur in this operation. The cylinders are numbered according to their capacity as measured by water contents, and as far as possible it is planned that the fuel and oxygen mixture shall fill the cylinder to within three-quarters inch of the top. The precise degree of pressure it is necessary to employ in filling the cylinder with this mixture can only be learned by experience; if too loosely packed the combustion is too rapid; if too tightly packed the charge will probably become extinguished before all is burnt. A combustion should last one minute.

7. The ignition fuse is made of four strands of lamp wick, one inch in length, dipped in potassium nitrate solution and dried. The four strands are twisted together, and one-quarter inch of the ends are then spread out in the form of feet, and the little igniter is placed upon the top of the charged cylinder with the ends lightly embedded in the mixture, which must be left loose and porous at this place.

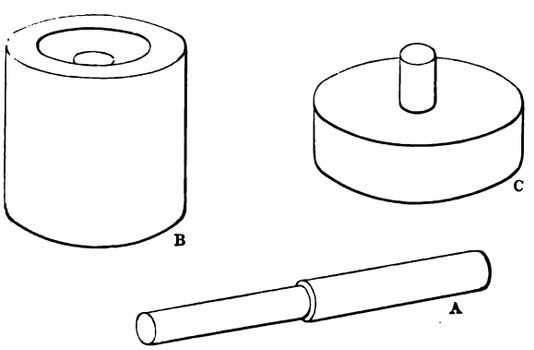


FIG. 14.—MOULD FOR FUEL BRIQUETTES.

8. The water equivalent of the apparatus is determined by actual trial with a standard fuel as already described.

9. The copper vessels, B, C, and D, in Fig. 9 are placed in the calorimeter after C is charged, and the temperature

[1] This is easily made by heating the end of a glass rod to redness and by pressing the hot end on a flat surface of cold iron.

Digitized by Google

is read when equilibrium is established. The tap of B must, of course, be closed during this period. The charge is then ignited by withdrawing and disconnecting B, C, and D for a very brief period of time.

Operating as described in 6 and 7, the author is seldom troubled with failures to ignite, or with incomplete combustion.

Using this modified form and method of working with the Lewis Thompson calorimeter, the author has obtained results which are within one per cent and two per cent of the calculated values of the fuel, when testing bituminous fuels containing over twenty-five per cent of volatile matter. The conditions under which the test is made must, however, be kept as far as possible the same as those under which the water equivalent is determined; and any wide variation in these conditions will lead to discrepancy in the results. With semi-bituminous and anthracite coals, the Lewis Thompson form of calorimeter yields, however, unsatisfactory results, owing to the amount of unconsumed carbon. Coke and peat also can not be burned in this calorimeter, so that its field of usefulness is somewhat narrowed and restricted.

For correct calorific tests of all these classes of fuel, either of the calorimeters about to be described must be used.

THE DARLING CALORIMETER.

The Darling calorimeter is based upon the principle of combustion in a current

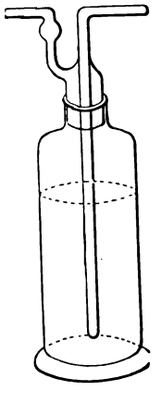


FIG. 15.—WASH BOTTLE FOR OXYGEN SUPPLY.

of oxygen gas at normal pressure, and the apparatus is a modified and improved form of the well-known William Thomson calorimeter. Fig. 11 shows the essential parts of the Darling calorimeter. A small nickel or platinum crucible, one and one-half inches high by one inch in diameter, is held by brass arms in the centre of the perforated brass base-plate of the apparatus. A flanged glass bell-jar provided with a rubber cork, carrying a brass oxygen supply pipe and two copper conducting wires, is clamped to the base-plate by means of rubber rings and by a brass ring plate held in position by screws or nuts. It is advisable to use a rubber ring above and below the glass flange on the bell-jar to avoid breaking this—when tightening the milled head

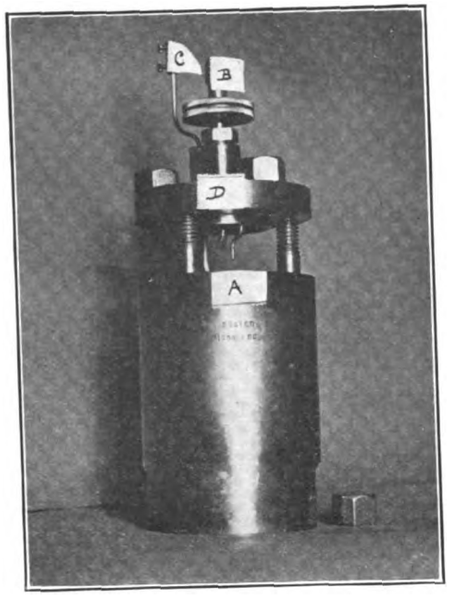


FIG. 16.—MAHLER-DONKIN BOMB CALORIMETER.

screws. A brass gauze ring is shown in position on the bell-jar in Fig. 11, but this is an addition to the original apparatus. Fig. 12 shows another form of the apparatus in which the brass oxygen supply tube is replaced by a tube of hard potash glass widened out to form a cup at its lower end, and connected above to the oxygen cylinder or gas-holder by a glass T piece. In the first form of the Darling apparatus, ignition of the charge occurs by means of a fine platinum wire fixed between the lower ends of the two copper conducting wires, which are themselves connected to four bichromate cells or to some other source of electrical energy. Fig 13 shows a convenient bichromate battery—made up of four pint cells. In the second form of apparatus, ignition occurs by means of a small piece of glowing charcoal (.01 to .02 gram) this being dropped down the oxygen supply tube by removing the small cork which closes the vertical end of the glass T piece. This method of ignition is preferable to that recommended by Darling as the use of sulphur for igniting the charge has many advantages. In both forms a sheet tin cylinder surrounding the glass vessel diminishes the reduction losses and is a useful addition to the original apparatus.

The method of carrying out a determination with the Darling calorimeter is as follows:—1,400 grammes of water are measured carefully into the glass vessel shown in Fig. 12, using a one-litre flask and graduated cylinder for this purpose. From half to one gram of the dry sample of fuel is weighed out into the crucible; this is placed in its holder and the apparatus is clamped together as shown in Figs. 11 and 12. If electric ignition is to be employed the ends of the two copper conducting wires are joined by a short piece of very fine platinum wire, the loop of which is made to dip under the surface of the fuel contained in the crucible. It is wise to try the effect of the current on this wire before clamping up the apparatus for each test, since at times the bichromate battery requires cleaning. The oxygen supply tube is now connected to the gas-holder or cylinder containing oxygen, and a slow but steady current of oxygen is passed through the apparatus, which is now ready for immersion in the glass vessel containing the water.

When immersed, the water should reach up to the neck rim of the bell-jar but not above it, and the air which is being displaced from the interior of the apparatus by oxygen should bubble up through the water in small bubbles, from

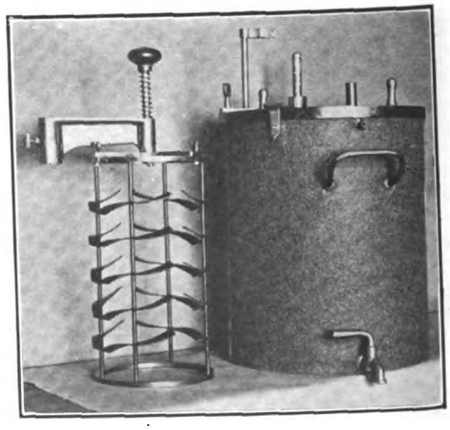


FIG. 17.—WATER VESSEL AND MIXING PADDLES.

all portions of the perforated base-plate. The temperature of the water is next taken at two-minute intervals, and when the mercury in the thermometer has become stationary, the stream of oxygen is made much more rapid, and the coal is ignited. If charcoal be used for ignition, the small weighed particle is held over a lighted match until it commences to glow, when it is dropped down the oxygen tube. When the coal contains much vola-

Digitized by Google

tile matter, there is some danger of explosion during the early part of the combustion, and considerable skill and experience in the management of the apparatus are necessary, to attain perfect combustion. It is advisable therefore to start with the lower end of the oxygen supply pipe high up in the bell-jar, and to have a very rapid current of oxygen when the coal (as shown by the approximate analysis) contains over thirty per cent of volatile matter.

When the greater portion of the volatile matter has been distilled and burnt, only coke remains in the crucible, and the oxygen tube can be pushed down gradually, until it is below the crucible rim. The combustion can be finished with the lower end of the oxygen supply tube nearly touching the glowing residue in

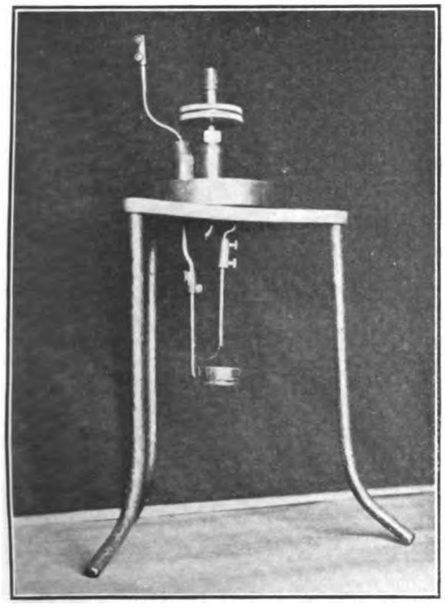


FIG. 18.—BOMB COVER WITH PLATINUM DISH AND IGNITION WIRE IN POSITION.

the crucible. When the tube shown in Fig. 10 is employed for supplying the oxygen to the fuel it is necessary to work this from side to side, in order to spread the stream of oxygen over the whole of the fuel and residue.

The combustion is finished when the residue in the crucible ceases to glow, but the crucible itself should become red-hot during the combustion, and in order to avoid premature loss of heat it is advisable to support the crucible upon an asbestos tray. The current of oxygen gas through the apparatus is then slackened, and the temperature of the water is noted every half minute, until a fall occurs. According to the inventor, four and one-half minutes should suffice to burn one gram of fuel, but the author has never succeeded in carrying out a test in this time. The calculation is made as before, by use of the equation $C = \frac{(1{,}400 + x)\ t}{w}$: in which C equals the calorific value of the fuel, t equals the gain in temperature of the water, w equals the weight of fuel used, and x is the water equivalent of the apparatus. Although a value for x is given with each apparatus sold, it is far better and safer to determine it by use of a standard combustible, such as cellulose or pure carbon, as described in the previous section of this article.

The Darling calorimeter only yields entirely satisfactory results with fuels low in ash and in volatile matter. When fuels containing a high percentage of volatile matter are burned in the Darling apparatus there is a tendency for some of the volatile hydrocarbons to escape unconsumed; and when fuels high in ash are tested, there is a tendency for portion of the fixed carbon to remain unburned in the crucible. In the case of coke, this unconsumed carbon may amount to ten per cent of the total combustible matter.

The first of these difficulties may be overcome by mixing one-third of its weight of china clay with the fuel before burning in the calorimeter. This remedy, however, is only partial, for it increases the amount of ash remaining in the crucible, and therefore the risk of some of the fixed carbon remaining unconsumed.

The second difficulty can only be overcome by making small pellets or briquettes of the fuel sample, and using these for combustion in the calorimeter in place of the finely powdered sample. Fig. 14 shows the pellet mould used by the writer for this purpose. Two grammes of the finely powdered sample are mixed in a small agate or glass mortar with one cubic centimetre of a one per cent solution of pure gum-arabic in water. Very bituminous fuels can be moulded without adding gum-arabic. This paste is then moulded into three cylinders in the mould shown. Each of these is cut while still moist into two halves with a sharp knife, and the six little pellets of fuel obtained in this way are then dried at 230 degrees centigrade for one hour in the air-bath. Two, three or four of these pellets, according to the weight required, are then used for the calorimetric test, which is carried out as already described.

When fuels containing less than ten per cent of volatile matter are tested in the Darling calorimeter, some difficulty will be met with in the absence of an electric current in causing them to ignite, for neither charcoal nor sulphur will always suffice to start the combustion. The best plan in such cases is to use a small weighed portion of some previously tested bituminous coal, either making a mixed pellet of the two coals, or using both in the powdered form and sprinkling a little of the standard bituminous fuel on the surface of the other in the platinum crucible. The different calorific value of the added fuel must of course be allowed for, in calculating the result of the test.

By using only half a gramme of fuel and a thermometer reading to one one-hundredth of a degree centigrade, the time required for burning the fuel and the gain in temperature can be reduced one-half, and the errors due to radiation losses correspondingly diminished. When working with this small

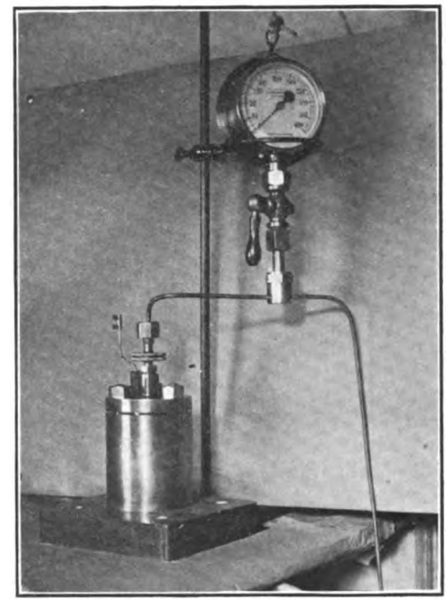


FIG. 19.—BOMB, WITH OXYGEN SUPPLY PIPE CONNECTED.

amount of fuel, very careful and accurate weighing and measurements are required to obtain reliable results. The combustion of the fuel can be effected much more quickly when the fuel is in briquette form, since the current of oxygen gas can be increased greatly without danger of blowing the fuel out of the crucible.

The oxygen used in working the Darling apparatus should either be stored in a gas-holder over water, or should be passed through a glass tower filled with pumice soaked in water, in order that it may take up before use all the water it can carry at the temperature of the laboratory.

It is also useful to have a wash bottle through which the oxygen bubbles in-

Digitized by Google

serted between the gas-holder or cylinder and the calorimeter; as in this way the speed of the current can be more easily noted and controlled. Fig. 15 shows a suitable form of wash bottle.

When used with the precautions decribed above, the Darling calorimeter can be made to yield accurate results with all classes of fuel. But as usually employed, the combustion is in many cases imperfect, and unless allowance be made for the unburned hydrocarbon gases or fixed carbon, the calorific values obtained are too low.

THE MAHLER-DONKIN BOMB CALORIMETER.

Figures 16 to 21 show the component parts of the Mahler-Donkin bomb calorimeter. The combustion of the fuel in this calorimeter is carried out in oxygen gas, at from 200 to 400 pounds' pressure. Fig. 16 shows the most important portion

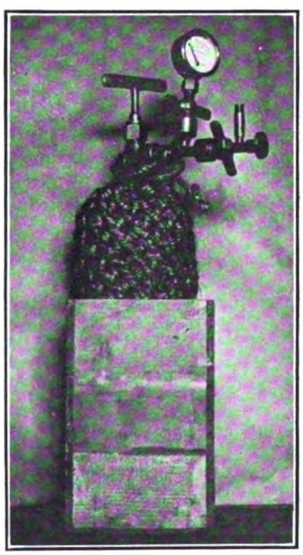


FIG. 20.—OXYGEN CYLINDER WITH VALVE AND PRESSURE GAUGE.

of the apparatus, namely the bomb. This is a heavy gun-metal cylinder (A), provided with three screwed stud pins for bolting down the cover D, and lined inside with gold to protect the metal from corrosion by the acids formed during combustion of the fuel. The cover is provided with a milled head screw valve B for regulating the inlet of oxygen gas; with an insulated conducting wire C which runs through the cover and terminates below, and with three heavy nuts for bolting down the cover on to the cylinder. Thin lead wire is used to make the joint between the cylinder and cover, and the bomb is tested up to 1,500 pounds' pressure before leaving the maker's works. Fig. 17 shows the rest of the apparatus: namely a water container and paddles for quickly obtaining a uniform temperature. A water-jacket and also an air-space surround the inner vessel containing the measured volume of water and the bomb, and the mixing paddles fit round the latter. These paddles can be worked up and down or in a circular manner, by the wooden knob which projects six inches above the water container when all the apparatus is fitted together. The ignition of the fuel occurs by electric heating, a fine platinum wire being used as bridge between the lower ends of the two electrodes fixed on to the bomb cover. Fig. 18 shows the cover alone supported on a tripod stand, with the small platinum dish and the platinum wire ignition loop. It is well to make a trial test of the electrical connections in this position, since if the platinum wire does not heat to redness it is comparatively easy to find out the cause, whereas later on, when the cover is bolted on to the cylinder and the bomb is immersed in the water, a failure to ignite causes much trouble. Platinum wire must be used for ignition purposes. The author uses the finest made, of which twelve inches weigh two grains. Iron wire can not be used, for it produces fused iron oxide on ignition and this speedily corrodes the gold plating of the bomb at those places where it falls. A small platinum dish, one inch in diameter and three-eighths-inch deep, is preferable to a crucible for holding the fuel, since it is easier in this case to arrange that the platinum loop shall dip in the fuel. For this purpose the wire is wound seven or eight times around the straight electrode, and the loop is lengthened as required by pulling one or more of these coils down with a pair of small forceps. The weight of fuel used for carrying out a test with the bomb calorimeter varies from .40 to 1.0 gramme. The smaller the quantity of fuel used, the smaller is the rise in temperature of the water, and the less is the time required for completing a test, both of which reduce the error due to radiation losses. On the other hand, this method of working demands great care in all weighing and measuring operations; and some degree of skill in manipulating the apparatus is necessary before correct results can be obtained when working with .5 gramme of fuel.

After weighing out the fuel roughly into the platinum dish, it is advisable to heat the same for one-half hour in the air-bath at 230 degrees centigrade, and to reweigh carefully before making the test with it. The dish is then transferred to the holder under the cover, the platinum wire-ignition loop is lowered carefully until its lower edge just dips into the fuel, and the cover is placed on the bomb and bolted down. Ten cubic centimeters of distilled water, to absorb the acid gases produced by the combustion, have been previously measured into the bomb. Great care must be taken not to jerk or jar the bomb while bolting on the cover, since this may cause a displacement of the ignition wire and a failure to ignite later on. A wooden block holder is provided with the Mahler-Donkin bomb, which can be screwed to the laboratory working bench; this greatly facilitates the screwing tight of the cover. The next step is to fill the bomb with oxygen, and the necessary connections to the oxygen cylinder are shown in Fig. 19. A pressure-gauge, recording up to 400 pounds, is

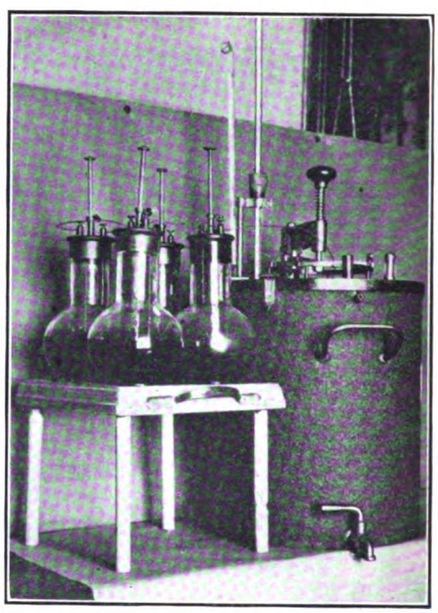


FIG. 21.—THE MAHLER-DONKIN BOMB CALORIMETER READY FOR IGNITION.

provided between the oxygen cylinder and the bomb, and a thick-walled copper tube, provided with flanged ends and nuts, is employed to connect this with the cylinder and bomb. Small lead washers assist in making these joints gas-tight. It is well to have a fine screw-regulating valve and a pressure-gauge reading up to 120 atmospheres attached to the oxygen cylinder, as shown in Fig. 20. Otherwise it is difficult to control properly the flow of gas into the bomb, and too rapid a rush of oxygen may cause some of the finely powdered fuel to be blown out of the platinum dish. The gas must be admitted to the bomb slowly. The amount required, as indicated by the pressure, varies with the amount of fuel used. For half a gramme of fuel, a pressure of 220 pounds suffices; for one gramme of fuel,

Digitized by Google

400 pounds is necessary. With this higher pressure there will be some difficulty in keeping all the joints tight, but slight leaks may be ignored. In the Mahler-Donkin bomb, as originally designed, a considerable loss of pressure and of gas occurred also on closing the milled head-screw valve on the top of the bomb, since to close this it was necessary to loosen the screw-nut connecting the oxygen supply pipe above it. The author has, therefore, had a small back-pressure valve inserted in his bomb, in the portion of the cover marked B, Fig. 15, and this comes into action and closes the exit pipe as soon as the exterior pressure is relieved. This is a most useful addition to the earlier design.

The milled head-screw valve is now closed, the bomb disconnected from the supply, and the opening in the top of the bomb is closed by the screw-nut shown in the foreground in Fig. 16. The bomb is now carefully transferred to the water vessel which has been previously filled with 2,500 cubic centimeters of water at the laboratory temperature, the mixing paddles are placed in position, and the conducting wires, from a bichromate battery of four cells, or from some other source of electrical energy (two amperes at twelve volts are required), are connected to the terminals on the bomb. The screw-nut, projecting above the water in the calorimeter vessel, is used as the second terminal on the bomb. The mixing paddles are now worked gently until the thermometer dipping in the water of the inner vessel ceases to rise or fall, and the fuel is then fired by depressing for three seconds the last of the zinc plates of the bichromate battery. Within half a minute, if the ignition has occurred properly, the thermometer will begin to rise, and the mixing paddles are again worked steadily until the mercury again becomes stationary. The final temperature is now recorded, and the test is finished.

For work with this calorimeter the author uses a specially made mercury thermometer, twenty-four inches in length, graduated in fiftieths and ranging from ten degrees centigrade to twenty-five degrees centigrade. With the aid of a magnifying glass one one-hundredth of a degree can easily be read on this thermometer.

The calculation is carried out as before by aid of the equation: $C = \frac{(2{,}500 + x)\,t}{w}$ in which C represents the calorific value, x the water equivalent of the apparatus, t = the gain in temperature and w = the weight of fuel used in grammes. The value of x is best determined as before, by making a test with pure cellulose naphthalene or carbon, and by inserting x as the unknown value in the above equation. Pure naphthalene has a calorific value of 9,692 calories, pure cellulose of 4,200 calories and pure amorphous carbon of 8,137 calories.

The Mahler-Donkin bomb yields accurate results with all classes of fuels, and when once fitted up with all the necessary accessories tests can be made with it in from one-half to one hour. The whole of the apparatus should be dismantled and cleaned after each test, especial attention being given to the bomb cylinder and cover, as the gold plating of these requires very careful cleaning and drying if it is to last any length of time. Portion of the thin platinum wire used for ignition is generally fused and burnt during the combustion, but the heat produced by this is included in the value of x used for the water equivalent of the apparatus.

When testing anthracite or coke the platinum wire ignition sometimes fails to ignite the charge, and to overcome this difficulty ten grammes of a standard bituminous fuel may be used on top of the weighed portion of coke or anthracite as ignition charge. The thermal value of this addition must be allowed for in calculating the results of the test.

A Letter from Manchuria.

The following excerpts from a private letter recently received in this city, from Manchuria, may prove of interest:

I am ever so much obliged to you for the ELECTRICAL REVIEW which I just received. I am greatly pleased to see that notwithstanding that nearly ten years have passed, you still remember our friendship. Many things have happened during the above-mentioned time. I will give you a short description of all.

When I returned from my trip with Patrick Alexander in 1897, I joined the telegraph again. In 1890 I was engaged as interpreter for the erection of the Lake Baikal ice-breaker, which was brought in pieces or sections to Listreincehnia on Lake Baikal and erected by Englishmen, whose interpreter I was. After she was finished, I was given a billet of third mate of the big boat called the "Baikal." In 1901 in the summer, I was engaged again as interpreter to a gold-mining Russian company which had a concession in Mongolia. The mines were to be worked with hydraulic power, the same as in California, and all the principal people were Americans from California; the chief manager was from the American side, James Dietrick, of San Francisco. The mines failed—certainly on account of everlasting frost, which a hydraulic can not take. We had also a dredger, which was a total failure; so I came to the conclusion that what you can do in America you can not do here.

After stopping at the mines two years, I had to leave on acount of their bankruptcy. In the summer of 1903, I returned to Irkutsk with 1,000 rubles in my pocket. My family, mind you, was wandering all the time with me. I could not find a job to suit me in Irkutsk, but I met a friend one day who told me that the Eastern Chinese Railway Company was engaging telegraph operators, so I applied for a billet, and received it. I arrived to headquarters of the company at Harbin with all the little Grants, in October, 1903. I was on my arrival ordered to Port Arthur, where I went; and it was in my presence, dear old friend, the first shot was fired at us. The war had opened, so I as quick as possible sent my family away, but I could not go; it was against my principles. The day after the war broke out I was made the superintendent of the central telegraph office, Eastern Chinese Railway Company, on account of the running away through fright of the chief, whose place I took.

I held out the whole of the siege, and stood to the last. I showed some bravery during the siege, for which I received a St. George's cross, of which I am proud; it is not for the sake of wearing the regalia, but for my son, who will very soon take his father's place, and that is a good example for a young man—to let him be like his father and be true to his country when he is needed.

The siege was awful: it is impossible to describe it on paper or by words—something awful at first, but a man gets used to it; it's nothing after a time; a man changes into something unexplainable; he loses fright, his nerves get ironized—if it's possible to express yourself that way; you have no pity for anything, and somehow or other you do not feel frightened to die.

After the capitulation, December 19, 1904, I was interpreter for the Russian committee for the handing over the railway to the Japs. I left Port Arthur, January 10, 1905, *via* Pigeon Bay, with all my telegraph clerks, whom I managed to pass as non-combatants. We went on Chinese junks to Chefoo, from there to Shanghai, and then to Odessa, where I arrived on March 13, 1905. . . . I am at present serving for the Eastern Chinese Railway Company, as English teacher. I am teaching English to telegraph clerks, which is necessary now to everybody. I have lots of private lessons, and I make now from 700 to 800 rubles per month—making money "hand over fist." It is a craze here now to learn English.

Could you be kind enough to send me some catalogues and prices of electrical supplies: messenger boxes, in fact a whole plant—relays, registers, boxes, batteries and diagrams for the district stations, for putting up a district messenger telegraph office—the latest messenger boxes, please.

A. GRANT.

Harbin, Manchuria, July 1.

Digitized by Google

Electric Operation of the Teltow Canal.

Description of the System in Use on an Important German Waterway.

By Frank C. Perkins.

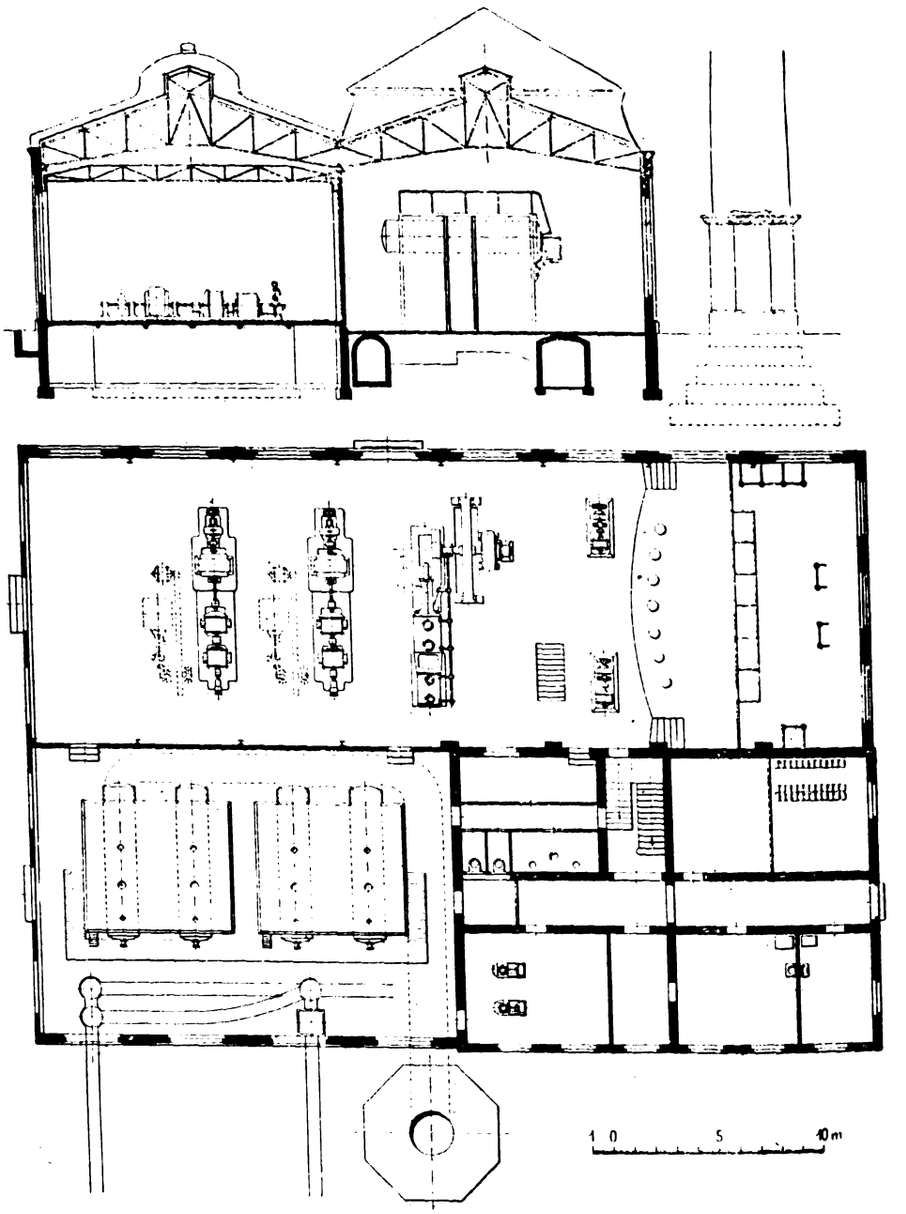
ELECTRIC canal towage in Germany has recently been demonstrated as commercially successful on the Teltow canal near Berlin, and the application of electricity to inland waterways has been shown to be most desirable.

The Teltow canal is 23.5 miles long and connects the river Spree with the Havel at Glienicker Lake. At the river Spree about nine miles from Berlin, near Drunau, the canal starts with a width of sixty-eight feet and a depth sufficient for canal boats drawing nearly six feet of water and having 1,200,000 pounds register. The boats usually employed on this canal are 110 feet long and 8.6 feet wide. The canal has a depth of eight feet at low water in the middle and seven feet at the sides.

Between Havel and the Spree there is a difference of level of about ninety-seven feet and a system of locks has been installed about five miles from the Havel, consisting of two locks placed side by side with a wide masonry wall between them. A system of conduits has been provided within this wall for filling and emptying the locks with a minimum amount of water, the arrangement being such that the water used by a boat going down the canal may be emptied into the other lock for raising the boat going in the opposite direction. During the low-water season water is pumped from the lower to the higher level by means of a centrifugal pump electrically operated, having a capacity of one cubic metre a second and electric hoisting gates are used at the locks. Each of these four electric hoist gates is operated by a fifteen-horse-power motor, running at a speed of 600 revolutions per minute. These electric motors as well as the power station for supplying the necessary current were installed by the Siemens-Schuckert Company, of Berlin. The motors are of the three-phase induction type, operating at a pressure of 200 volts. The gates may be raised to their full height of 8.27 meters in one minute by means of electric power. Electromagnetic brakes are provided and the gates are counterbalanced with variable weights, the electric motors being employed for both hoisting and lowering.

During high water it is necessary to conduct a portion of the water from high to low level and this is done by means of a gate in the middle wall operated by an eight-horse-power induction motor. This alternating-current motor is also operated from the power station at a speed of 580 revolutions a minute.

The accompanying illustration shows the interior of the power station of the Teltow canal which is equipped with a 300-horse-power reciprocating engine installed at that end of the station nearest the switchboard, together with two steam turbines of the Zoelly design, constructed by Escher, Wyss & Company, of Zurich, Switzerland. Each of these turbine units consists of two steam turbines, a high-pressure and a low-pressure turbine, provided with five runner discs, and developing a total of 1,000 horse-power. There is thus a total capacity of 2,300 horse-power, two 1,000-horse-power turbines and one 300-horse-power reciprocating engine. Space has been provided for other units to be added as additional power is required. The reciprocating engine is coupled to a large revolving-field alternator, and a multipolar direct-current dynamo on the same shaft.



PLAN AND ELEVATION OF CENTRAL POWER STATION, TELTOW CANAL.

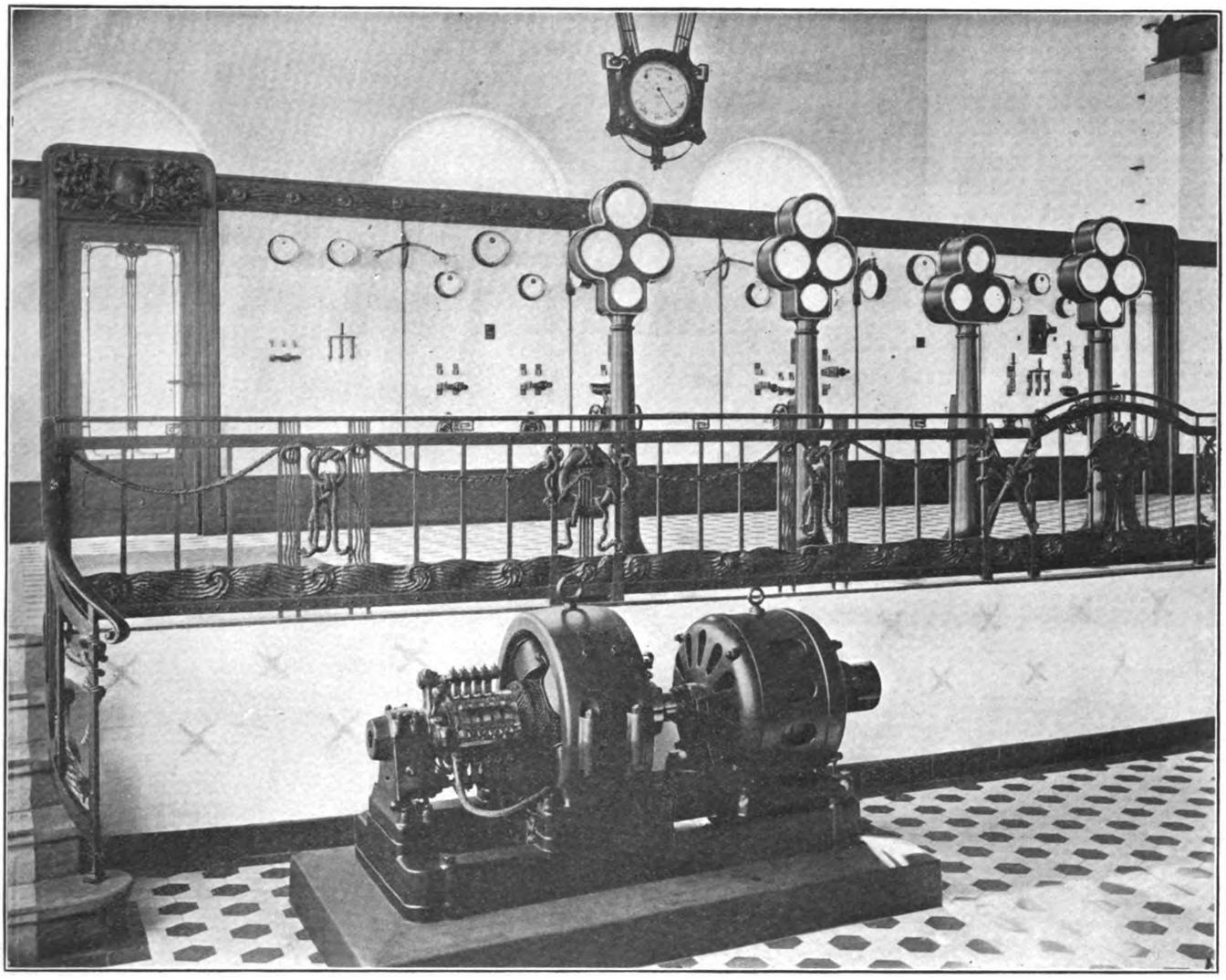
Each of the 1,000-horse-power steam turbines is directly coupled to a three-

Digitized by Google

phase alternator of the revolving-field type, supplying a current of 6,000 volts and a frequency of fifty cycles per second. On the same shaft is mounted a Siemens-Schuckert compound-wound direct-current dynamo of the inner-pole type, supplying a continuous current at a pressure of 600 volts. The alternators driven by the steam turbines have a rating of 650 kilowatts, and 230 kilowatts is the output of the alternator direct-connected to the reciprocating steam engine. The direct-current machine driven by this engine is rated at 110 kilowatts, while the two continuous-current dynamos operated by the steam turbine are of 200 kilowatts each.

In connection with the steam turbine, jet condensers are employed and three-phase motors are utilized for driving the pumps. A vacuum of ninety-five per cent is maintained, as there is plenty of condensing water. Steam is supplied to the high-pressure turbine at a pressure of 180 pounds per square inch, superheating being provided to 300 degrees centigrade. There are four water-tube boilers, each of which is provided with a superheater which can be utilized or not as desired, the latter having a heating surface of sixty-five square feet, supplying 8,000 pounds of superheated steam per hour. Each of the boilers has a heating surface of 2,200 square feet, and supplies steam to the turbines at the rate of 13.4 pounds of steam per horse-power-hour, this being the consumption of the 1,000-horse-power turbine at full load. At half-load the steam consumption is increased to 15.6 pounds. At three-quarters load the consumption is 14.3 pounds.

At the end of the Teltow power station, near the switchboard, are located the exciter units which consist of three-phase alternating-current motors of the induction type direct-coupled to shunt-wound direct-current dynamos rated at thirty-two kilowatts, supplying the exciting current at sixty-five volts. The three-phase induction motor of each exciter set is supplied with an alternating current of 220 volts and drives the generator at a speed of 960 revolutions per minute. A storage battery has also been provided for lighting the station and exciting the alternator fields when desired or in case of emergency. This accumulator plant consists of thirty-six storage belts, each having a capacity of 126 amperes for a period of half an hour, which is sufficient for lighting as well as exciting the two large alternators for that length of time.



SWITCHBOARD AND EXCITER SETS AT TELTOW CANAL CENTRAL POWER STATION.

At the East end of the canal a substation has been provided which is equipped with two rotary converters, having a capacity of 150 kilowatts each, and operating at a speed of 1,000 revolutions a minute. Space is also provided for a third unit when desired.

In the Teltow central station there is an overhead traveling crane of sixteen and one-half tons' capacity.

For the operation of a locomotive towing the canal barges, for the trolley line and for the towing carriages at the locks,

Digitized by Google

continuous current is utilized, while for all auxiliary work, as well as for lighting purposes, the three-phase alternating current is utilized.

Various types of engines, motors and hauling methods have been tried on this canal. Alcohol engines as well as gas engines have been utilized on the boats, also steam engines with oil-fired boilers and electric overhead trolleys with two collecting poles have been tried for conveying current to electric motors in experimental boats.

A sixty-horse-power Daimler alcohol motor was placed in one of the boats and was found to take .01 kilogramme of alcohol per ton-kilometre (0.035 pound per ton-mile). This would result in a cost per ton-kilometre of one-twentieth of a cent with alcohol costing five cents per kilogramme (.08 cent per ton-mile).

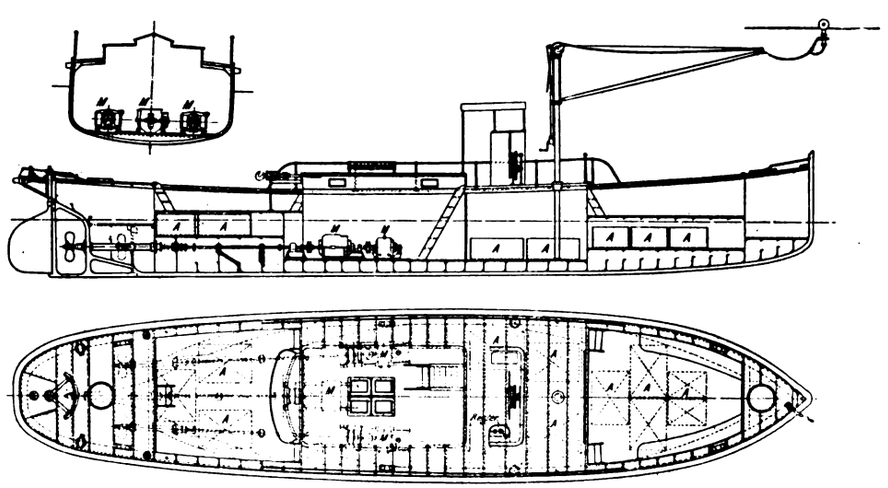
With the oil-fired boilers and the steam engine the cost of operation when towing two boats with a load of 2,400,000 pounds at a speed of two and a half miles per hour would be .01 cent per ton-kilometre (.016 cent per ton-mile), with oil costing less than a cent per kilogramme. The steam oil-fired boiler tug was found to take 1.1 pounds of fuel oil per horse-power-hour, the boat taking 100 horse-power at the speed above mentioned.

An electric tug was also tried and at the same speed, two and a half miles per hour, the boat was found to have an efficiency of twenty-two per cent, the energy consumption being nine kilowatt-hours per ton-kilometre (14.5 kilowatt-hours per ton-mile). The efficiency was found to be low, and therefore the cost of operation so high that the electric power tug was given up. This experimental boat with motor-driven trolley, called the Teltow, was of the triple-screw type and was provided with a storage battery of 220 cells, having an output in five hours' discharge of 244 ampere-hours. The battery was located in three of the six compartments of this boat, with a total weight of 26,000 pounds.

Each of the three propellers was provided with a series direct-current motor connected to the shafts by flexible coupling. The three motors were placed in one compartment. The motor driving the centre shaft had a capacity of twenty-five horse-power and ran at a speed of from 300 to 500 revolutions a minute, while the two motors driving the side propellers developed twenty horse-power each.

For collecting the current to supply the motors of the electric tug, double trolley poles were tried, but were not very successful, and the Lombard-Gerin motor-driven trolley was also used, which gave better success, although it was noted that the trolley-collecting motor would tend to lag behind when the boat was operating at full speed under light load, while it would travel in advance of the tug when several heavy canal-boats were being pulled. As before mentioned, the cost of operation caused the electric-power tug-canal haulage to be given up in favor of a locomotive towing the boats from the side of the canal on a specially constructed track.

The Siemens & Halske canal locomotive haulage was designed to operate on a track of one-meter gauge, hauling two loaded canal-boats of 600 tons each at a speed of 2.5 miles per hour. This locomotive was found to require an energy consumption, at the above speed, of 5.5 kilowatt-hours per ton-mile, while with a speed of 3.1 miles per hour, the energy consumed was found to be 8.5 kilowatt-hours per ton-mile. It is stated that the mean efficiency of the locomotive was sixty-five per cent.



Plan and Elevation of Electrical Towboat, Teltow Canal.

This electric canal-haulage locomotive was provided with a four-wheel truck, equipped with two eight-horse-power electric motors of the series direct-current type, and a trailing pair of wheels supporting the rear end of the locomotive with the guide arm and drum for the tow line. The hauling motors were connected by two sets of gears to the axles, operating at a speed of 800 revolutions a minute; these series motors were driven from a 500-volt overhead trolley line. The guide-arm for the tow line is manipulated by a three-horse-power motor connected with a screw to the arm through a pair of bevel gears. This motor operates at a speed of 1,460 revolutions per minute, and is also used for driving the drum which winds up the towing rope consisting of a ten-millimeter wire line. The coupling of the drum is of the friction type, so arranged that when a pull of 2,500 pounds is exceeded, slipping will occur. Therefore when starting a heavy load the locomotive will take its load gradually, as the 400-pound pull required in starting a 600-ton boat will cause the drum to slip until it is partially under way.

The locomotive weighs 16.5 tons. The greater part of the weight is carried by the wheels on the side toward the land, this being 4,200 pounds for each of the driving wheels and 1,200 kilogrammes for the trailing wheel. On the side toward the canal, the weight on the trailing wheel is 850 pounds and on each driving wheel, 3,000 pounds.

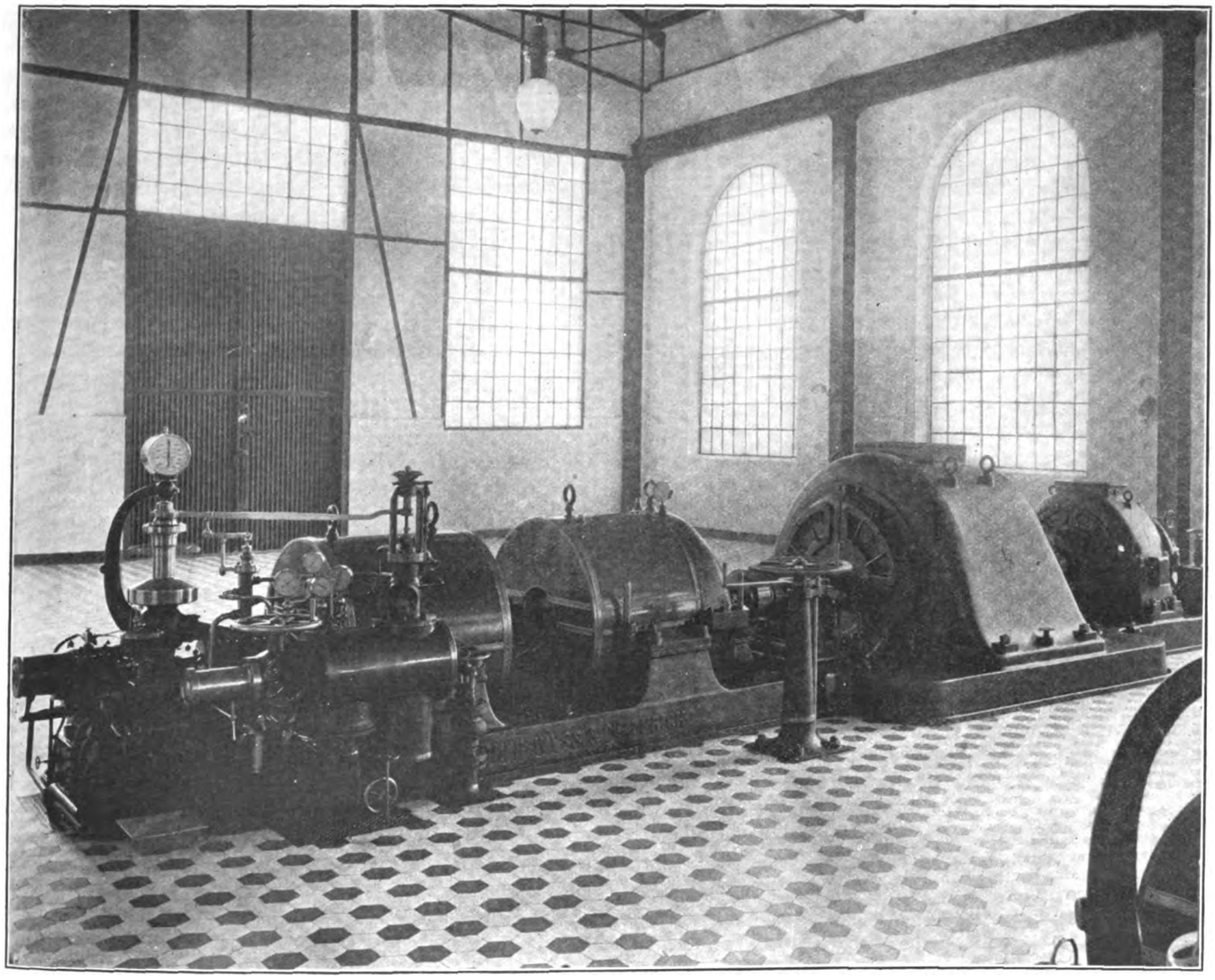
The arrangement of the weight of all the auxiliaries on the side of the locomotive away from the canal as well as the placing of the driving motors, as far as possible, on that side is on account of the tendency to tip the locomotive by the pull on the tow line. In order to overcome this to a still greater degree the rail on the side nearest the canal is raised somewhat higher than the inland rail.

For handling the boats at the locks special provision has to be made and a trestle construction was built, extending 455 feet along the middle of the canal, provided with two parallel tracks. For hauling the boats into and out of the locks electrically operated crane-cars were provided on these tracks, each weighing 3,300 pounds. The current used on these crane-cars is from the direct-current system of 600 volts, continuous-current motors are utilized operating at a speed of a trifle over 1,000 revolutions a minute. The trucks are geared to the track by means of two sets of gears. Each motor develops from ten to twelve horse-power,

Digitized by Google

which is sufficient to haul a boat in one-half hour from a point about 350 meters from one end of the lock to a similar distance at the other end. The two locks can be operated at the same time, with two boats in each lock, giving a tonnage of from 60,000 to 70,000 in twenty-four hours, or about 35,000 tons in twelve hours.

According to a recent report of the United States consul at Brussels, a laboratory museum of electricity in that town will be opened to the public next month. The museum has been built and equipped by R. Goldschmidt, of Brussels, whose object in presenting the museum is the development and extension of the use and application of electricity in Belgium by practical experimental instruction. The institution will contain all kinds of electrical models and appliances, which may be freely handled for study and experiment. Models and apparatus will be conveniently placed at the disposal of the public upon separate tables, and may be connected with the electric supply at will.



TELTOW CANAL STEAM TURBINE, CENTRAL POWER STATION.

COLOR PHENOMENA IN PHOTOMETRY.[1]

BY J. S. DOW, B.SC.

The discussion of Dr. Fleming's paper on Photometry, read before the Institution of Electrical Engineers in 1903, revealed great differences of opinion on the importance of color phenomena in photometry, and it still does not seem to be generally known to what extent they are noticeable under ordinary working conditions. This may be due to the fact that most of the work done on this subject was carried out with special apparatus, such as the spectro-photometer, and not with the ordinary implements of photometry.

It therefore occurred to the author that some simple experiments on these points, carried out by him at the Central Technical College on an ordinary photometrical bench, might be of interest.

[1] Paper read before the Physical Society, of London, May 25, 1906. *Phil. Mag.*, August, 1906.

The sources of light were two similar glow lamps, which could be screened with glass of different colors, and which were compared by means of one or other of several different photometers in the usual way. Four photometers were made use of during the experiments—the Lummer-Brodhun, the grease-spot, the Joly, and the flicker.

The uncertainties which may be introduced by color phenomena appear to be due to four separate effects:

1. The difficulty experienced in forming a judgment in the case of differently colored lights, and the possibility that the judgments of different people may not be the same.
2. The fact that the apparent relative brightness of two surfaces, illuminated by light of different color, depends on the part of the retina on which the image of them is received.
3. The Purkinje phenomena.
4. The possibility, when mirrors are

Digitized by Google

made use of, that the coefficient of reflexion may not be the same for different colored lights.

1. No doubt people differ in their capacity in this respect, but according to the author's experience it is chiefly a matter of practice. After a considerable amount of practice, he has found that it is possible to secure fairly consistent results even when comparing such colors as ruby-red and signal-green, while any one unused to such work would be quite unable to do so. Extraordinarily consistent results were sometimes obtained, but it was found that if the observer stopped work for an hour or so, his readings afterwards would settle down to another very consistent value, but differing by, perhaps, five or even ten per cent or so from those obtained before. This seems to suggest that extreme consistency in reading is partly a matter of visual memory. We recall the impression previously received by the eye and involuntarily set the photometer, the next time, so as to produce the same appearance of the field of view.

The difference in sensibility of different eyes to a particular color certainly introduces another disturbing factor in observations made by different people. The author has not met with any serious differences in judging the color contrasts which ordinarily occur, but it might be supposed that, in such an extreme case as that quoted above, considerable divergences in judgment would exist, and have, indeed, been recorded by Sir William Abney, Professor Rood and others.

It must be noted, however, that the effect mentioned in 2 must be eliminated, in order to make any satisfactory comparisons. All the figures given in this paper were obtained by the author himself, though corroborative results from other eyes were obtained in many cases.

2. This effect has been very completely dealt with by Sir William Abney in his investigation on color vision.

It has long been known that the central portion of the retina—"the yellow spot"—is much more sensitive to the red end, and less sensitive to the blue end of the spectrum, than the surrounding portion of the retina.

It has been suggested that the "yellow spot," being yellow in color, will obstruct the blue rays, but will allow the yellow rays to pass through practically unimpeded to the light-perceiving organs. This explanation, however, does not explain why the differences observed are distinctly more noticeable at low illuminations.

There appears to be another physiological effect, which will be referred to later.

Suppose, now, that we compare a red and a green light with a Joly photometer. An image of the illuminated blocks is formed on the retina, and we adjust the position of the photometer until the red and green appear equally bright.

But if we now observe the photometer obliquely, or if we observe it with the eye at a different distance away, the image falls on a different part of the retina where the sensibility to red and green may be different. Consequently the red and green may no longer appear equally bright.

And if a photometer with blocks of a different size were used we might again come to a different conclusion; for, even if the eye were kept at the same distance, the size of the image would be different, and a new portion of the retina would be covered by it.

The position of the photometer, for

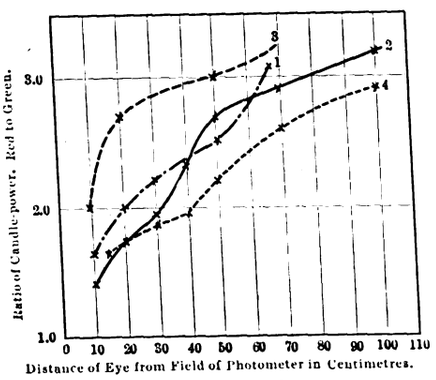


FIG. 1.—RUBY-RED LIGHT COMPARED WITH SIGNAL-GREEN.

(1) Lummer-Brodhun Photometer (telescope removed.) (2) Joly Photometer. (3) Joly Photometer (linear dimensions of blocks reduced one-half.) (4) Grease-spot Photometer.

which we obtain balance, therefore, depends upon—

(*a*) The obliquity at which rays from the illuminated surface strike the eye.

(*b*) The distance away of the eye from the surface.

(*c*) The size of the surfaces.

The first point is not very important, for in focussing our eyes on the surfaces we involuntarily look straight at them. But (*b*) and (*c*) may easily affect the readings considerably. This is brought out in the curves in Fig. 1.

These curves were obtained as follows: Two glow lamps, screened with red and green glass respectively, were run at a constant P.D., and compared by means of each of the three photometers referred to above.

In each case a series of readings was obtained with the eye at different distances away from the illuminated surfaces. It should be mentioned that in the case of the Lummer-Brodhun photometer, the telescope was removed while the readings were taken. As will appear later, however, considerable variation is possible even with the telescope in position, as in use.

Curves 1, 2 and 3 speak for themselves. They bring out two points. Firstly, that the ratio of the candle-powers of the red and green lights, as thus observed, is quite different for each photometer. Secondly, that this ratio depends on the distance of the eye from the photometer, the red becoming more and more accentuated as the eye recedes. Also the red is most accentuated and the curve is steepest for the Lummer-Brodhun photometer, in which the field is smallest.

Curve 4 was obtained by placing in front of the blocks of the Joly photometer a paper screen which reduced its linear dimensions by one-half. The reduction in size of the blocks corresponds with a still further accentuation of the red.

This effect has been found to be quite distinctly observable in several commonly occurring comparisons. Fig. 2 exhibits the connection between the apparent relative candle-power and the distance away of the eye with a Joly photometer, when a Nernst lamp was compared with a glow lamp (running at 3.7 watts per candle-power), and when an incandescent mantle was compared with a Methven burner.

In the Joly photometer the distance away of the eye is left entirely to the inclination of the observer, and it will be seen from the above that differences of five per cent or more might easily be introduced between the readings of different observers in this way.

In the Lummer-Brodhun photometer the distance of the eye is limited, to some extent, by the use of the telescope. But the position of the telescope can be varied between wide limits without putting the field out of focus, and this latitude allows of a considerable difference in the readings.

In the table below the extreme differences are given for these two limiting positions of the telescope:

Nature of Lights Compared.	Ratio of Candle-Power.		Percentage Difference.
	Telescope In.	Telescope Out.	
Ruby-red to signal green.....	1.65	2.20	25.0
Glow lamp (3.7 watts per candle power) to Nernst lamp....	1.38	1 43	3.5
Methven gas standard to incandescent mantle.....	0.129	0.135	4.4
Harcourt ten candle-power Pentane standard to Fleming standard lamp.	0.652	0.657	0.77

Here, again, a distinct difference in

Digitized by Google

reading is produced in several practical cases.

It is also remarkable that a small but distinct effect was produced in the last case, even though the flame of the Harcourt lamp is only very slightly redder to the eye than the light from the Fleming glow lamp.

It is difficult, of course, to speak with certainty of such a small change as this—a change which would be produced by moving a photometer, set midway between two lights two metres apart, a distance of less than two millimetres. But the writer has usually found that the mean of a set of readings, taken with the telescope out, worked out to a value slightly different from the mean of those taken with the telescope in, and the difference was always in favor of the redder of the two lights. It need hardly be said that the difference observed might be important in such work as these two standards are used for.

There is one other point that requires mention. It is, of course, often necessary to reverse a photometer in order to correct for any differences between the

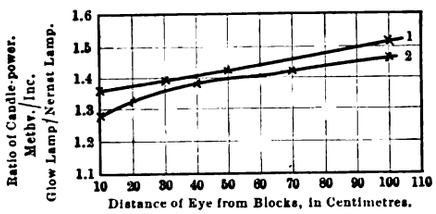


FIG. 2.—CURVES FOR JOLY PHOTOMETER.

(1) Glow lamp compared with Nernst lamp. (2) Methven gas standard compared with incandescent mantle.

two sides of the screen, etc. However, for lights, of similar color, very little difference is produced by doing so, as a rule.

But when the lights differ in color the Lummer-Brodhun behaves differently from the Joly and grease-spot photometers. In the case of the latter, the image the retina receives is unaltered by reversing. But, with the Lummer-Brodhun, the image is reversed. If, before reversing, we see a green disc with a red centre, after reversing we see a red disc with a green centre.

We should, therefore, expect a much greater difference on reversing the photometer in the case of the Lummer-Brodhun.

The following figures, obtained for similarly colored lights, and for red and green lights, exhibit this:

Photometers Used.	Lights of Similar Color.			Red to Green Light.		
	Ratio of C. P.		Per Cent Difference.	Ratio of C. P.		Per Cent Difference.
	1st Pos.	2d Pos.		1st Pos.	2d Pos.	
Joly.....	0.93	0.91	2	2.24	2.12	5.5
Grease-spot....	0.94	0.91	3	1.81	1.70	6.0
Lummer-Brodhun.	0.95	0.91	4	2.10	1.75	18.0

3. The Purkinje phenomenon has often been referred to as the chief source of trouble in heterochromatic photometry, but it appears to be only troublesome at very low illuminations.

An experiment was shown illustrating the Purkinje effect. A series of colored screens, diminishing in size from about four feet square, as shown in the diagram (Fig. 3), were illuminated by a thirty-two candle-power glow lamp at a distance of about ten feet away. All these screens were made from the same identical red and blue paper, but, even at normal illuminations, it could be seen that as the surfaces became smaller the red appeared brighter and brighter in comparison with the blue. The red, however, was distinctly the brighter, even in the case of the very large screen.

The illumination was now weakened by introducing resistance in series with the glow lamp, and the blue began to appear brighter. A point was soon reached when, for the very large screen, the blue was unquestionably brighter than the red. At this stage the difference in appearance of the different-sized screens was much more marked than at the higher illumination; and, in the case of the smaller screens, the red was still much brighter than the blue.

As the light was still further weakened the colors began to disappear until, eventually, the red appeared as black, while the blue shone out with a phosphorescent white appearance. After this point the blue also fades away until nothing can be seen.

There is, however, a distinct difference between the behavior of the very big screen and the very small ones. In the case of the latter the Purkinje effect is much weaker. Both colors seem to fade away together, and, by the time the Purkinje effect is really noticeable on the big screen, the very small screen can scarcely be seen at all.

In fact, to see the Purkinje effect really well, it is necessary to stand quite close up even to the big field.

A very interesting physiological explanation of these effects has been given by M. Sartori in a recent paper.[1]

Dotted about over the retina are two varieties of light-perceiving organs, known from their appearance as the "rods" and the "cones" respectively. The rods, it is thought, are sensitive to light but can not perceive color. Light of any color appears to them white, but they are most sensitive to blue light. They are, moreover, sensitive to very weak light; but as the illumination is increased they become, as it were, saturated, and do not respond any further. The cones, on the other hand, perceive color, but are most sensitive to yellow-green light, and while they do not respond at the low illuminations at which the rods can act, they continue to respond further to increased stimulus, once they have started, long after the rods have ceased to do so.

At normal illuminations, therefore, it is the cones which chiefly act, and we see

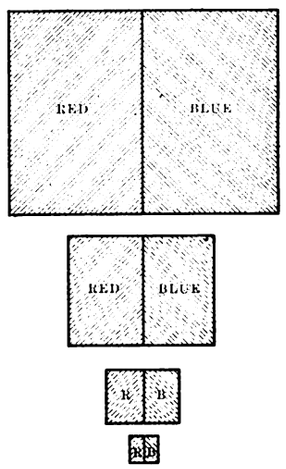


FIG. 3.—SERIES OF COLORED SCREENS ILLUSTRATING PURKINJE EFFECT.

color. At very low illuminations the action of the rods is predominant, and we can not see color, while light of a bluish color shines out with a whitish appearance. As the illumination is increased the cones suddenly begin to act and the colors appear. Then takes place what has been called "The Battle of the Rods and Cones." It is while this battle is in progress that the Purkinje effect is noticeable.

But the Purkinje effect is complicated by the fact that the rods and cones are unequally distributed over the retina. At the yellow spot the cones are predominant. Consequently, the Purkinje effect is much weaker when the field of view subtends a small angle at the eye.

This uneven distribution of the rods and cones will also explain the fact, referred to above, that at low illuminations the size

[1] *Electrotechnik und Maschinenbau*, March 18, 1906.

Digitized by Google

of the field of view can produce much greater differences in the results.

In order to gain an idea at what illumination the effect becomes noticeable in practice, the following experiment was carried out:

Two 100-volt eight-candle-power glow lamps were run in series with a constant P.D. of 190 volts across them.

One was screened with red glass and the other with green glass. The distance between the two lamps was varied from twenty inches to 250 inches, and the mean of a set of readings, giving their relative candle-power, taken in each case. In order to avoid the effect mentioned in 2 above, the Lummer-Brodhun photometer was used, and the telescope was kept in exactly the same position throughout the experiment.

Fig. 4 shows the result of plotting the ratio of the candle-power of the two lamps against the illumination of the photometer disc, in candle-metres.

From what has been said above, it is clear that we can not strictly define the candle-power of a red light in terms of white-light standard, because this ratio depends upon the distance of the eye from illuminated surfaces.

Nevertheless, in order to give an idea of the order of illumination used, the red lamp was compared against a two-candle-power Methven gas standard, using the Lummer-Brodhun photometer, and its candle-power worked out to something of the order of 0.25 candle-power.

The relative illuminations used in the curve are expressed in terms of this figure.

It will be seen it is only when the illumination has been reduced to about 0.2 candle metre that the ratio of the red to the green light begins to decrease.

The same experiment was tried on several occasions with lights of different candle-power, and it was always found that fairly consistent results were obtained until the illumination fell to something of the order specified above, when the accentuation of the green light began to appear.

At such illuminations it is very difficult to obtain readings at all, and the mean of a great many should be taken. The eye seems to be in a state of uncertainty, and one receives the impression that the lights are continually varying. In fact the eye seems to be in a state analogous with that of unsaturated iron on the steep part of the magnetization curve.

It may safely be assumed, therefore, that in all ordinary cases, where the illumination would be at least ten or twelve times as great as that employed above, where the field of view would subtend a comparatively small angle at the eye, and where we should never meet with such an extreme color contrast as in this case, the Purkinje phenomena will not materially influence the results.

4. In order to obtain the curve of vertical distribution of light from arc lamps, etc., the beam of light is often reflected in the desired direction by means of a forty-five degree mirror.[1] When this is done, the question arises, whether the coefficient of reflection of the mirror will be the same for lights of different color.

The following experiment was carried out with a silvered glass mirror of this type: Two 220-volt thirty-two candle-power lamps were run in parallel off a constant P.D. of 200 volts. The two lamps were compared against each other direct. They were then compared when the light from one of them was reflected along the bench from the mirror. In this way, the coefficient of reflection of the mirror is easily obtained.

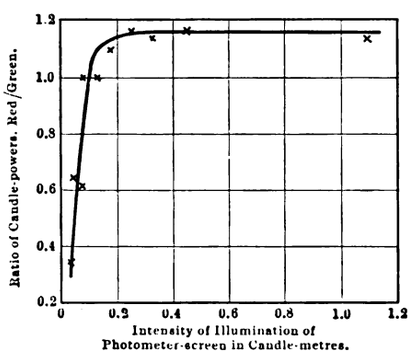


FIG. 4.—CURVE, EXHIBITING PURKINJE PHENOMENA FOR RUBY-RED AND SIGNAL GREEN LIGHTS.

This was repeated when the lamps were screened with red and green glass, successively.

The mean of one set of determinations gave—

Coefficient of reflection, 78.8 per cent for unscreened lamps; 79.0 per cent for red light; 77.8 per cent for green light.

Repetitions of the experiment gave slightly differing results, but it was found that the values for the three different colors did not differ among themselves by more than 2.5 per cent. Moreover, no connection could be traced between these differences and the colors for the difference was sometimes in favor of the red light and sometimes in favor of the green.

We may safely conclude, therefore, that in all ordinary cases, where the difference in color is less pronounced than that adopted here, the effect is inappreciable.

In any case, the adoption of adjustable photometers of the Simmance-Abady type will probably render mirrors unnecessary in obtaining curves of distribution of light in the future.

The only really important effect, under ordinary working conditions, therefore, is that described under the second heading. It has been shown that this may, apparently, give rise to a perceptible discrepancy even when lights so similar in color as the Harcourt ten-candle Pentane standard and the Fleming glow lamp standard are compared.

FLICKER PHOTOMETERS.

The interesting question now arises whether photometers of the Flicker type are also influenced by these color phenomena.

If, as is claimed, the disappearance indicates that the two surfaces appear equally illuminated to the eye, one would suppose that all the conditions which determine this impresson must also determine the point of disappearance of the flicker. On the other hand T. C. Porter and others have come to the conclusion that the flicker, at ordinary illuminations, is independent of color.

Through the kindness of Messrs. Everett, Edgcumbe & Company the author has been able to make some experiments on the points referred to with a photometer of this kind.

It is clear, in the first place, that when comparing lights of different color, the readings of an ordinary photometer and a flicker photometer may not agree even if the latter be independent of all color effects. For instance, when two lamps giving light of exactly the same color were compared, the results with the Joly photometer and the flicker photometer were exactly the same. The two lamps were now screened with red and green glass respectively, and the ratio of the red to the green, obtained by the flicker photometer, was about 1.34; but with the Joly photometer it was found possible to get readings from 0.7 to 1.4 for distances of the eye up to one-half metre. Agreement between the photometers occurred when the eye was about 40 centimetres away from the blocks of the Joly.

One difficulty met with in this investigation was as follows: As the effects observed were comparatively small, it was advisable to use lights widely differing in color. On the other hand the position of minimum flicker, though sufficiently sharply defined in most practical cases, is far from being so when such colors as red and green are observed. In such cases, the method followed was to note the position of the photometer in which a flicker

[1] A mirror, that is, which rotates about an axis making an angle of forty-five degrees with its plane.

Digitized by Google

was just visible on either side of balance, and take the mean. There is, however, another method of judging the position of balance for these two colors.

When the photometer is too near the red light, the field of view in the photometer appears reddish in tint. Similarly, a greenish tinge shows that the green illumination is the stronger. When the illumination of the two surfaces, illuminated by light of these two complementary colors, is the same, an intermediate grayish tinge is produced. To the writer's eye the transition from red to gray to green was sharper than the disappearance of the flicker, and a series of tests showed that the result was the same in each case. The method, however, is only applicable to complementary colors.

Some experiments were first made to discover whether a difference of reading could be produced by altering the telescope, as in the case of the Lummer-Brodhun photometer, but no distinct difference was observable. Next the telescope was removed, and readings were taken with the eye about twenty centimetres from the aperture. A brass tube was then inserted which allowed the aperture to be inspected from a distance of 60 centimetres from the eye. It was then observed that, as the eye was withdrawn, the field became distinctly redder, and readings taken by the "disappearance of flicker" method also showed a change of relative candle-power in favor of the red. The following table exhibits some of the results obtained:

Nature of Lights Compared.	Eye 20 Cm. from Aperture.	Eye 60 Cm. from Aperture.	Percentage Change.
Ruby-red to signal green.	$\frac{\text{Red}}{\text{Green}} = 1.52$	$\frac{\text{Red}}{\text{Green}} = 1.70$	12
Ruby-red to light from unscreened glow lamp (white).	$\frac{\text{Red}}{\text{White}} = 0.70$	$\frac{\text{Red}}{\text{White}} = 0.75$	6
Methven gas standard to incandescent mantle.	$\frac{\text{Methv.}}{\text{Inc.}} = 0.28$	$\frac{\text{Methv.}}{\text{Inc.}} = 0.29$	3

The effect is very noticeable when observed in the following way: Supposing we are comparing red and green, and have placed the photometer so as to secure balance. Move the photometer until a distinct flicker can just be seen owing to the green being too bright. It will be found that as the eye is removed the flicker gradually disappears. But if the photometer is put out of balance on the red side, the flicker does not disappear but becomes if anything more distinct as the eye is removed.

It appears therefore that this flicker photometer is affected by the distance of the eye, but, apparently, not to a sufficient extent to be noticeable when the telescope is used, as in ordinary work.

It is difficult to see why these effects should be so much less noticeable than with ordinary photometers. It almost seems as though, when two differently colored objects are placed side by side, any change in their relative illumination becomes exaggerated, thus creating a different impression to that received when they are viewed alternately (as in a flicker photometer).

An attempt was also made to discover whether the flicker photometer was subject to the Purkinje phenomenon. Now it is well known that the speed required to just make the flicker disappear depends upon the illumination, and the writer has found it impossible to judge the point of disappearance of the flicker with any certainty at the extremely weak illuminations necessary to produce the Purkinje effect.

The plan of "color-reading" referred to above was therefore adopted. It may be objected that in doing so the real question at issue is avoided altogether. But the method, while admittedly not so satisfactory as the "disappearance of flicker" method from this point of view, has been shown to give the same results at ordinary illuminations, and to the writer it seems impossible that the green illumination could be brighter and yet the field of view appear red.

Two 100-volt eight-candle-power lamps screened with red and green glass in the usual manner were used for the experiments. They were first run at 100 volts, and compared against each other at different distances. The two lamps were then run off fifty volts only, so as to produce a very low illumination, and the experiment repeated. The following table shows very clearly the influence of the Purkinje effect.

Lamps Run at 100 Volts.		Lamps Run at 50 Volts.	
Distance Between Lamps.	Ratio $\frac{\text{Red}}{\text{Green}}$	Distance Between Lamps.	Ratio $\frac{\text{Red}}{\text{Green}}$
50 inches	2.32	40 inches	2.0
60 "	2.26	50 "	1.5
70 "	2.25	60 "	1.1
120 "	2.15	70 "	0.7
150 "	2.25	90 "	0.6

At the higher illumination the readings differed among themselves considerably (as was only to be expected with such a great color contrast), but they do not seem to be connected in any way with the illumination.

The readings at the low illumination can only be regarded as very approximate, but they bring out very clearly the accentuation of the green as the illumination gets weaker.

The conclusion the writer draws from these experiments is that flicker photometers are affected by the same color phenomena which affect ordinary photometers.

The interesting assertion was made by Messrs. Simmance and Abady, in a paper before the Physical Society,[1] that a color-blind person obtained practically the same results with their flicker photometer as people with normal sight. On the other hand, Sir William Abney, speaking of color-blindness, remarks:[2]

"We can not hope, for instance, that the red-blind, who sees no red in the extreme end of the spectrum, would show any luminosity in that region. . . . One of the most striking experiments in color-vision is to place a bright red patch on the screen and to ask a red-blind to make a match in luminosity with the white. The latter will have to be reduced to almost darkness—a darkness, indeed, that makes the match almost incredible."

It seems incredible that such a person, when comparing red and green with a flicker photometer, would obtain the same results as if he had normal sight. However, it appears that, according to Dr. Edridge Green,[3] color-blindness is of two kinds. A person may be unable to distinguish, say, red light by color, but nevertheless a red object may appear as *luminous* to him as to any one else. On the other hand, the color-blindness may be due to the fact that the eye is incapable of perceiving red light at all. A color-blind person of the first variety would presumably make normal photometrical readings. A person of the second class must, surely, obtain abnormal readings with all photometers, flicker or otherwise.

This is borne out by some of Professor O. N. Rood's experiments on flicker.[4] He found that those of his students who were color-blind obtained abnormal results with his flicker photometer. Indeed, he actually used the flicker photometer to investigate not only cases of color-blindness, but also the difference in sensibility to light of different colors of the eyes of persons with normal sight.

In conclusion, the writer wishes to express his great indebtedness to Professor Ayrton, and also to J. M. McEwan, for their assistance and for many valuable suggestions.

[1] *Phil. Mag.*, vii., p. 341 (1904).

[2] "Color-Vision," p. 88.

[3] "The Physical Aspects of a Theory of Color-Vision," by F. W. Edridge Green, M.D., British Association, 1902.

[4] *American Journal of Science*, 1899, p. 258.

Digitized by Google

Length of Wave and Speed of Propagation of Electrical Phenomena.

By definition the wave-length of a vibration is equal to the product of the period of vibration by the speed of propagation. The same definition ought to be applicable to electrical discharges through matter, in which the distance is that between adjacent ions. Examining this view, G. Rosset holds that it should be possible to check it by the known wave-length of visible discharges. When a luminous discharge is obtained—for example, in the violet—the wave-length of the light given off is about 0.0004 millimetre. From data obtained in measuring the sparking distance in gases it has been found that the number of ions present is about 16×10^{12} under atmospheric pressure, and that a rarefaction of about eighty-seven per cent must be obtained in order to secure violet light. This would bring the distance separating ions remarkably close to that called for by the preceding observation. Examining next the speed of propagation of electrical phenomena it is shown that this is directly proportional to the square root of the specific inductive capacity of the dielectric medium and to the one-sixth power of the concentration of the ions. Applying these figures to the speed of propagation of an electrical effect in iron and in copper, good agreement is secured, for it has been found experimentally that the speed in iron is about 62,000 miles per second, and in copper about 112,000; while the specific resistivity of the two metals indicates corresponding concentrations of the ions, the ratio being 1.84 to one. Considering the expression for speed of propagation, it is shown that it varies inversely as square root of the constant of attraction in Coulomb's law. Now, from Maxwell's theory, the speed of light is proportional to this same figure, so that the speed of propagation of electrical phenomena is greater for a given concentration of ions or electrons the poorer the dielectric medium is as a transmitter of light. This is strikingly illustrated by the relation between the opacity and conductivity of the vitreous and crystallized states of selenium.

Copper prices keep climbing and the market objective seems to be twenty cents. There has been a great eagerness to secure supplies, and more inquiries have come to producers than can possibly be entertained. It is estimated that this country alone is using copper at the rate of 720,000,000 pounds per year.—*Copper Gossip.*

THE RELATION OF THE ALTERNATING-CURRENT MOTOR TO CENTRAL-STATION POWER BUSINESS.

BY E. W. LLOYD.[1]

The bearing that the development of the alternating-current motor has on the securing of power business is greater than generally supposed.

It is not the intention to treat this subject in any but a general way, the object of this paper being merely to call to your attention the necessity of the cooperation of central-station men with the manufacturers, encouraging them in the design of apparatus that will meet the requirements of customers applying for central-station service.

We all run across cases where business was lost because we could not secure motors that would do the work as satisfactorily as the direct-current motor, the margin between the cost of the operation of a private plant and central-station service being so small that in order to secure the best results from machinery, the manufacturer often decides to install his own plant and direct-current motors with a resulting loss to the central-station company.

If we can secure motors that will do the work asked for by the customer, we will help our own cause materially.

With the increase in the capacity of central stations and the tendency towards the generation of alternating current at high potential in large units, it has become possible to furnish power in large quantities at a low price to the consumer several miles from these central stations.

If this power can be furnished directly from our overhead or underground lines with the use of transformers instead of installing substations, even for large quantities of power, the saving to the central-station companies will be material. Some companies are to-day installing substations on customers' premises, furnishing them power, and standing the loss in transformation as well as the investment involved.

The past few years have seen a large increase in the use of alternating-current motors in connection with factory work. This has been largely due to the decreased cost of these motors, the prices now approximating closely prices of direct-current motors of the same size and speeds.

Excepting on tools and machinery requiring variable speeds, the alternating-current motor is generally admitted to be a better prime mover than the direct-current motor, owing to its overload characteristics.

This motor having been developed to a point where it can be guaranteed as a perfectly reliable prime mover as far as ordinary work is concerned, we are only waiting for the development for variable speed work for factory use.

There have been numerous developments on single and multi-phase motors for variable speed work by different manufacturers, one company having on the market single-phase motors up to three horse-power that will do variable speed work with very fair results.

While, as with the three-phase motor, the operation of this type of motor is not as successful as the direct-current motor, still it is a great step in advance and of the utmost importance to central-station companies.

Already the possibility of equipping cranes and hoists with alternating-current motors has been realized. In Chicago we have several manufacturers using current from the three-phase, 220-volt, sixty-cycle system who have their factory equipped with traveling cranes using three-phase motors. These equipments, while not perfect, are reliable enough so that the parties using them are very well satisfied. In fact one large customer, having approximately 700 horse-power in motors, is changing over a number of traveling cranes from direct-current to alternating-current motors. This is being done in order to save the loss in the changing of the current from alternating to direct current through rotary converters. One large alternating-current crane is already in operation, and is proving entirely satisfactory.

We have also equipped several jib cranes with alternating-current motors with satisfaction, being able to handle molten metal in five-ton ladles with perfect safety.

One large foundry has several ladles running on tracks equipped with variable speed alternating-current motors, enabling the operator to tip the same at will, and as easily as if equipped with direct-current motors.

For small printing-press work we have arranged to install three-phase variable speed motors on cylinder presses, and while we know it is not possible to get the wide range of speed or efficiency possible with the direct-current motor, still the installation is a vast improvement over the

[1] Read before the Association of Edison Illuminating Companies, Frontenac, Thousand Islands, N. Y., September 4, 5 and 6, 1906.

Digitized by Google

old installation or belt drive and cone pulley.

The possibility of equipping alternating-current motors with automatic starting devices is bound to be realized. With this device it is possible to start and stop a motor driving an air compressor from the varying pressure in the storage tank. One company has a starter ready for the market which it will guarantee.

With alternating-current motors doing the work described above, the troubles of obtaining power business in larger quantities are to some extent overcome, as one of the most difficult obstacles in the way of obtaining this business was the fact that the alternating-current motor was not capable of giving anywhere near the duty to be obtained of the direct-current motor.

The alternating-current motor has many advantages: its ability to operate under overloads, which would destroy a direct-current motor; it can operate in dirty places without extraordinary attention; its freedom from sparking; and last, but not least, the low cost of maintenance.

The direct-current motor has been specialized in many ways and designs, and in small sizes is made to accomplish results economically by the removal of many of the friction losses present in shops where shaft driving was used.

The manufacturers of alternating-current apparatus have not as yet made these motors to meet conditions required in individual driving, such as that used in connection with stereotype machinery, printing machinery, bookbinding machinery, or any of the small tools now generally equipped with individual motors, but there is no reason that this can not be done.

Alternating-current motors equipped with back-gears would find a ready market to-day, as the demand for individual drive on all classes of machinery in factories is more pronounced every day.

As near as I can ascertain, there has not been the demand on the manufacturers for variable speeds in these motors that there might have been; the manufacturers being left to do the experimenting, if not leisurely, still not as fast possibly as if the demand had been greater and more urgent.

Certain manufacturers of apparatus have refused, not later than a year ago, to manufacture traveling cranes equipped with alternating-current motors, and if it had not been pointed out to them in a forcible manner that their competitors would get the business, they would still be in the same frame of mind.

If our central-station power business is to increase in outlying districts and we are to take care of this business with the same advantages to the customer as in the districts where we furnish direct current, we must have a prime mover that will fit all cases.

In our efforts to obtain power business in the alternating-current districts, we find that it is essential that we be able to recommend to our customers elevators that will operate satisfactorily on the alternating-current system without undue disturbance to the pressure on these lines.

There has been a large amount of money and a great deal of thought put into the development of a direct-connected, alternating-current electric elevator, but I believe it safe to say that the progress made in the last two years has been greater than in the previous ten, and that the next two years will see even greater advances along these lines.

We can now see alternating-current, multi-phase motors in connection with elevator service giving excellent results, as the manufacturers are ready to place on the market machines of this type that have been perfected to such a point that their operation is quite satisfactory, the manufacturers stating that the machine takes about double full-load current in starting.

While, as true of other alternating-current motors for regular duty, they are not as good as are direct-current motors as yet, still these elevators are very excellent indeed, considering the many difficulties that were necessary to be overcome in connection with their design and manufacture.

We all know that when the direct-connected, direct-current elevator was connected to our lines years ago, many of the companies had serious trouble with their pressure on these lines.

The demand for the alternating-current elevator is growing rapidly, and in direct proportion to this demand the design is becoming better.

It is possible to-day to obtain an alternating-current, direct-connected, multi-phase elevator that is practically noiseless in its operation so far as the motors, brakes and controller are concerned, and as these three sources of noise have been the objectionable feature in alternating-current elevators in the past, we can safely say that an elevator of this type can be secured that is practically noiseless.

I had the pleasure of examining a machine of this type in operation, and it was as free of noise as is necessary, running practically the same as a direct-current, drum-type machine. This machine is equipped with magnet control, the main magnets operating directly from the alternating-current circuits. Driven from the worm shaft by a Renolds silent chain is a small direct-current dynamo, which is used to furnish current to the acceleration magnets on the controller.

Machines of the larger sizes are equipped with this direct-current dynamo, while machines of smaller sizes for apartment-house work can be operated with alternating-current magnet controller without the use of direct current, and the elevator companies are prepared to take orders for this class of machine at this writing.

The manufacturers have had in operation for nine months an alternating-current motor with alternating magnet control in their shops. They claim that the machine has not had any further adjustment than that which would be required by an ordinary direct-current controller. This machine was also automatically operated by push buttons.

While I did not have the pleasure of seeing this controller in operation, I will say that the alternating-current magnets operated in conjunction with the elevator which was equipped with a small dynamo operating the acceleration magnets did not make a particle of noise. The elevator is question had a speed of 210 feet a minute. The elevator company promised speeds up to 300 feet a minute for 1,500-pound lifts.

These elevators are equipped with alternating-current magnet brakes in the same general way as the direct-current elevators. The brake on the worm shaft seemed to work perfectly.

In addition to the electric brake, this car was equipped with a device preventing accident to the elevator should there be any phase changes on the line. This device would prevent the operation of the car until the trouble was rectified.

The push-button type of elevator has not, I believe, received the support from central-station companies that it should. This type of elevator is in an excellent state of development, and there is no doubt a wide field for its use in apartment buildings in outlying districts.

This push-button elevator has been perfected in connection with an alternating-current, multi-phase motor to such an extent that it can be operated very satisfactorily, at least good enough for all ordinary purposes.

The hoisting part of the apparatus runs

Digitized by Google

very smoothly, and the controlling part of the mechanism is very fine indeed, it being practically impossible to have an accident on this type of machine through any thoughtlessness on the part of the person operating it.

Outside of New York, I am not aware that there are any automatic elevators to speak of, even in the largest cities in this country, while in Europe I am told they are quite common.

Taking it altogether, the situation as regards the electric elevator is very flattering indeed. The progress being made is very good and promises to continue.

The experiments being conducted in connection with all types of electric elevators cover a large field, and a great deal of money is being spent and many able men are constantly designing new devices for the perfection of this class of elevator.

The progress in the design of single-phase motors in connection with direct-connected elevators has not been as satisfactory as with the multi-phase motor.

We have one single-phase, direct-connected elevator on our lines in Chicago which was installed to replace an old 500-volt machine. The old apparatus was used; the motor and controller only being changed. The operation of this elevator, while giving fairly good results to the apartment building, is hardly satisfactory to us, as the starting current is about five times the full-load current. When the line is well loaded the effect is not appreciable, but during times when the line is lightly loaded the effect on the lighting system is very noticeable.

The motor in getting up to speed makes considerable noise, and even when running at normal speed is more noisy than desirable. The company making it claim they will in a short time be able to place on the market a machine that will act more satisfactorily, but there is room for a considerable improvement before this outfit will approach the smoothness of operation of the multi-phase machine above mentioned.

We hope to see many improvements in the design of alternating-current apparatus, and, as stated in the first part of this paper, we should cooperate in encouraging the manufacturers in making apparatus that will suit all conditions of service.

Unless we are prepared to make considerable reductions in the price of current we must get this class of business by removing every possible waste, increasing the output of each machine and improving the operation of them by the application of devices that can be operated electrically and automatically.

While investigating the progress made in the manufacture of alternating-current elevators, the improvements in the electric traction elevator were brought to my notice, and I thought a word at this time, while somewhat outside of the scope of this paper, might not be amiss regarding high-speed electric elevators for office buildings.

To-day in the larger cities the use of electric elevators has increased to a very large extent, so that owners and builders of high buildings seriously consider, and very often favorably, the installation of electric elevators instead of hydraulic. Not only the first cost is less, but the electric elevator has been perfected to such an extent that the smoothness of operation compares favorably with all types of hydraulic elevators, not only for local but for express service either in dry-goods stores or office buildings.

The traction elevator has practically solved the high speed, high lift, electric elevator problem, and while there will no doubt be many improvements in electric elevators in the future, still this type of elevator is bound to have a great influence in favor of central-station service in office buildings and stores in our large cities, owing to smoothness of running and economy of operation.

The traction elevator can be placed either on the roof of a building or in the basement, whichever is the most desirable and economical, taking up little space in either location.

The main objection to the traction elevator to-day is that it is not quite as economical in the consumption of current as the drum type of elevator, owing to the very low motor speed and correspondingly large size of the motor.

The present motor for this type of elevator has a speed of from sixty to 100 revolutions per minute.

To make a commercial piece of apparatus of this speed, the efficiency of the motor is sacrificed to some extent. Necessarily the size of a motor of this speed is larger than of the standard commercial motor, and the shop and material costs are greater.

Experiments are at present being made with high-speed motors for traction elevator work, and the prospects of obtaining satisfactory results look very bright. If this feat is accomplished it will further reduce the initial and operating cost of the traction elevator.

The drum type of machine has been improved greatly in the past few years. The magnet control has had a wonderful influence on the smooth running of machines of this type.

The electric brake has also been improved, and this type of brake is not only now applied to the worm shaft, but is also applied internally to the drum itself in such a way that it greatly increases the smoothness of the operation of this type of elevator in stopping, thus permitting the operation of drum types of elevators at high speed, and according to the manufacturers up to 400 feet a minute.

More strenuous missionary work among architects and owners of buildings about to be erected, with information of the proper sort in regard to electric elevators, would go a long way towards increasing the popularity of this type of machine.

The elevator companies are in this position: they are able to build any type of machine, and it makes little difference to them whether or not the customer uses central-station service. It is up to the electric light companies to take hold of the situation in a methodical manner, obtaining accurate information regarding the cost of operaton of different types of elevators. There have been many figures submitted regarding these costs, but I believe the subject will stand closer investigation.

With the advance in the design and manufacture of electric elevators, placing this machine on a high plane, it seems to me that enough evidence could be secured so that we would not be afraid to present the true costs of operation to our customers with great advantage to ourselves.

The Montreal Light, Heat and Power Company's Soulanges Canal Power Station.

The Montreal Light, Heat and Power Company has recently contracted with the Canadian Westinghouse Company, Limited, for a large addition to their power equipment. The apparatus contracted for is for the new Soulanges Canal power station on the St. Lawrence river. The equipment consists of three 3,750-kilowatt revolving-field alternating-current, two-bearing generators connected to water turbines. These generators are 7,200 alternations, 4,000 volts, three-phase, operating at 225 revolutions per minute. There are also two 150-kilowatt direct-current, 125-volt exciter units. Thirteen 2,500-kilowatt oil-insulated, water-cooled transformers are an important part of the equipment. Seven of these transformers will be used for raising the voltage at their generating station from 4,000 to 44,000 volts, and six of them will be used at the lowering end of the transmission line, stepping down the voltage from 44,000 to 12,000.

The generators and exciters will be controlled by motor-operated rheostats and the complete switchboard apparatus, which the Canadian Westinghouse Company is furnishing for both the main and substations, will involve the latest type of electrical control, representing the highest development of switchboard apparatus.

Digitized by Google

Convention of the Illinois Electrical Association.

The annual meeting of the Illinois Electrical Association was held at Springfield, Ill., September 19 and 20. The sessions were convened at the Leland Hotel, and over 100 superintendents and managers of electric light plants were in attendance. A number of exhibits of electrical apparatus were also made.

Mayor Deveraux welcomed the visitors to Springfield. After the preliminary work a paper entitled "System of Accounting for a Moderate-Sized Plant," was read by W. J. Achepohl, of Galesburg. Following the discussion of this paper the remainder of the morning was taken up by W. G. Austin, of Effingham, who presented a paper entitled "Gas Engines." This subject was also thoroughly discussed.

In the afternoon a paper by J. Robert Crouse, entitled "Profitable Commercial Cooperation," was presented. Mr. Crouse was unable to be present, and the paper was read by one of his associates. A paper entitled "Electrical Meters" was read by Robert C. Lanphier, of Springfield.

Following the reading of papers in the afternoon the members of the association boarded special cars and visited the plant of the Sangamo Electric Company. The watch factory at Springfield was also visited, and the power-station of the Public Utilities Company inspected. Luncheon was served at Washington Park Casino, and in the evening the guests were entertained at a theatre party.

The association concluded its convention on the afternoon of September 20. The following programme was presented for the day: reports of insurance committee and other committees; general talk on points of interest in connection with station operating, discussion to be opened by Charles Sharp, of Moline; paper by F. W. Willcox, Harrison, N. J., entitled "Present Status of the Incandescent Lamp."

In the afternoon the executive committee went into executive session and the following officers were elected:

President—J. N. C. Shumway, Taylorville.

First vice-president—E. L. Brown, Elmwood.

Second vice-president—E. McDonald, Lincoln.

Third vice-president—E. H. Gray, El Paso.

Fourth vice-president—O. L. Hyatt, Chicago.

Secretary—H. E. Chubbuck, La Salle.

Treasurer—J. J. Frey, Hillsboro.

Executive committee—Emil G. Schmidt, Springfield; Charles Sharp, Moline; W. M. McKinley, Champaign; Frank J. Baker, Chicago; David Davis, Litchfield. The executive committee was authorized to select the place of the next meeting and to make all arrangements.

After the business session in the afternoon the members of the association were the guests of the Illinois Traction System, and a trip was made over the company's line, inspecting the power plant at Riverton.

The Opening of the Camden-Atlantic City Line of the West Jersey & Seashore Railroad.

The new West Jersey & Seashore Railroad which has been electrified between Camden and Atlantic City, N. J., by the Pennsylvania Railroad, was opened for passenger traffic on Tuesday, September 18. A full schedule of trains has been arranged, express trains leaving Camden and Atlantic City every hour on the hour, from 7 A. M. to 11 P. M. daily, making the run in ninety minutes.

In the construction of its high-speed electric line from Camden to Atlantic City, the West Jersey & Seashore Railroad Company has taken care to cover the third rail wherever the road comes into or crosses public property; as well as at other places where it is accessible to the public.

The greater part of the sixty-five miles of double-track road runs through property owned by the West Jersey & Seashore. On both sides, the tracks are separated from the abutting property by stout fences.

Wherever the tracks cross a public street or road, the side fences turn in toward the track and across the tracks themselves, and meeting the fence is a "cattle guard."

The third rail never continues across a public highway, but stops five feet back of the property line. The current is carried under the highway by connecting wires. With contact shoes on all cars a train is able to maintain continual connection with the third rail at the crossings.

Unusual precautions have been taken to protect the third rail at stations. In front of the stations and for a considerable distance beyond in both directions it is covered over the top by a board, and directly opposite the platforms there is an additional covering on the side. The "shoe" attached to the car goes under the top covering to make contact with the charged rail.

The third rail is protected on station sidings, for the sake of employés, just as it is in front of platforms. Along the "team tracks," too, where freight is loaded and unloaded, the same measures have been taken.

The third rail gives way to overhead trolley wherever the electric road parallels public streets, as in Camden, the western terminus, Vineland, and Millville. When the current comes from the trolley the contact shoes are not charged at all, as there is a switch in the car to disconnect them when the third rail ends.

In Atlantic City, from the terminus to the point where the tracks go upon the elevated structure, the third rail is protected all the way. Even up on the "filling," the approach to the elevated structure, with high embankments on both sides, the wooden coverings are installed. The crossings at Ohio avenue, Indiana avenue, Illinois avenue, Kentucky avenue and the rest are just as they would be if trolley wires furnished the current.

Meeting of the Colorado Electric Light, Power and Railway Association.

The annual meeting of the Colorado Electric Light, Power and Railway Association was held at Denver, Col., September 20. The programme included the reading of papers entitled "Voltage Regulation," by Leonard Wilson; "The Use of Polyphase Motors in Outlying Districts," by W. A. Carter; "Profitable Commercial Cooperation," by J. Robert Crouse; "The Lighting of Small Stores," by J. R. Cravath; "Watertight Lightning Arresters," by A. M. Ballou; "Transformer Testing and Line Records for Transformers," by E. P. Dillon, and "Steam Turbines," by C. C. Chapple.

The members of the convention visited the power-house of the Denver City Tramway Company as guests of the company, and also inspected the high-tension substations of this company. The supply houses furnished a theatre party and other forms of entertainment, and a trip was made to the foot-hills of the Rocky Mountains.

The secretary's report showed the association to be in a flourishing condition, with a largely increased membership. The convention was well attended.

Officers were elected as follows:

President, George B. Tripp.

Vice-president, W. C. Matthews.

Secretary and treasurer, J. F. Dostal, Denver, Col.

Additional members of the executive committee: F. W. Frueauff, J. E. Beeler.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

What Degree of Accuracy Is Feasible and Necessary in Wiring Calculations?

Certain inconsistencies in wiring calculations are pointed out by Albert Scheible, who questions why they should exist and suggests more consistent practice. Wiring tables give the size of wire to an average exactness of 0.01 per cent, and he has found it the practice to use these figures to the last place, although the wire itself may vary one per cent in size and methods of computing length allow for a variation of two per cent. Another practice in the use of the resistance constant differs also, some using a constant as low as 10.35, and others eleven. Other figures met are 10.5, 10.8 and 10.6. Certain authors adopt a constant not stating any conditions of temperature and purity of copper. Others use a rather large constant; for instance in dynamo design, and thus allow for a longer wire than that computed, not giving any reason why the wire should always be longer, and not shorter, than the calculated length. To avoid these discrepancies it is suggested that certain approximate dimensions, accurate to one-half per cent, be used, and the same method be done with respect to the resistance of these sizes of wire.—*Abstracted from the Journal of the Western Society of Engineers (Chicago), August.*

A Thermochemical Electric Generator.

When sulphur dioxide water and bromine are brought together sulphuric acid and hydrobromic acid are formed, with a liberation of energy. Under proper conditions this may appear as electrical energy, developing 0.63 volt per couple. The mixture of acids may then be heated and decomposed into the original constituents and used over again in the cell. This method of generating electricity has been patented in France by L. P. Basset. The cell consists of a hermetically sealed vessel divided into a number of compartments by means of porous partitions, each compartment being again divided by a carbon wall. Sulphurous acid is circulated through half of these chambers, bromine water being passed through the alternate ones. The apparatus thus forms a series of electrolytic cells, the carbon-plates being the electrodes. To make the process continuous, the sulphurous acid and the bromine solutions are passed through the cell from reservoirs. After leaving the cell, the mixture is carried to a vaporizer, where the application of heat brings about the decomposition of the two acids. The sulphur dioxide passes off as a vapor, bromine passing away with the water of decomposition, the two chemicals being then ready to be returned to their respective reservoirs.—*Translated and abstracted from La Revue Électrique (Paris), July 30.*

Coils of Bare Aluminum Wire.

The suggestion is made here that advantage be taken of the fact that aluminum rapidly becomes covered with an oxide which is a fair insulator. This makes possible the winding of coils of bare aluminum wire, the oxide providing sufficient insulation between adjacent turns. This may be done without any special precaution being taken when the pressure between adjacent layers is not greater than one-half volt. In general, it is considerably less than this. For coils exposed to higher potentials, the completely wound coil may be submerged in a chemical bath which produces an oxidation resulting in a coating of insulation sufficiently strong to resist 100 volts; but, in general, it is not necessary to have resource to this method, since the moisture contained in the air is usually sufficient. For large coils, where there may be large differences of potential, a hydroscopic material may be interposed between adjacent layers. Paper is excellent for this, and it is well to wet it as each layer is placed on. It then rapidly produces an insulating coating. If the coil be intended for alternating currents it is well to pass a direct current through it for about fifteen minutes, thus heating it to about 100 to 120 degrees centigrade. After such preparation the paper may be completely carbonized without producing a short circuit. In general, coils wound in this way give the same properties for the same dimensions as when insulated copper wire is employed, for the saving due to the absence of insulation will more than make up for the lower conductivity and therefore the larger cross-section of the aluminum wire. For larger coils it may be advisable to employ square wire. Coils have been prepared in this way and have been submitted to various treatments without any breakdown in the insulation appearing. A table is submitted showing the dimensions of various coils wound with insulated copper and bare aluminum wire. The aluminum coil of the same dimensions and resistance is considerably lighter, yet contains about the same number of turns. A similar comparison is made between the field coils of a 1,500-kilowatt generator. The coils have the same interior and exterior diameter and length. The same number of turns is obtained on each winding with approximately the same length of wire. The resistance is also the same, but the weight of the aluminum coils is less than half that of the copper and the cost about seventy-five per cent as much.—*Translated and abstracted from L'Industrie Électrique (Paris), August 25.*

Planning the Construction of a Power Plant.

The location of the power plant and, in particular, the relation of this with respect to the water supply, fuel supply, storage and handling is considered at some length by A. E. Dixon. One important feature frequently overlooked is the available labor supply. The attractions which the neighborhood presents have a great deal to do with making the men contented with the locality. Where possible it is desirable to select a site which will attract men with families, and who can therefore be depended upon. With regard to water supply considerable latitude is allowable, owing to the possibility of piping from a distance. It is advisable to provide city connections when available in case of emergencies. An insufficient supply of water should be supplemented by a cooling plant. Considering the fuel the cost should be reckoned as that at which the fuel is delivered to the boilers, including in this the cost of disposing of the ash. It is more important to be close to a supply of fuel than to the ash dump. For large plants fuel storage has become absolutely necessary, and various systems which have been

Digitized by Google

adopted are described somewhat in detail. It has been found by Playfair and Meyer that the fuel value of stored coal may decrease about thirty-five per cent in a few years. It is well to provide steam at the storage yard for thawing out the coal-handling apparatus as well as the coal in the cars during the winter. Spontaneous combustion not infrequently takes place in such storage yards, often going on for months before it is detected. When such fires occur generally the only method of extinguishing them is to move the coal. Various methods of handling coal and delivering it to the boilers are described. It is held that when conveyers are used the runs should be horizontal and vertical, and not inclined. Friction is frequently very large in these devices.—*Abstracted from the Engineering Magazine (New York), September.*

The Voltage Regulation of a Continuous-Current Dynamo.

Many methods have been proposed for predetermining the regulation of alternators. In this article H. M. Hobart develops a similar method for predicting the regulation of continuous-current dynamos. The method consists in analyzing the effects which enter into the problem and deducing formulæ for their resulting effect. The armature reaction at any time depends upon the brush position, and is usually expressed in ampere turns per pole piece. It is usually divided into two parts, the demagnetizing and the distorting components. The former is found to be proportional to the brush lead expressed in commutator segments, to the current, and to the number of armature turns per segment; and inversely proportional to the number of conducting paths through the armature from positive to negative brushes. The influence of the distorting ampere turns is proportional to the number of commutator segments per pole, less those included in the double angle of lead, to the current flowing, and to the number of armature turns per segment; and inversely to the number of paths through the armature from positive to negative brushes. These deductions are expressed as equations which may be applied to any machine if the data of the machine be given. The application to a 500-kilowatt dynamo is shown, the predetermined characteristics being compared with those found experimentally. The agreement is fairly satisfactory.—*Abstracted from the Electrical Review (London), August 24.*

A Korean Hydroelectric Transmission Plant.

The Maraposa Commercial and Mining Company has operated, with considerable success, electric plants in connection with its California mines, and its experiences there led to the adoption of the same method for certain mines in Korea in which the members of the company are interested. William M. Dean, who superintended the installation of the hydraulic and electric equipment, describes here the character of the plant and the difficulties under which it was built. The mines are situated about forty miles from the Yalu river, and had been operated by steam, the fuel being wood. The scarcity of this led to the adoption of water power. Much difficulty was encountered in securing satisfactory poles. Any wood obtainable was used, and the bases of the poles were charred, other methods of preserving not being available. The transmission line is five miles long. The holes were dug by Korean labor, and the poles were erected by Chinamen. The iron work was done by Japanese. The equipment consists of a turbine operating under a 110-foot head, direct-connected to a 500-kilowatt, 13,000-volt, rotating field, three-phase alternator. The pipe-line is 325 feet long. Much of this equipment reached the site considerably the worse for wear, the transformers and other electrical apparatus being soaked with water and covered with ice. The plant was put into operation in October of last year, and has already effected a considerable saving in the cost of developing the mines. The conditions for operating a water-power electric plant in Korea are similar to those in northern California, except for the difficulty of getting competent operators.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), September 8.*

The Iron Arc.

In this communication Professor W. G. Cady described some interesting work which has been done at his laboratory with the iron arc. While experimenting with the electric arc between iron electrodes, H. D. Arnold found that there was a certain critical potential difference at which an abrupt change took place in the conditions of the arc. Subsequent investigation has shown that the effect is closely analogous to the hissing point of the carbon arc. If the iron arc be started with a large external resistance and maintained at such a length that the current is well below one ampere, it burns with little or no sound, and its appearance in the neighborhood of the anode is very diffuse and ill-defined. As the external resistance is gradually decreased, the potential difference falls and the current rises, until a certain critical value, depending upon the length of the arc and the size of the electrodes, is reached. At this point a very small decrease in external resistance suffices to cause a sudden increase in current and drop in potential difference, precisely as with the carbon arc. At the same time, the arc contracts, a bright spot appears on the anode, and a characteristic hissing sound begins. A further increase in the current is accompanied by a continued decrease in potential difference. The hissing stage begins at a different potential difference from that in the case of the carbon arc. If the experiment be carried out in the reverse order, starting with a large current, the discontinuity is encountered again, but not until the current has been diminished beyond the value that it had at the beginning of the hissing stage. With the arcs of six millimetres in length and more the current on the hissing stage can, with care, be decreased until it is smaller than the previous largest value on the quiet stage. Thus there are two possible values of potential difference for the same current and length of arc, one corresponding to the quiet and the other to the hissing stage. With the iron arc there is no definite crater. Each electrode terminates in a viscous incandescent globule, apparently magnetic oxide of iron. When the arc is hissing strongly the discharge seems to take place from a small area on the surface of this globule. A large increase in diameter of the electrodes is accompanied by only a small increase in the value of the critical current. This varies between 0.8 ampere and 1.5 amperes, over a wide range of values of length of arc and thickness of electrodes. With the arc burning on the quiet stage in the neighborhood of the hissing point, hissing can be precipitated by shortening the arc. After the current has been increased somewhat beyond the hissing point the arc begins to rotate rapidly, producing a ring instead of a spot of light on the anode. This phenomenon is accompanied by a high-pitched whistle which degenerates into a sputter and finally turns into a steady hiss as the current is further increased. At the beginning of the whistling stage the arc has a curious tendency to jump back into the quiet stage. It is possible that slight irregularities in the electromotive force supply may serve to precipitate the change from one stage to the other, even though the current be not that at which the change normally takes place.—*Abstracted from Nature (London), August 30.*

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

COSTS OF, AND RESULTS FROM SOLICITING AND ADVERTISING.[1]

BY HOWARD K. MOHR.

In compiling a report on this subject the endeavor has been to get away as far as possible from an expression of personal opinion, and to ascertain the facts in connection with the cost and efficiency of soliciting and advertising as demonstrated by the methods in vogue and results obtained by the member companies, the subject of rates being excluded.

To this end thirty-one questions were framed, eighteen on soliciting and thirteen on advertising, covering the subject broadly. These questions were printed upon sheets for convenient reply and mailed to every company in the association. It was realized that certain questions, particularly some of those on advertising, would not receive many answers, due to the fact that some of the companies are not advertising systematically; but it was the hope and expectation that more of the companies would have given full and frank replies than has actually been the case.

For convenience of reference the questions submitted are herewith reprinted.

SOLICITING.

1. Gross revenue per year, of your company, for light and power for commercial business, exclusive of municipal business and merchandise sales.
2. Average cost of soliciting for past three years, charging to this account all expenses for securing new business, except advertising.
3. State number of contracts closed and 16-candle-power equivalent, 1905, as compared with 1904, these figures to be exclusive of increase of installation of old customers.
4. Give number of solicitors employed at present and average number during the year 1905. State number whose work is wholly soliciting and the number of solicitors who have mixed duties.
5. What is the average salary of your solicitors per year (not including heads of departments).
6. State methods of payment of solicitors, whether salary or commission or both; and on what basis do you pay commission? If you have changed from one system to the other what has been the result?
7. Do you allow premiums of any kind for successful work and on what basis?
8. State the average number of contracts secured per solicitor per year. (This refers to solicitors only; do not include heads of departments.)
9. State the average amount of new business secured per year per solicitor in 16-candle-power equivalent. (This refers to business secured by solicitors only; do not include heads of departments.)
10. Into how many branches is your soliciting department divided? Name them, prescribing the duties or limitations of each branch.
11. Do you allow commissions to architects, engineers, builders, wiring or motor contracts, and on what basis? If so, does it aid you in securing new business, and to what extent?
12. Do you divide your territory, giving a stated section to each solicitor, or do you permit each to extend his work in whichever direction he can secure contracts?
13. Describe your follow-up system for checking solicitors' work.
14. How often do your solicitors meet for general conference, and how freely may they discuss existing conditions at such conferences?
15. State how many inhabitants there are in your city for each solicitor employed. Answer this question by dividing your population by the total number of your employees who do the work of soliciting.
16. What was your percentage during 1905, of business connected to business removed from your circuits? In other words, for every 100 16-candle-power equivalent connected to the system, how many 16-candle-power equivalent were lost?
17. Do you employ women for soliciting in the residence district? If so, are they successful and why?
18. What general or specific rules do you follow in the matter of making investments for installation incident to getting new business? Please divide your answer as follows, stating method in each case:

a. Do you make free sign installations?
b. Do you make free motor installations or do you make use of a loan proposition?
c. Would you make the investment necessary to change an elevator from hydraulic to electric?
d. Do you do any wiring free of charge (residences or stores)? Do you supply first installation and free renewals of special lamps, such as the High Efficiency and Nernst lamps?
e. In shutting down isolated plants, do you aid in financing the electric installation, and how?

ADVERTISING.

1. What did you spend on advertising during the past year, excluding the cost of your bulletin, if you publish one?
2. State the cost of each subdivision of your advertising account, such as newspapers, follow-up advertising, street-car advertising, miscellaneous.
3. State the total number of direct replies received to advertising for one year.
4. State the number of contracts closed during the year 1905 by following up actual replies received. Exclude all contracts closed with parties whose names are on your mailing lists but who made no direct replies to advertising sent out.
5. Using the number of contracts closed as per Question 4, state the 16-candle-power equivalent of this business and the estimated yearly value of the same.
6. How do you check up the results of newspaper advertising? Do you look upon newspaper advertising for the central station as a measure of policy or as furnishing a direct return, or do you think it is partially one and partially the other?
7. What in your opinion is the best method of advertising for the central station with a limited appropriation; in other words, if an appropriation of from $5,000 to $15,000 were made, would you spend it in newspaper, follow-up, or street-car advertising, and why?
8. How much per capita of population in your territory did you spend on advertising during 1905? (Include all advertising expenses.)
9. In a follow-up system, which do you consider the better policy—frequent communications of average workmanship as to printing, designs, etc., or fewer communications of higher grade? How often each month or year would you circularize a given list?
10. What did your bulletin cost you during the year 1905?
11. How did you compile your mailing lists and what method do you pursue in keeping them up to date?
12. Give whatever data you have showing the advertising value of electric signs.
13. Send a copy of what you consider the most efficient advertisement you have ever issued, judged by actual replies or sales resulting from the same. Also a copy of the best newspaper advertisement; the best mailing card; the best circular letter; the best booklet, judged by the same standard; with percentage of replies received to pieces mailed (if the latter is possible). Also send a copy of your most effective bulletin cover.

SOLICITING.

Cost of Soliciting—Questions 1, 2, 4, 5 and 15 deal directly with the cost of soliciting. They were framed with the thought that the answers would indicate a more or less definite method of determining how much money should be spent in order to get business in proportion to the revenue of any one company or the population of the territory covered, etc.

The gross revenue exclusive of municipal business was asked for, inasmuch as the latter is obtained, as a rule, without the aid of the soliciting department. An analysis of the replies obtained discloses the fact that the cost of soliciting for all companies approximates one per cent of the gross revenue. That figure seems to hold, with two exceptions, in all companies whose gross revenue is under $1,000,000 per annum.

The cost of soliciting for companies whose gross revenue falls between one million and two and one-half millions falls

[1] Abstract of a paper read before the Association of Edison Illuminating Companies, Frontenac, Thousand Islands, N. Y., September 4, 5 and 6, 1906.

Digitized by Google

below one per cent and then takes a jump to one and three-quarters per cent for the companies that have a gross revenue of three million dollars and over.

If allowances are made therefore, for the element of difference in bookkeeping, the figure of one per cent of gross revenue exclusive of municipal business as applied to the expense of a business-getting department would seem to be the accepted annual cost among central stations. It may, or may not, however, be significant that as a company approaches the two-million-dollar class it seems to reduce its proportionate expenditure with a proportionate reduction in business-getting results as shown by the per cent increase in new business. When a company breaks into the three-million-dollar class, however, there appears to be a sudden awakening to the fact that liberal expenditure is required if largely increased revenue is an object, and here we see the cost of the business-getting department almost doubled.

Would these facts tend to prove that the cost of an efficient business-getting department should approximate two per cent rather than one per cent of the gross revenue per annum? If it has proven a wise expenditure for the three-million-dollar company, why not for the half-million-dollar company?

Questions 4 and 15 were asked with the idea that there might be some reasonable indication of how many solicitors would be required to cover a given field, worked out on the population basis. The result was unsatisfactory, the population per solicitor varying from 10,000 to 75,000. Twenty-five thousand of population per solicitor seems to be an average figure for the smaller companies, although we find one $500,000 company that employs no solicitor at all. In the larger cities there is a great divergence in these figures, although it should be noted that among the five largest cities the companies who show the greatest connected load per capita have the smallest number of people per solicitor, showing that it pays to cover your field thoroughly.

There appears to be considerable unanimity among the member companies as to the proper average salary of a solicitor, the figure of $900 per annum being that which appears most frequently. The business of selling electricity requires expert salesmanship. It frequently requires a certain technical knowledge. The public as a whole knows little about electrical terms or costs. They can be interested and finally convinced only by salesmen who understand their subject fully and talk of it enthusiastically; above all, they resent the sending of a boy to do a man's work.

Can you get any more than an average man for an average salary of $75 per month? You certainly can not get an expert salesman!

Straight salary without premiums is the almost universal method of paying a solicitor, but it is safe to say that the majority of central station managers would like to be convinced of the efficacy of a commission in increasing a solicitor's initiative.

The average solicitor working for a stated salary is prone to fix a certain number of contracts closed monthly as a standard. If he approximates that standard he is content, or nearly so. Would not a commission in addition to his salary (based on lamp equivalent contracted for and connected) on all lamps over a certain determined number per month provide the necessary fillip to his jaded soliciting consciousness?

Three companies who answered this question pursue a combination salary and commission method of paying solicitors. One answer is as follows:

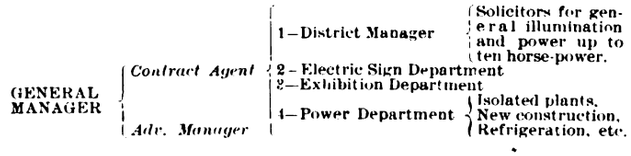
"Each solicitor is allotted a certain number of sixteen candle-power equivalent to obtain each year, and a commission is paid on all above eighty per cent of this amount on a basis of fifty cents for each customer obtained and one cent per each sixteen candle-power equivalent. About eighteen months ago we changed to the above basis with good results; the majority of the solicitors obtaining considerably more business since that time. This year we have changed from the yearly basis of paying commission to the monthly basis, with the result that a solicitor who before did not obtain a commission is now receiving a commission every month."

It would be exceedingly interesting and instructive if the representatives of those three companies would give us the benefit of their experience in this matter, with a little further information as to the details involved.

Methods of Handling the Solicitor—Questions 6, 7, 10, 12 and 14 were asked for the purpose of bringing out the various methods of handling the solicitor and developing his capabilities and resources.

The answers to Questions 10 and 12 brought out nothing that is new. The smaller companies who do not employ more than five to eight salesmen do not subdivide the work of the soliciting department. The general rule seems to be to allow them to get business of any nature when and how they can. As the companies develop, however, there is a tendency—a necessity is probably a better word—to break up the soliciting department into distinct branches. This phase reaches its highest development in the business-getting organization of the largest five or six companies, and here we find that tendency towards specializing which is present to a large degree in almost all manufacturing operations of magnitude.

A composite organization of the soliciting department of the large companies would be approximately as follows:



The popular method of keeping track of the solicitor's work is through the medium of the daily report, either directly to the contract agent or, in some cases, to the district manager—some of the companies have the solicitors make daily written reports of visits made, including date and result of each visit. These reports are forwarded daily to a record clerk at the main office for file and follow up.

Probably the newest feature of the business-getting department of a central station is the monthly solicitors' meeting held by a few of the companies. These meetings are not unlike training schools. They are presided over by the contract agent, and papers are prepared in advance and read each month by the engineers, district managers, and other employees. These papers are on a variety of subjects germane to the business-getting department and perforce of interest to the solicitor. After the papers are read a general discussion follows, in which all employees present are expected to take part. These meetings are in effect miniature Edison conventions, and should at least tend to increase the efficiency of a solicitor.

The Results of Soliciting—How may we properly gauge the results of soliciting—the efficiency of a soliciting department and the individual solicitor? Questions Nos. 3, 8 and 9 were intended to bring out answers which would throw some light

Digitized by Google

upon this subject. The result has been bewildering.

There are those who will at once say it is impossible to judge a solicitor's work in New York by comparing it with the work of a solicitor in a town of 50,000 inhabitants, and that the temperament and requirements of people living in different sections of the country vary so greatly that a comparison such as this would be worthless.

The question is debatable.

If allowances are made for varying conditions it may be possible to agree upon some middle ground, some approximate standard. It does not seem reasonable that such a great variation should exist between companies operating in cities of approximately the same class, as is shown by the answers received to the above questions.

If we except the solicitor who is engaged upon special work, isolated plant investigation and follow-up, for example, is it possible to agree upon a reasonable number of contracts which the general solicitor may be expected to secure in a year's time?

The average number of contracts secured per solicitor for different member companies in all sections varied from 110 to 494 per annum, but that fact does not prove that comparison is impossible, for the above-mentioned averages applied to two cities of the same class!

The average number of contracts secured per solicitor per year for all companies who replied to this question was 240. This is not an average of an average, but is the total number of contracts for all companies divided by the total number of solicitors.

The smaller companies averaged up to this figure very well; in fact, the majority of them ran above it. It would therefore seem that a company located in a city of the first class without competition should find food for reflection, if its figures fall below the average mentioned.

The average number of contracts secured per solicitor may be affected by the fact that one company will have a greater number of solicitors in proportion to the number of prospects than another, and there are, no doubt, other qualifying circumstances, but this data may be an entering wedge, or may at least suggest other methods of arriving at some conclusion in this matter.

One of the member companies during the year 1905 secured 20,000 new contracts (averaging 494 per solicitor); this same company used the combination salary and commission method of paying solicitors. Is there any significance in this fact, or is there some other explanation for these truly remarkable figures?

A yearly compilation of figures bearing upon soliciting results, with the sincere cooperation of the member companies, should prove of practical value to the central station manager.

Proportion of lamps disconnected to lamps connected each year may not have any direct bearing on the cost and results of soliciting except as an index of the character of the business secured, but, on the basis of "a penny saved is a penny earned," it is important.

Fifty-six lamps lost to 100 gained appeared to be the highest figure in the answers received to Question 16, varying from that number to 20 lost to 100 gained as a minimum. An analysis of the answers received would seem to show 43 lamps lost to 100 gained as an average, with 40 to 100 as a figure to be striven for.

WARRANTABLE INVESTMENT TO SECURE NEW BUSINESS.

It would be entirely impossible to do justice to this subject within the confines of a report. There is perhaps a greater divergence of opinion and treatment of this matter among central station managers than any other problem which they have to face. And nowadays the condition is met almost daily of losing business or gaining it by either making investment or refusing to do so.

The policy of making free sign installations seems to be generally accepted as good practice. Free signs have proven big money earners wherever tried and there seems to be no difference of opinion on this point. A number of the member companies, however, in the face of these results, do not as yet take advantage of this opportunity for advertisement and increased income.

A reasonable method of making free sign installations, in use by one of the member companies, is as follows:

Term contract of two or three years, with monthly guarantee (depending upon number of lamps and cost of sign) the sign and wiring remaining the property of the company.

Very few of the companies make free motor installations. One company sells the motors at cost; another makes a free trial loan of thirty or sixty days, motor to be paid for at end of that time if satisfactory; a third rents motors "on occasion at so much per month." There is apparently no well-tried-out method.

None of the companies makes the investment necessary to change an elevator from steam hydraulic to electric hydraulic.

The matter of free wiring is handled in a variety of ways. Many companies do no free wiring of any description; some do free wiring for outside arc lamps only; others do free wiring for incandescent window lighting, and when policy demands it in order to retain old business. One company does free wiring if the prospective customer is of the long-burning variety; in practically all cases this same company pays for the wiring in free current. For example, if a man makes an expenditure of $100 in wiring, the company allows him to use $100 worth of current at regular rates without charge.

In shutting down isolated plants and substituting central station service, the larger companies furnish the bulk of experience. There is a disposition to aid in financing this change by the purchase of the steam machinery at second-hand valuation. Where the size of the prospective business demands it, the old plant is purchased at a high valuation, the company so doing taking a chance of losing a little on re-sale; necessary wiring is sometimes done free of charge, where it is necessary in order to connect the business to the company's circuits. There is no fixed rule apparently in handling such cases; each company does what it has to in order to secure the business, the amount of investment by the company depending upon the shrewdness or demands of the prospect.

It ought to be possible by discussion and free exchange of experience to determine what is legitimate and what is illegitimate investment in order to secure new business, and also to agree upon a more or less certain method of handling the individual cases arising where investment is necessary.

ADVERTISING.

Starting with the premise that advertising is not only a good thing but also an essential adjunct to the business-getting department of a central station, how may we determine the proper expenditure and the reasonable results to be expected therefrom?

There is such a paucity of reliable information upon this subject, as evinced by the incomplete replies received to the questions asked, that it is extremely difficult to arrive at any definite conclusions. Only four member companies turned in a complete set of answers; quite a number of the companies answered in part; some kept no records, and others did no advertising at all.

Questions 1, 2, 8 and 10 of the adver-

Digitized by Google

tising section are concerned directly with the cost of advertising, with a view of determining the amount of an appropriation in comparison with the gross revenue[1] of any one company.

Advertising costs of the member companies varied from one-quarter of one per cent to two and one-half per cent of the gross revenue, the average figure being one and one-quarter per cent. One of the smallest companies furnished the highest figure of two and one-half per cent and the average expenditure of the larger companies was close to one and three-quarters per cent of the gross. It would seem therefore that the companies who do advertising in the most systematic manner are very closely approximating the figure of two per cent of the gross revenue mentioned some time ago.

A central station about to start a systematic advertising campaign and not knowing how much to appropriate for the purpose might determine on two per cent of the gross revenue as a very good figure, judging from the experience of the other member companies, but to state that two per cent is the proper amount for all companies might be misleading and contrary to fact. One of the best-known men in the advertising world covered the question of advertising appropriation as follows:

"How much can be judiciously spent for advertising depends largely on the possibilities of the business. If the field is such that the business can be increased indefinitely, the amount of money that can be judiciously paid for advertising is only limited by the ability to pay. Where the field is limited and only a certain amount of business can be developed any way, the advertising appropriation should be governed accordingly."

Having obtained an appropriation for advertising, how may the money be spent to the best advantage?

Questions 6, 7, 9, 11 and 12 were framed to bring out the experience and judgment of the various member companies upon this subject. An analysis of the answers received shows a considerable unanimity in thought regarding the most efficient method of expenditure, and a composite opinion upon the handling of a given appropriation would be approximately as follows:

Spend three-fifths of appropriation upon a follow-up campaign of direct mail advertising.

Spend one-fifth of appropriation upon newspaper advertising and street-car advertising.

Spend one-fifth of appropriation upon miscellaneous advertising, including bulletin, stuffers for bills, etc.

There is a distinct feeling that a series of novelty mailing cards, fac-simile typewritten letters, booklets, etc., judiciously interspersed and mailed to carefully compiled lists, is far and away the most efficient and resultful kind of advertising for the central station. There are several reasons for this, one of them being the nature of the commodity we have to sell and its necessary appeal to distinct classes.

Power users are a distinct class; so are users of electric signs; so are users of electric light, although in less degree; the percentage of people also who can not afford to wire their dwellings for electricity is considerable.

It follows, therefore, that the large percentage of waste circulation inevitable in newspaper advertising reaches its maximum in the case of the central station. Added to this is the difficulty of telling the electrical story properly and fully in the advertising columns of the newspapers without utilizing more space, at greater expense, than would be commensurate with results obtained.

The function of newspaper advertising for the central station appears to be threefold, namely, educational, supplementary, and as a measure of policy. As an educational factor, in letting the public at large know what you are doing—creating an interest and, if possible, a pride in your organization as a municipal institution—it is valuable; in supplementing and emphasizing your follow-up campaign it has its uses; from the standpoint of "good policy" it may mean a whole lot or nothing.

The money spent upon the bulletin seems to meet universal approval—the results from an educational standpoint are invaluable, and the uses which it may be made to serve are only partially realized. Stuffers of varied description, accompanying the bills, and even printed matter upon the bills themselves, bearing upon matters electrical, unquestionably serve a good purpose.

Nothing is more important than the proper compilation of a mailing list, and it is one of the most difficult problems the advertising man is obliged to face. The favorite and apparently the best method of making up this list is to have the solicitors thoroughly canvass their districts and send in the names of the most likely prospects contained therein. The value of such a list, however, depends entirely upon the sincerity of the solicitor, and the thoroughness with which he goes about his work.

In addition to the names furnished by the solicitors, the list should be filled out with names obtained from such publications as the Stationary Engineers' Directory, the Blue Book, and city directory. It should also contain the names of architects and builders and engineers and the names of prominent men in the municipality.

The data regarding the value of electric signs erected by the central stations for their own advertising purposes are not sufficiently specific to be of value.

ADVERTISING RESULTS.

If advertising is worth anything it should certainly be worth while to keep a record of the traceable results; and yet only three companies kept records of replies received to advertisements and contracts closed as a result therefrom. There are, of course, indirect results and benefits from advertising which it is impossible to measure, but the direct reply to an advertisement, with its attendant follow-up by a solicitor and the eventual signing of a contract, should certainly be a matter of record.

The simplest kind of a card index would fulfill every requirement for reference, and an office boy would have sufficient ability to take care of it.

Executive officers are apt to demand tangible results for moneys spent upon physical betterments or for an increase in the salary list, and there is no good reason why they should not demand the same thing from an advertising department, which is spending several per cent of the company's gross revenue each year.

If all of the companies kept such records, it would be possible to judge of the relative efficiency of the advertising issued, and possibly to determine upon an average cost per inquiry as well as a maximum cost, which latter figure, if exceeded, would be sufficient warrant for an organization to either change its advertising policy or seek reasons for the excessive expense.

So few companies kept track of advertising results that it serves no very good purpose to review the figures; as a matter of record, however, costs per inquiry received (considering follow-up costs only) varied from $2 to $25, and in return for expenditures during 1905, varying from $6,500 to $27,000, the estimated yearly value of contracts obtained as a direct result of "follow-up" advertising varied from three-fourths of the investment to seven times the investment, proportionate results sufficiently wide apart to be worthy of comment.

The percentage of contracts eventually closed as a result of replies received to advertising compared to the total number of replies received varied from eight per cent, the lowest figure, to thirteen per cent, the highest, which figures may have some bearing upon the efficiency of the respective soliciting departments.

[1] Gross revenue, as per Question 1, soliciting section.

Digitized by Google

An Interesting Emergency Application of Electricity.

Every once in a while the utility of electricity is demonstrated in some way which, while appearing very simple after the application has been made, in its originality called for a good deal of ingenuity and achieved results which were not possible by any other means. There has just come to our notice an interesting application of electricity which demonstrates once again the emergency utility of this form of energy. At the Philadelphia Mint a well is being bored which has reached a depth of some 540 feet. A few weeks ago one side of the jar rein

Electromagnet and Broken Tool.

of the drill, eighteen inches long and weighing nineteen pounds, broke off and wedged cross-ways in the hole at the bottom. The contractor doing the work fished for ten days trying to recover the broken piece without result, as he was unable to get hold of it, the bore being through rock. He had about decided to abandon the well when Peter E. Apgar, chief electrician of the mint, volunteered to get out the broken piece. Mr. Apgar took a piece of steel shaft, three inches in diameter, placed on one end a spool, seven inches by nine and one-half inches, wound with No. 18 cotton magnet wire, covered this with a copper sheathing, and attached to it a piece of No. 14 braided Okonite wire. The splice from the magnet to the wire was covered with a piece of lead pipe and filled with paraffine to make it watertight. The electromagnet thus constructed was lowered to the bottom with the current off. Current was turned on, 220 volts, one and one-quarter amperes. The electromagnet was then drawn up, bringing with it the broken tool and all the metal particles that were in the well from the boring. The water pressure in the bore was 250 pounds; the temperature of the water, fifty-six degrees, and the depth of the well, 540 feet. Mr. Apgar was highly pleased by the serviceability of this rubber-covered wire under these severe conditions. The accompanying illustration shows the electromagnet with the broken bar after it had been withdrawn from the bore.

The Electrical Trades Exposition Company.

The annual meeting of the stockholders of the Electrical Trades Exposition Company was held in Chicago, Ill., on Tuesday, September 11, for the purpose of electing directors for the ensuing year. The following directors were elected: Samuel Insull, Charles E. Gregory, G. H. Atkin, Stewart Spalding, Ellsworth B. Overshiner, George B. Foster, T. P. Gaylord, Homer E. Niesz, H. B. McMeal, W. W. Low and J. P. Cracraft.

At a meeting of the board of directors immediately following the stockholders' meeting the present officers were reelected as follows:

President, Samuel Insull.

Vice-presidents, Ellsworth B. Overshiner and Charles E. Gregory.

Treasurer, John J. Abbott.

Secretary, Stewart Spalding.

Managing Director Homer E. Niesz reports over eighty per cent of the floor space in the main exhibit hall of the Coliseum building already contracted for, for the second annual electrical show, to be held January 14-26, 1907.

Staff Additions for Sanderson & Porter.

Sanderson & Porter, engineers and contractors, New York city, announce that Richard S. Buck, consulting engineer of the department of bridges, New York city, has been admitted as a member of the firm. The partners in the firm of Sanderson & Porter are now Edwin N. Sanderson, H. Hobart Porter, Francis Blossom, Richmond Talbot and Richard S. Buck.

The firm covers in its operations all lines of civil, mechanical and electrical engineering, and has designed, constructed and operated steam and hydroelectric power plants, railways and lighting properties in various parts of the country.

Included in its engineering and construction work, now under way, are 50,000 horse-power of hydroelectric work in two developments on the Pacific coast; the power-house equipment and transmission system of the McCall Ferry Power Company on the Susquehanna river; extensive additions to the New Orleans street railway and lighting properties, and to those of the Mahoning & Shenango Valley Railway and Light Company, of Youngstown, Ohio, and Newcastle, Pa.

Illumination Tests.

To the Editor of the Electrical Review:

In your recent issue of the Electrical Review I note that you reprint a statement of a test at Bamberger's department store, Newark, N. J., in which a Moore tube, some Nernst and some incandescent lamps are compared.

A cursory examination of the illustrations and data accompanying this article would indicate to any one having knowledge of the art of illumination that neither the Nernst nor the incandescent lamps were installed in accordance with good illuminating engineering practice. For instance, six-glower Nernst lamps were used placed eight feet six inches from the floor, with a partition in the room nine feet from the floor, so that no benefit could be derived from the units placed in one of the rooms in the opposite room or space. Six-glower lamps should never be used where the ceiling is less than twelve feet.

In conclusion, a test or a comparative statement of illuminants is of value only when all the illuminants compared are installed in a proper manner to accomplish the desired results.

Max Harris.

Pittsburg, Pa., September 24.

The Association of Edison Illuminating Companies.

At the convention of the Association of Edison Illuminating Companies, held on September 4, 5 and 6 at the Hotel Frontenac, Thousand Islands, N. Y., the following officers were elected: president, Alex Dow, Detroit, Mich.; vice-president, Thomas O'Dea, Erie, Pa.; treasurer, Louis A. Ferguson, Chicago, Ill.; secretary, Ernest H. Davis, Williamsport, Pa.

Executive committee—Alex Dow, Detroit; Joseph B. McCall, Philadelphia; Samuel Insull, Chicago; J. W. Lieb, Jr., New York city; Charles L. Edgar, Boston; Thomas E. Murray, New York city; L. A. Ferguson, *ex officio*, Chicago; E. H. Davis, *ex officio*, Williamsport.

Digitized by Google

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Balanced-Draft Gas-Producer Furnace.

The accompanying illustrations show the application of the balanced-draft gas-producer furnace to steam boilers. Fig. 1 shows the balanced-draft gas producer furnace as applied to a water-tube boiler with a Dutch oven extended furnace. Fig. 2 shows a front view and cross-section of the furnace.

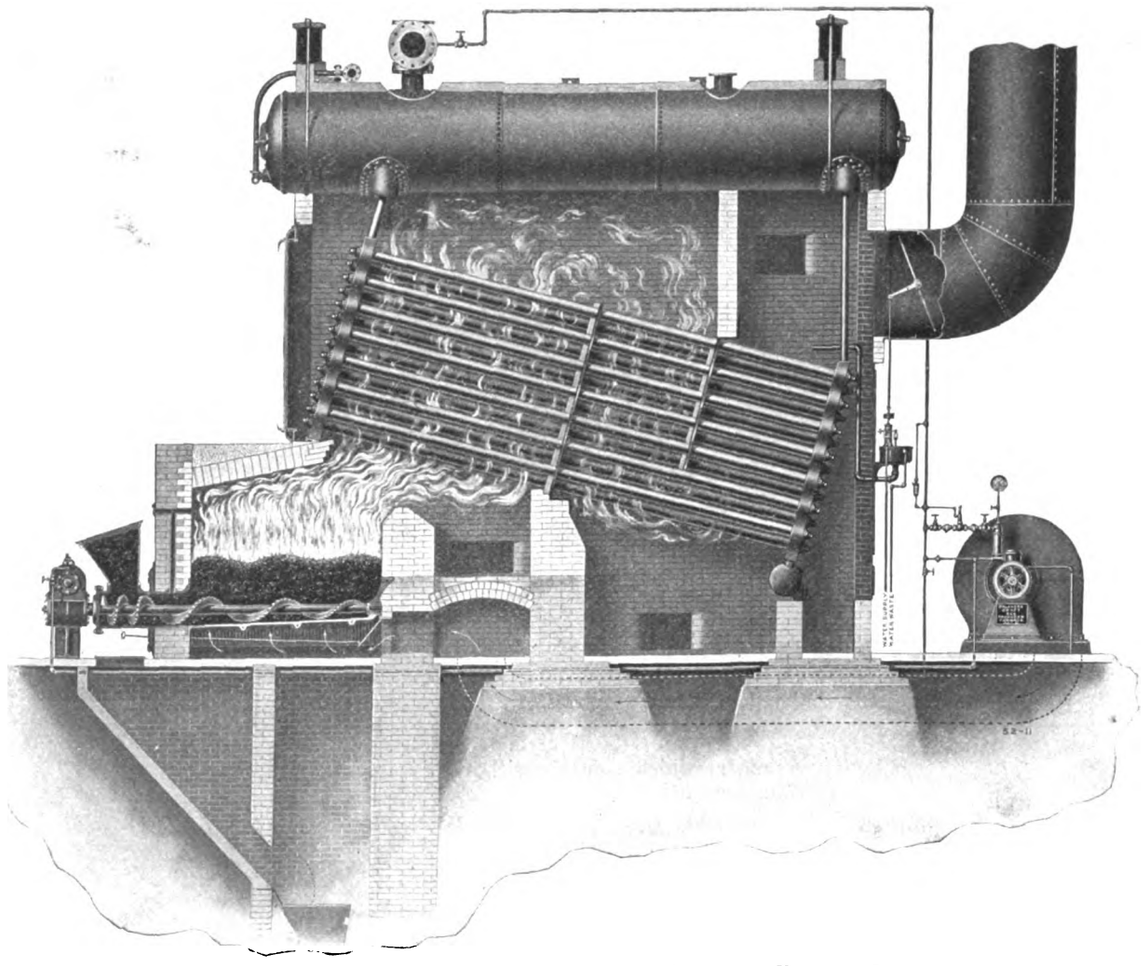


FIG. 1.—SECTIONAL VIEW OF BALANCED-DRAFT GAS-PRODUCER FURNACE SYSTEM.

The term, "balanced-draft gas-producer furnace," is an attempt to express in words the combination of certain mechanical apparatus which accomplishes the scientific, correct and commercially perfect combustion of fuel under boilers or in any furnace. At a recent meeting of the Brooklyn (N. Y.) Engineers' Club, Embury McLean, of the Engineer Company, 111 Broadway, New York city, stated that the resulting economies average about twenty-five per cent in the installations made to date, with about the same average increase in capacity. The capacity increase has amounted in exceptional instances to over 100 per cent. The "balanced draft" automatically maintains in the furnace a pressure equal to the surrounding atmosphere and limits the air introduced to the quantity required to effect perfect combustion through the entire range of demands upon the boiler. The "gas producer" part of the system is a mechanical method of feeding the coal into the furnace in such a manner that the heat of the furnace liberates the moisture and volatile matter, which combines with the requisite quantity of air, which has been heated to the temperature of combustion essentially as in a producer-gas furnace. The carbon is then consumed while passing down the inclined grates.

The draft is balanced by throttling the suction of the chimney in exact proportion to the speed of a specially designed fan blower which supplies air to the ash pit. The speed of the fan is governed by variations in the boiler pressure. The rate of feed of the fuel is also controlled by the variations in the boiler pressure, so that a constant ratio of air to coal is maintained for all rates of combustion. The attained result is that twelve pounds of air, combining with one pound of coal, produce maximum efficiency, maximum economy and reduce to a minimum the liability of injury to the furnace and boilers.

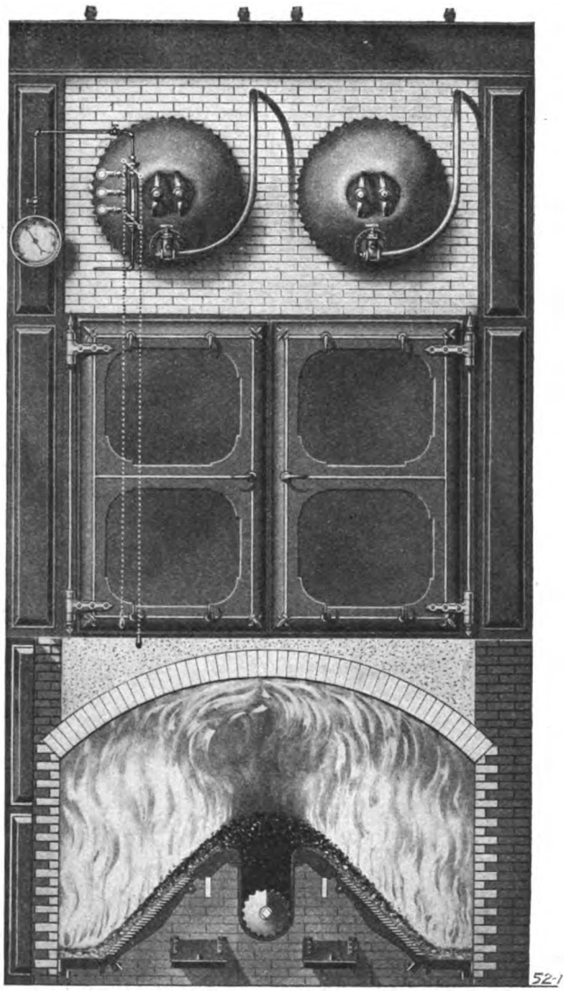
It will be observed in the illustrations that the conveyer worm acts as a conveyer, as such is generally understood, for about one-third of its length. The pitch of the worm of the conveyer changes just back of the front of the furnace wall from an angle in which the conveying principle

Digitized by Google

predominates to an angle in which the lifting principle predominates.

The coal is forced from the hopper through the entrance tube and into the U-shaped trough, from which it is lifted to the surface of the fire and allowed to roll gradually by gravity down the surfaces of the inclined grates, the proper inclination of which to effect the required result has been accurately determined. The variations in the pitch of the conveyer worm, in order to provide an absolutely even distribution of the coal from the front to the rear of the furnace, have also been accurately determined.

In operation the fuel assumes an uneven surface from front to rear of the furnace and has a motion similar to that of waves on the surface of a body of water, each wave corresponding to a cycle of the conveyer worm. This movement has been found to be advantageous, assisting in loosening up the fuel and freeing the volatile gases, accentuating the producer-gas furnace effect.



FRONT VIEW OF BALANCE-DRAFT GAS-PRODUCER FURNACE SYSTEM.

The Improved "Dow" Adjuster.

The Marshall Electric Manufacturing Company, Boston, Mass., has put on the market an improved form of the "Dow" adjuster, an illustration of which is shown herewith. This device is used for raising or lowering an incandescent lamp suspended from a cord. The device works like a curtain fixture, and the cords are rolled entirely out of sight.

The adjuster consists of a metal shell or barrel, inside of which is a long coiled flat piano wire spring. To this barrel is fastened an eye, around which the cord is wound, and on the end of this barrel are two pawls which engage the spindle fastened to the shell. When the adjuster is quickly released, it will go up until stopped by the hand. At the same time it can be pulled down to any desired position, at which point it will remain until further adjusted.

"DOW" ADJUSTER.

Large stocks of these adjusters are now in the hands of the branch offices of the company—227 Fulton street, New York city; 169 Adams street, Chicago, Ill., as well as the Boston works.

New Electrical Engineering Company.

The Connally-McIlheran Electrical Engineering Company has been incorporated at Chattanooga, Tenn., with a capital stock of $10,000. The engineers identified with this company are as follows: W. B. Connally, formerly electrical engineer with the Wellman-Seaver-Morgan Company; W. C. McIlheran, formerly electrical engineer for the Decatur Car Wheel and Manufacturing Company; W. C. McAfee, electrical engineer, Atlanta Steel Hoop Company, and H. A. Clark, electrical engineer, United States Cast Iron Pipe and Foundry Company.

Sturgess Water-Wheel Governors.

The accompanying illustrations show two forms of Sturgess water-wheel governors made by the Sturgess Engineering Department of the Ludlow Valve Manufacturing Company, Troy, N. Y. Fig. 1 shows the type "M" governor, producing a rotary motion at the terminal shaft. This is the standard machine for turbines having gates operated by a rotary shaft. It consists of a shaft-type centrifugal governor at the top, controlling, by means of a long vertical lever, the valve attached to the side of the cylinder. This admits pressure into the cylinder, the piston of which rotates the gate shaft by means of a concealed steel rack and pinion. This rack has a substantial guide, ensuring its alignment and a proper meshing of the teeth, avoiding the use of a piston rod and gland.

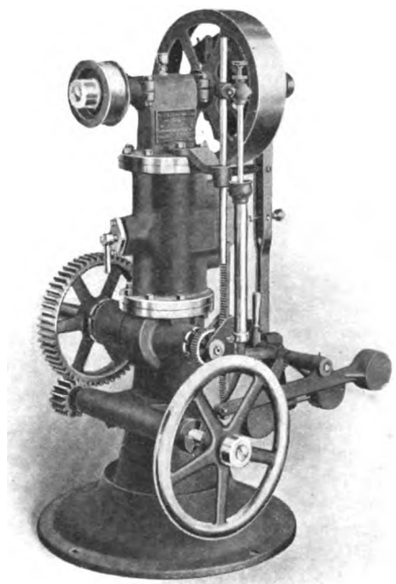


FIG. 1.—STURGESS TYPE "M" WATER-WHEEL GOVERNOR.

The compensator for preventing racing is simple in design, correct in principle, and causes the governor to make definite movements exactly proportionate to the change of load.

The centrifugal governor is of the standard shaft type, having a high power-factor to enable it to absolutely control the valve.

In the two smaller sizes the admission to the cylinder is controlled by a hardened-steel piston valve operated directly from the governor lever, the valve being set in a valve chamber bolted to the side of the cylinder.

In the three larger sizes, four poppet valves are employed to give admission and

Digitized by Google

exhaust. The poppet valves are operated by a small hydraulic cylinder controlled by the pilot valve and centrifugal governor, the piston of the cylinder being connected to an arm on a rock shaft carried

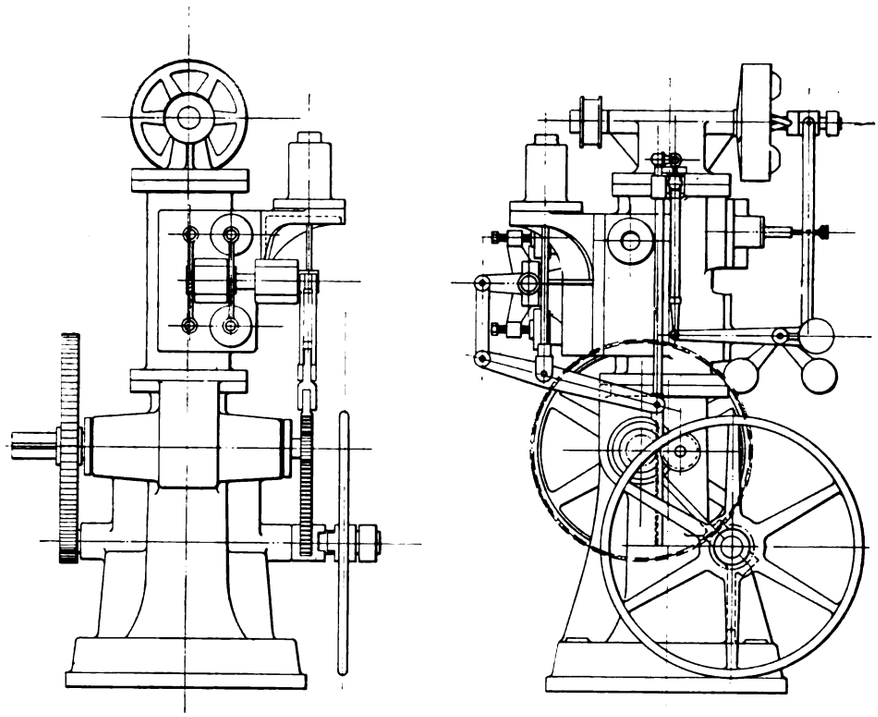


FIG. 2.—ARRANGEMENT OF PARTS, STURGESS TYPE "M" WATER-WHEEL GOVERNOR.

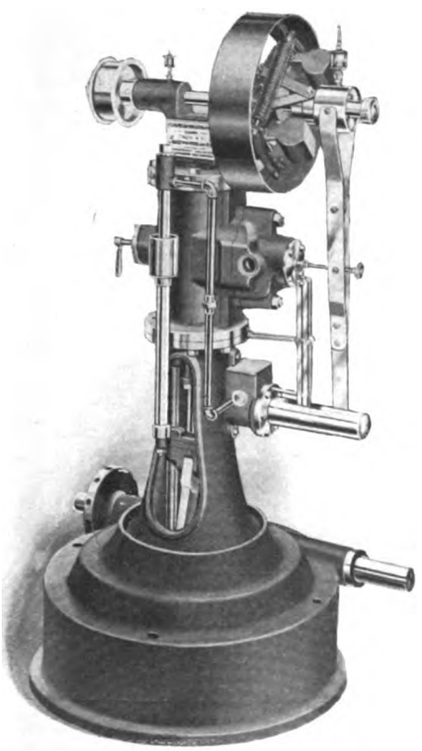


FIG. 3.—STURGESS TYPE "L" WATER-WHEEL GOVERNOR.

in bearings. The two upper valves are pressure and exhaust valves controlling the upward movement of the main piston. The two lower valves similarly control the downward movement of the piston. All valves open against the pressure.

These governors will completely open or shut the gate in one and one-half seconds. Under gradual changes of load they will maintain the speed within three-quarters of one per cent of normal. Under sudden changes of load they will promptly move the gate to the new position required by the changed load, the movement commencing before the speed has exceeded three-quarters of one per cent from normal.

Fig. 2 is a diagrammatic representation of the type "M" governor, showing the relationship of the various parts.

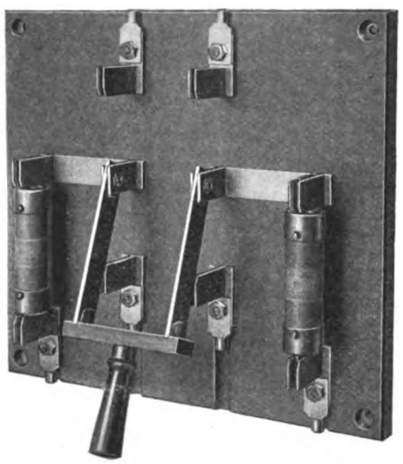
Fig. 3 shows the type "L" governor with rock shaft for producing an oscillatory motion of seventy-five degrees at the terminal shaft. The type "L" governors are similar to type "M" in all respects, except that in place of the rack and pinion and rotary shaft they have a rock shaft operated by an arm and link connection to the piston rod of the main cylinder.

The centrifugal governor valve mechanism and compensator are of the standard design, the same as is used with the type "M" governors.

The Chicago Pneumatic Tool Company reports its trade for the month of August to be the heaviest in the history of the organization, both in business booked and shipments made, the latter exceeding all previous monthly records by fifteen per cent.

An Improved Type of Lever Switch.

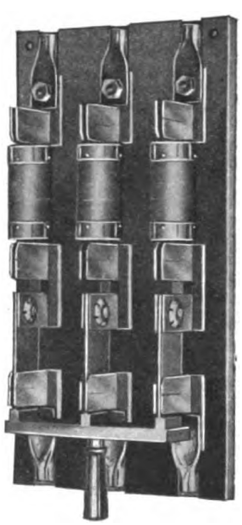
The General Electric Company has recently developed a line of knife-blade switches, to be known as D-12 lever switches, which meet exactly the require-



DOUBLE-POLE, DOUBLE-THROW ENCLOSED FUSE SWITCH.

ments of this class of electrical apparatus. In the first place the switch is of simple construction. Sweated joints have been eliminated so far as practicable, and such joints as are sweated are reenforced by other means of fastening. Similar parts of switches of the same capacity are made interchangeable, and the workmanship throughout is of a high grade.

Every detail in these switches is care-



TRIPLE-POLE, DOUBLE-THROW ENCLOSED FUSE SWITCH.

fully worked out. The cross-bars are made of selected black fibre secured firmly to the blade, while the handles are made of hard wood stained black and polished, and firmly attached to the cross-bars by heavy studs and insulated nuts. In order to provide for very low rise in temperature, the contact clips are generously pro-

Digitized by Google

portioned from hard-drawn spring copper, securely pinned and soldered into the clip blocks, and the hinge clips are provided with large and substantial spring washers which serve to maintain good contact by compensating the slight wear incident to long-continued use. These spring washers are provided with positively locked nuts, so that contacts are prevented from working loose in the most severe service. Hard-drawn copper is used in the construction of the blades.

General Electric switches of this type can be furnished with connections, either for enclosed fuses of the National Electric Code standard or link fuses. Single and double-pole, double-throw switches have off-set fuse connections, necessitating but one set of fuses. The standard switch for enclosed fuses is so arranged that when the switch is open the fuses are on the load side. This arrangement can be varied, however, and switches can be furnished so arranged that, when open, the fuses will be between the switch and the service. D-12 switches are made in single, double, triple and four-pole types.

The Dean Hook Switch.

The accompanying illustrations show the method of stamping and attaching the hook switch with which the Dean Electric Company, Elyria, Ohio, is equipping its standard instruments. This is said to be one of the most efficient pieces of apparatus ever constructed. The switch hook lever is made in the most substantial manner possible, and gives an exceptionally neat appearance. This hook is made by pressing and drawing it into the proper shape, by numerous operations, from one piece of heavy sheet brass. The number of operations required to form this hook compacts it in such a way as to close all the pores in the metal, thereby strengthening and hardening it so that when completed it has the appearance of a solid metal hook lever.

Fig. 1 shows the blank from which the switch hook lever is formed. Fig. 2 shows the hook switch lever as it is drawn into triangular shape at the top of the forks, ensuring great strength at this point of construction. The metal is doubled over not only at the bottom of the lever, but at both prongs, making the lever very rigid.

FIG. 1.—BLANK FROM WHICH HOOK LEVER IS FORMED.

Fig. 3 shows the completed hook switch lever, and Fig. 4 shows the self-contained hook switch with the hook lever removed. Fig. 5 shows the hook lever locked into position in the hook switch.

FIG. 2.—BLANK DRAWN INTO SHAPE.

The hook switch, in connection with the one-piece hook lever, provides an exceptional facility in allowing the lever to be removed, avoiding extra space taken up in shipping and storage, and preventing the switch mechanism from being damaged.

FIG. 3.—COMPLETED HOOK LEVER.

The lever need not be installed in position until after the telephone is mounted on the wall. When the lever is once in place it is securely locked by a spring catch and can then only be removed by opening the lid of the telephone box, as the release is located on the body of the switch.

The removing and replacing of the lever do not require tools, nor is it necessary to disturb the switch hook mechanism, which is actuated by the stub lever. This lever serves also as a lock to hold the hook lever in place and partakes of its motion when the hook is operated.

The hook switch is self-contained in every sense, and is complete in itself, even to the escutcheon, so that no dependence need be placed on the telephone cabinet for operating or holding the parts in their relative positions. It is fastened to the telephone by four screws passing through the escutcheon frame. An opening, fifteen-sixteenths of an inch in diameter, is provided for inserting the body of the switch. The contact springs are mounted on a small metal block which forms a unit.

The various combinations of springs, necessary to adapt the hook switch to different circuits, are interchangeable with the remainder of the machine. The illustration, herewith, shows the two-contact spring combination for use with a central battery telephone. The contact springs are made from the best grade of spring, German silver tipped with platinum points and insulated with hard rubber. The hook switch frame and lever are thoroughly insulated from the parts entering the circuit. The actuating or main spring is of special German make, heavy and long, with its tension applied near the fulcrum of the lever. The entire hook is finished in heavy nickel-plate and the parts are copper-plated under the nickel.

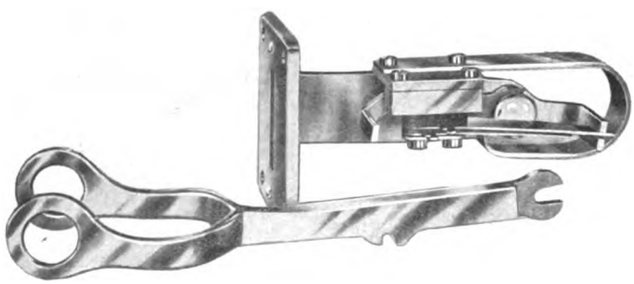


FIG. 4.—HOOK SWITCH AND HOOK LEVER

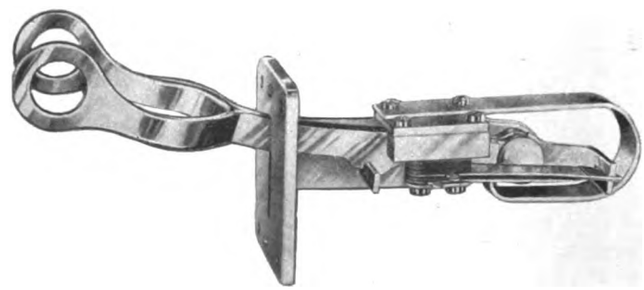


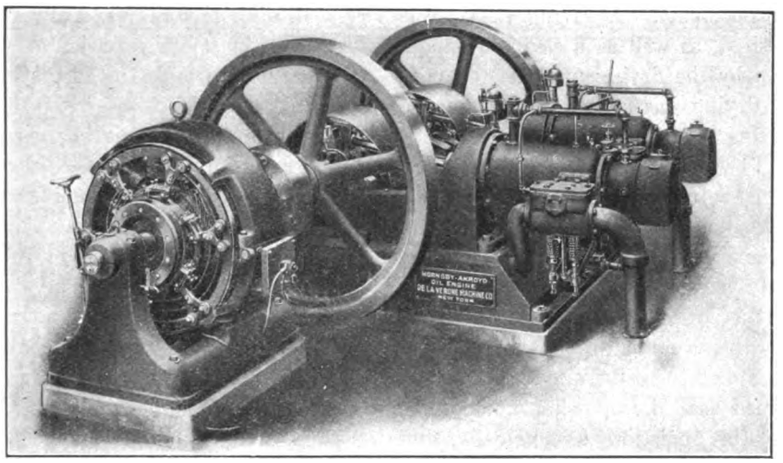
FIG. 5.—HOOK SWITCH AND HOOK LEVER ASSEMBLED.

The report of the Interstate Commerce Commission gives the gross earnings of the railways of the United States for the year ending June 30, 1905, as $2,082,482,406.

Digitized by Google

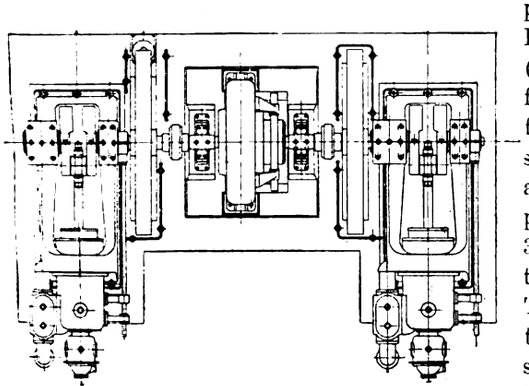
Crude and Fuel Oil Generator Sets.

The accompanying illustrations show two types of generator sets, several of



TWIN-CYLINDER OIL ENGINE WITH GENERATOR MOUNTED ON OUTBOARD BEARING.

which have recently been installed by the De La Vergne Machine Company, New York city. The engine used is the Hornsby-Akroyd, which operates on kerosene, crude or fuel oil, delivering a brake-horse-



TWIN-CYLINDER OIL ENGINE WITH GENERATOR MOUNTED BETWEEN CYLINDERS.

power-hour on a little less than a pound of oil. This machine is built in sizes from five horse-power to 250 horse-power. In the twin-cylinder type the generator is sometimes placed between the cylinders, as is shown in the accompanying diagram.

Electric Equipment for the Hudson Company's Tunnels.

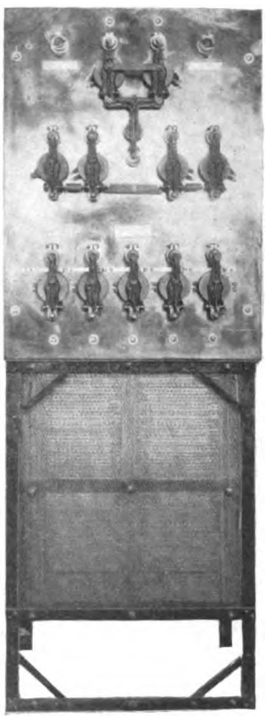
The twin tunnels of the Hudson Company, connecting Jersey City with New York, under the North river, represent the most recent development in electrical projects centering about New York city. Construction work on these tunnels was finished about a year ago and work on the electrification will begin at once. Fifty electric cars will be operated, taking their power from the third rail.

Each tunnel will have a single track; the north tube carrying the west bound traffic and the south tube carrying the east bound or New York traffic. The cars will be operated in trains by the Sprague-General Electric system of multiple unit control in a manner similar to that employed on the New York subway trains. Each car will be equipped with two GE-76 (160-horse-power) railway motors. Power for this new development will be supplied from a large station on the New Jersey side, located between Jersey City and Newark. Curtis steam turbines will be employed; initial equipments including two 3000-kilowatt, 11,000-volt machines and two 6000-kilowatt, 11,000-volt machines. The total power so generated will be distributed at high voltage to three substations where the alternating current will be stepped down to 650 volts direct-current through transformers and rotary converters. These substations will be located as follows: substation number one, Greenwich and Christopher streets, New York, containing five 1,500-kilowatt rotary converters and fifteen step-down transformers; substation number 2, Washington and First streets, Jersey City, containing four 1,500-kilowatt rotary converters and twelve step-down transformers; and substation number 3, Cortlandt and Church streets, New York city, containing two 1,500-kilowatt rotary converters and six step-down transformers. Each substation will, in addition, contain one spare 1,500-kilowatt transformer.

It is expected that when the new line is in operation the running time between the various suburban cities of New Jersey and New York city will be reduced one-half. The General Electric Company will furnish the complete electrical equipment.

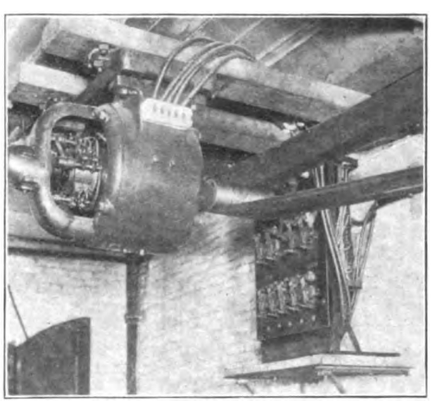
Automatic Motor-Controlling Devices.

The New York Electric Controller Company, 21-27 New Chambers street, New York city, has placed on the market what is claimed to be the most compact



ELEVATOR CONTROLLER.

and easily operated automatic elevator controller ever designed. The accompanying illustrations give an idea of the appearance of the motor controller and its adaptability to various situations. With this motor-controlling device there are no

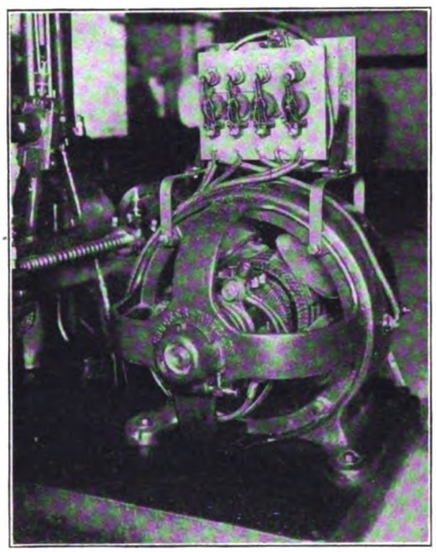


MOTOR STARTER APPLIED TO CEILING MOTOR.

rubbing contacts; suction air pots, cams, gears and belts are eliminated, and the apparatus works entirely without such auxiliaries as compression cylinders, retarding springs or dashpots. The action of the apparatus embodies a new invention, and the contacts are made through carbon blocks, the rocking arms being

Digitized by Google

actuated by gravity supplemented by the pressure of a light spring to overcome residual magnetism on the breaking of the circuit. The apparatus is so arranged that only such movements as have been predetermined can take place. For instance, it is impossible for one set of contacts to operate without the proper supplemental action on the part of every



MOTOR-STARTER FASTENED TO FRAME OF MOTOR.

other contact on the board. Should mechanical injury or continued service necessitate the changing or repairing of any part the construction is so simple that the defective piece may be easily removed and a new part substituted at small cost.

The resistance used with this device is of special construction, the flat resistance strips being laid up upon an insulating base in such a manner as to ensure thorough ventilation.

A number of these motor-starters and controllers have been in operation for some time, so that every feature of the apparatus has been actually tried out, with, it is asserted, the most satisfactory results. G. A. Annable is the general sales manager for this apparatus.

Vacuum Drying and Impregnating Apparatus.

The accompanying illustration shows the vacuum drying and impregnating apparatus made by the J. P. Devine Company, Buffalo, N. Y., under American rights granted by the firm of Emil Passburg, of Berlin, Germany. The usual method of drying rubber by means of hot air passed through drying rooms under pressure from a fan or similar device has provoked a demand for an apparatus which would remove the moisture and at the same time eliminate the possibility of charging the drying material with deleterious substances in the form of dust which might be carried into the drying room by the fan blast. A saving in time is also desired, as well as a saving in space occupied by the drying material. Again, hot-air drying has a tendency to harden the drying material, particularly if the material be porous, by closing up its pores.

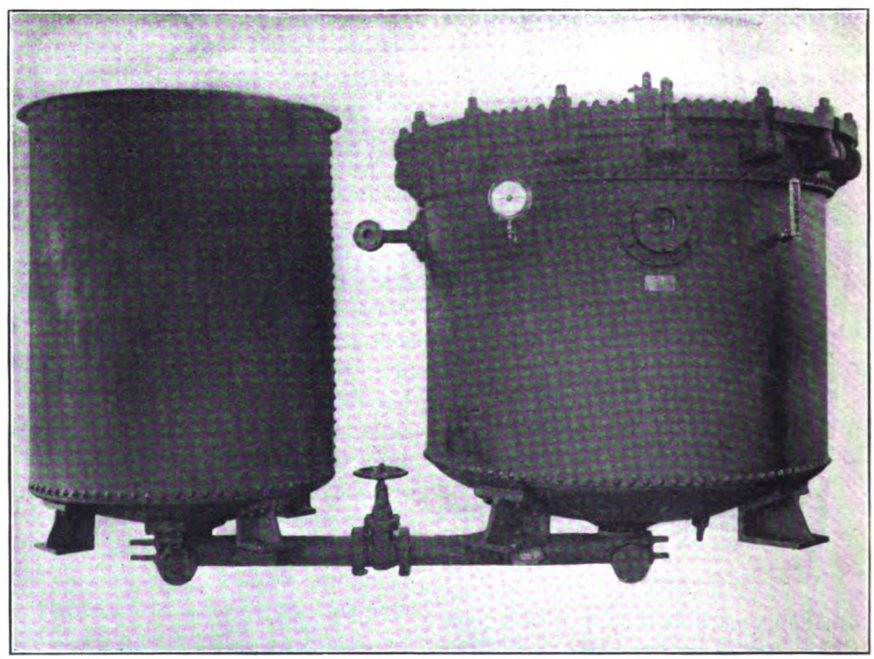
Where the rubber is to be used for electrical insulating purposes it is particularly desirable that every particle of moisture be removed, keeping the drying material at as low a temperature as possible.

With the vacuum drying and impregnating apparatus illustrated herewith it is claimed that it is possible not only to remove the moisture economically, but also to remove it at so low a temperature as to absolutely exclude deterioration in quality.

Under vacuum the slow evaporation, such as exists under atmospheric pressure, is turned into a rapid boiling of the water, not raising, but lowering, the temperature, as the boiling point is reduced from 212 degrees to ninety-five degrees Fahrenheit.

Where textile materials or porous fabrics are to be impregnated with an insulating compound the vacuum and pressure system of impregnation is found to be very desirable, inasmuch as the impregnating compound is forced into a most intimate contact with the fabric under treatment. To further improve the method of impregnation the impregnating compound is allowed to enter the vacuum impregnating vessel by means of atmospheric pressure. This is subsequently increased by adding artificial pressure (compressed air) to the required extent, so that the innermost particles of the material are filled with the insulating compound.

The enforced impregnating or combined impregnating process, under vacuum together with artificial pressure, is necessary only for materials which are of a very close texture or have to be treated with heavy compounds. The two processes, however, need not be undertaken in one vessel. The drying under vacuum may take place in one vessel, and the impregnation in another. When removing the materials from the vacuum drier into the vacuum impregnator it is necessary to break the vacuum in the former vessel and allow atmospheric air to enter it and, naturally, the pores of the insulating material. As this air only fills such pores once and can only once deposit the moisture it carries, this moisture will have no detrimental effect, as it has no circulation and but little enters anyway. In addition to this, as soon as the material is placed in a vacuum-impregnating vessel the latter, which may be fitted with heating coils, is evacuated, and the insulating material is at once freed from atmospheric air and also from any particle of moisture which it may have absorbed during its transit from the vacuum drier to the impregnating vessel.



VACUUM DRYING AND IMPREGNATING APPARATUS.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

UNITED STATES INDEPENDENT TELEPHONE COMPANY TO ISSUE $2,500,000 NOTES—It is announced that the directors of the United States Independent Telephone Company have authorized the issuance of notes to the value of $2,500,000, to pay six per cent interest and run two years.

THE NEW YORK-CHICAGO ELECTRIC AIR-LINE PROJECT—A syndicate headed by Joseph Ramsey, Jr., formerly president of the Wabash Railroad, has applied for a charter for the construction of a trunk line across Pennsylvania, to be known as the Keystone Air Line. This is supposed to be part of the project for the road from New York to Chicago. The capitalization of the Keystone Air Line is given at $450,000.

NEW JERSEY COMMISSION TO INVESTIGATE PUBLIC UTILITY CORPORATIONS—The last legislature of New Jersey passed a law providing for the appointment of a commission to investigate the feasibility of dividing the profits of public utility corporations between such companies and the municipalities in which the properties are operated. Governor Stokes has appointed the following commission: Joseph H. McGraw, Madison; A. B. Leach, South Orange, and Alfred N. Barber, Trenton.

COLORADO & SOUTHERN TO ELECTRIFY A PORTION OF ITS LINE—Contracts for constructing an electric line from Denver to Boulder, Col., for the Colorado & Southern Railway have been signed with the Westinghouse Electric and Manufacturing Company. The plan for electrifying the steam line operating between Denver and Boulder has been abandoned. It is expected that by June 1, 1907, the electric road will be in operation and will handle much of the passenger business between the two cities.

RAILWAYS COMPANY GENERAL REDUCES CAPITAL STOCK— At the annual meeting, in Jersey City, N. J., of the Railways Company General, the stockholders authorized the reduction of the capital stock from $900,000 to $700,000. The old board of directors was reelected. The reduction of $200,000 in the capital stock was, it is understood, effected by the purchase and retirement of that amount of stock. The Railways Company General was incorporated in New Jersey in 1899, to acquire, control and operate street railways, gas, electric light and water plants. The company's headquarters is at Philadelphia, Pa.

NEW YORK CENTRAL TO INCREASE CAPITAL STOCK—The directors of the New York Central & Hudson River Railroad have authorized the issuance of $29,839,560 of stock to stockholders at par. This issue is equal to twenty per cent of the present holdings of stockholders. It is issued to stock of record October 16. The right to subscribe terminates on November 30. The proceeds of the issue are to be used for the purpose of paying for different improvement work that the company has under way, as well as to make provision for new equipment. A portion of this issue will be applied to the expenditures incurred in connection with the New York city terminal.

EXTENSIVE CALIFORNIA ELECTRIC LINE—A new double-track electric railway connecting Los Gatos and San Carlos, Cal., fifty miles long, and running along the lower slopes of the foothills in the Santa Clara valley, will, it is announced, be completed within the next six months. The Peninsular Railway Company, a corporation which is controlled by people who are prominently identified with the Southern Pacific Company, is now engaged in building the road. It is planned to build three new towns along the line. One of these will be located at the junction of the branch railroad which runs to Meridian, and thence to San Jose, and will be about nine miles distant from San Jose. Another will be opposite Mountain View station on the Southern Pacific line.

GEORGIAN BAY CANAL DEVELOPMENT—It is announced that the report of the engineer in charge of the Georgian Bay canal survey, to be presented to the Dominion parliament at the approaching session in November, will show the feasibility of a hydroelectric development of 1,250,000 horse-power along the route. It is considered that an expenditure of $100,000,000 will be justified for the increased facilities afforded for the transportation of the products of the western fields to the Atlantic seaboard by this proposed great waterway. If, in addition, the electric development is realized, there will be a much stronger incentive for proceeding with the work as a national undertaking. Electricity would not only be utilized for the varied uses of commerce, but also for developing the mineral wealth contiguous to the river.

MUELLER CERTIFICATE ISSUE DECLARED CONSTITUTIONAL—Judge Thomas G. Windes, in the Circuit Court at Chicago, Ill., on September 15 decided in favor of the city of Chicago in the injunction suit based on the Mueller law, which provides for the issuance of $75,000,000 of railway certificates by the city. The law was declared constitutional by the court, which held that subsequent ordinances regarding the purchase and operation of street railways passed by the city are in compliance with the law. The decision was a complete victory for the city, the court holding against every point advanced by the complainants in their bill, which was dismissed for want of equity. The case will now be appealed to the State Supreme Court, which, it is expected, will take it under advisement next month.

NEW TELEPHONE COMPANY—The Subscribers' Mutual Telephone Company has been incorporated at Baltimore, Md., with a capitalization of $500,000. The company expects to enter the field of active business in about thirty days, and, it is announced, will compete for subscribers at lower rates than those of the existing companies. Mutual stock ownership and the use of an automatic telephone will also be offered. The incorporators of the company are: J. Lefferts Conard, of Trenton, N. J., president; Thomas E. Weems, of New York city; James W. Owens, of Indianapolis; Charles C. Wight, of Baltimore, and Samuel B. Hardy, of Anne Arundel county, Md. Mr. Wight will be secretary-treasurer of the company. Messrs. Henry Yewell Bready and James W. Owens, general counsel, and Frank B. Bready & Company, fiscal agents.

TEXAS TRACTION COMPANY—A company with a capitalization of $15,000,000 has been organized at Galveston for the purpose of constructing and maintaining several hundred miles of electric road in the state of Texas. The capital is all from the state of Texas, and it is expected that the new organization will absorb the Texas Traction Company, of Dallas, which owns several electric light and power plants in north Texas. The contract has been let to Suderman & Dolson, contractors of Galveston, for building an interurban electric line between Dallas and Sherman. The contract also includes power-houses and substations. The main power-station and shops will be located at McKinney. Among those interested in the enterprise are J. F. Strickland, of Dallas; William H. Bean, Howe; E. M. House, Austin; John S. Heard and J. L. White, of McKinney; F. F. Dumas and George W. Bowman, of Austin.

NEW PUBLICATIONS.

COLUMBUS, OHIO—The board of trade, Columbus, Ohio, has published a portfolio illustrating and describing the principal features of the city of Columbus. This portfolio is replete with interesting data and certainly reflects great credit upon the city.

GAS-DRIVEN ELECTRIC POWER SYSTEMS—A paper presented before the Engineers' Society of Western Pennsylvania, June 5, 1906, by J. R. Bibbins, entitled "Gas-Driven Power Systems as Exemplified in the Warren & Jamestown Street Railway," has been reprinted by the Westinghouse Companies' publishing department, by courtesy of the society.

Digitized by Google

ELECTRIC RAILWAYS.

MEMPHIS, TENN.—The Memphis Street Railway Company will erect a new car barn at a cost of $100,000.

ASHLAND, VA.—The track-laying of the new electric line has been completed almost to the Chickahominy river, and it is expected that the line will be in operation early in December.

ALBION, N. Y.—Engineering and grading for the roadbed of the Buffalo, Lockport & Rochester trolley road is being done east of Holley and at Knowlesville, west of Albion.

SAN FRANCISCO, CAL.—The ordinance granting the Presidio & Ferries Railroad Company the privilege of using electric traction on all of its lines where the grades will permit has been passed.

FORT WORTH, TEX.—The election held to decide whether or not a franchise should be granted to the Northern Texas Traction Company to operate on additional streets resulted in the company's favor.

BROOKLYN, N. Y.—The New York & Long Island Traction Company has inaugurated a direct service from Jamaica to Hempstead and Mineola, connecting with the Freeport and Rockville Centre trolley line.

AKRON, OHIO—Among other improvements being made by the Northern Ohio Traction and Light Company which will greatly add to the transportation facilities of its lines, is the double tracking of the Akron, Bedford & Cleveland line through Bedford.

CHEYENNE, WYO.—The Northern Colorado Power and Light Company, which recently purchased the plant of the Cheyenne Light, Fuel and Power Company, is considering the establishment of a system of street railways in Cheyenne, connecting Cheyenne with Fort Russell.

RICHMOND, VA.—The Henrico board of supervisors has given the Virginia Power and Passenger Company a ten-year franchise to build a road out the boulevard from Broad street to the new fair grounds on the north side of the Richmond, Fredericksburg & Potomac Railroad.

ATLANTA, GA.—Work will be begun on the Hapeville extension of the East Point car line of the Georgia Railway and Electric Company by the first of January next. By the latter part of spring it is the purpose of the company to operate on a regular schedule between Hapeville and Atlanta.

COLUMBUS, OHIO—A further extension of the Schoepf-Morgan interurban lines is being planned which will give Columbus an opening into territory hitherto rather difficult of access. This is the extension of the Scioto river line to Plain City, Marysville and possibly further north to Bellefontaine.

CASTLEDALE, UTAH—Don C. Robbins, of Salt Lake, has applied to the commissioners of Emery county for a franchise to run an electric railway on the highways of the county. The northern terminal of the road is to be at Mound, on the Rio Grande Western, and the entire line will be in Emery county.

TERRE HAUTE, IND.—The Terre Haute Traction and Light Company this year will expend something over $600,000 in adding to its Water street power station, reconstructing and realigning a considerable portion of the Brazil line, building a transmission line between Terre Haute and Brazil, and erecting substations at Seelyville and Brazil.

AUSTIN, TEX.—Warren Bicknell, John A. Harper, J. B. Nutt and E. W. Christy, all of Cleveland, Ohio; W. O. Allen, of Fostoria, Ohio, and Cary B. Close, of Toledo, Ohio, are named as the incorporators of the Citizens' Railway and Light Company, of Fort Worth, Tex. The company has a capital stock of $1,000,000, and is organized to build a system of interurban railway radiating out of Fort Worth.

BUFFALO, N. Y.—Ground has been broken for the new trolley line along the lake shore that will eventually give Buffalo a trolley connection with Erie, Pa., this being the line which former Lieutenant-Governor William F. Sheehan, of New York, and Joseph B. Mayer, of this city, have promoted, and which will come in to Buffalo over the Buffalo & Hamburg line and a new extension along the Hamburg turnpike.

SALT LAKE CITY, UTAH—After negotiations that have been carried on for some time, the Utah Light and Railway Company has agreed upon terms and signed a contract to furnish power for the Ogden Rapid Transit Company's lines for a period of seven years, commencing with the first of the year. This agreement will mean the abandoning of the Washington avenue power-house. For a long time this has been inadequate to the demands for power to operate the lines of the transit company.

ALBANY, N. Y.—The Paul Smith's Electric Light, Power and Railroad Company has been granted authority by the State Railroad Commission to build an electric line about nine miles long through the Adirondacks from Lake Clear railroad station in the town of Harrietstown, Franklin county, to Paul Smith's, at Saranac, with a branch from the main line to Upper St. Regis Landing. The company was incorporated by Paul Smith and others some time ago and has a capital of $100,000.

WHEELING, W. VA.—The Dillonvale & Ohio River Traction Company, which proposes to construct a traction line from Portland station or Rayland to Dillonvale, has the survey completed. One of the officials of the company stated that he was not prepared to say that the line would be built this fall, but that it was most probable that some of the grading would be done. The line will be six miles long and will connect with the new extension of the Steubenville & Wheeling Traction Company at Rayland.

NORTH ADAMS, MASS.—Extensive plans are on foot for the rebuilding of the Hoosac Valley street railway system next spring. They call for the rebuilding of the entire old part of the system, making it modern in every particular, and the elimination of many grades and curves on the Williamstown line, which is to connect with the new Bennington-North Adams electric railway, in order to make an hourly run between North Adams and Bennington possible. One of the new features will be the installation of a new telephone system with a central office in Pittsfield.

BIRMINGHAM, ALA.—The Tidewater Development Company, which has undertaken to build a double track electric railroad from Tuscaloosa, on the Warrior river, to Gadsden, on the Coosa, a distance of 115 miles, the road to pass through Birmingham, has about completed the surveys for the line, and actual construction, it is announced, will begin soon. When the road is in operation it will connect with steamship lines which are to be established on the Coosa river at the northern terminus and on the Warrior at the southern terminus. The road will be for both freight and passenger traffic.

POTTSTOWN, PA.—Trolley service between Philadelphia and Harrisburg before July 1, 1907, was promised at a meeting of town council by Superintendent George Hoeger, of the Schuylkill Valley Traction Company. The promise was made after council had passed the ordinance granting the Pottstown & Northern Company the privilege to widen its tracks, for which right $16,000 is to be paid. The latter road, which was formerly the old Ringing Rocks line, will now be purchased by the Schuylkill Valley Traction Company, and used as a link in its Reading-Philadelphia trolley system. The sum of $28,000 is to be paid for it, which does not include Ringing Rocks Park.

MAHONINGTOWN, PA.—The right of way for a trolley line from Mahoningtown to Morado Park has been secured and plans for the construction of the line are now being considered. When this line is running there will be not only a complete trolley system between New Castle and Pittsburg, but it will be possible to go from New Castle almost to Sisterville, W. Va., without interruption. With the breach between Morado Park and Mahoningtown covered, it will be possible to go by trolley through Youngstown to Cleveland about fourteen miles north of Leavittsburg. This breach will be tracked within a short time, making a continuous trolley system from Pittsburg to Cleveland.

JACKSON, MISS.—The Claremont Railroad Company has applied to the governor for a proclamation authorizing organization. The prime movers in the enterprise are R. K. Jayne and M. Jayne, of Jackson; William Walker and others, of Brandon. The idea is to connect Jackson with several of the neighboring towns by electric road. Brandon, Clinton, Raymond, Coopers Well and other places will come in on the line if sufficient encouragement is given. The scheme is not only to build a trolley line, but to furnish electric lights to the several towns en route. This line will in no way interfere with the line projected from Jackson to Vicksburg, though they will parallel from here to Clinton, a distance of ten miles.

Digitized by Google

TELEPHONE AND TELEGRAPH.

MONTPELIER, VT.—The Orange County Telephone Company is planning to extend its lines from Barre and Northfield into this city.

MARTIN'S FERRY, OHIO—The American Telephone and Telegraph Company is building a long-distance line from Martin's Ferry to Columbus, Ohio.

BRATTLEBORO, VT.—A new telephone line has been placed in operation, connecting with Williamsville *via* South Wardsboro, East Dover and South Newfane.

PASCO, WASH.—The Independent Telephone Company has secured a franchise at Pasco, and will put in an exchange which will have long-distance connections.

QUEBEC, QUEBEC—The system of the Bell Telephone Company, of Canada, has been further extended by the completion of a line from St. Raymond to St. Leonard de Portneuf.

OAKLAND, CAL.—The Sunset Telephone Company has installed an additional cable between Oakland and San Francisco, in order to increase the efficiency of the long-distance service.

SPOKANE, WASH.—The Independent Telephone Company has its chief engineer, H. A. Zahm, in the Big Bend country, south of Spokane, looking over the field with a view to putting in a line.

HUBBARDSTON, MASS.—Workmen employed by the New England Telephone and Telegraph Company are engaged in stringing wires from the Hubbardston exchange to Barre by way of Williamsville.

SHARON, OHIO—The Bell Telephone Company is contemplating underground wires, a new office building and new common battery system at Sharon. The proposed improvements, plans for which have been made, will cost about $200,000.

CHICAGO, ILL.—The Chicago Telephone Company will establish an extensive division headquarters at the northeast corner of Fillmore street and South Forty-first avenue. The headquarters will comprise a barn and large warehouse for storage purposes.

BOSTON, MASS.—An entirely new operating plant has been put into commission by the New England Telephone Company in the South Boston exchange district. It is located in a specially constructed building and its equipment embodies the latest improvements.

BROCKTON, MASS.—An acceptance of the telephone franchise has been filed by the Home Automatic Telephone Company. The acceptance is unconditional, as required by the terms of the franchise, the company assuming all conditions and requirements therein without reservation.

LITTLE ROCK, ARK.—A local telephone system will be established at Sulphur Rock, work on which is now progressing. The capital stock of the company is $2,000, and the officers are: Sam Tuggle, president; J. K. Rawlings, secretary; W. R. Rice, treasurer, and J. C. Gill, business manager.

PHILADELPHIA, PA.—The Bell Telephone Company has had work begun on its new exchange, at 1632-1636 Diamond street, to be known as the Diamond Exchange. It will be of hard brick, forty-four feet one and one-half inches by 102 feet 2 inches in dimensions, and will cost $40,000.

LEAVENWORTH, KAN.—The People's Home Telephone Company has begun work on the laying of the new underground conduits in the business portion of the city. This work will be the preliminary portion to the installation of an entirely new telephone system. Its completion alone will require something like two months.

SPOKANE, WASH.—The capital stock of the Interstate Telephone Company is to be increased to $500,000 to provide funds for building extensions to the present lines of the company. It is semi-officially stated that when new lines now contemplated are completed the Interstate company will have an extensive system in Washington, Idaho and Oregon.

SPOKANE, WASH.—A. D. Campbell, manager of the Western Union system, announces that with the installation of the new equipment this month the company will have the largest gravity system in the United States. Thirty dynamo machines are being installed in the company's new quarters in the Wolverton Building. The company has 5,000 batteries in its Spokane office.

READING, PA.—All work has been completed on the rural telephone and telegraph line running from Kutztown to Kempton, and the system is now in operation. It passes through the following villages: Dietrich's Mill, Liscum, Stein's Distillery, Krumsville, Wesnersville and Kempton. It is the intention of the company to extend the line, in the near future, a distance of three miles beyond Kempton, and requests have been made that it be extended to Grimsville, New Smithville and Claussville.

ALBANY, N. Y.—Arrangements have been completed for the transfer of the stock of the Commercial Telephone Company, of Troy, to the United Message Company, and the sale will take place on October 10. A guarantee deposit of $5,000 has been made by the purchasing company. The stock will be purchased on this basis: $42.50 per share for the $50 shares and $85 per share for the $100 shares of preferred stock, and $15 for the $50 shares and $30 for the $100 shares of the common stock.

CARLYLE, ILL.—The Clinton County Telephone Company has sold its entire system in Clinton county to the Citizens' Telephone and Telegraph Company for $11,000. It will be operated in connection with the Central Union company, which gives a long-distance service. The officers of the new company are: Hugh V. Murray, of Carlyle, president; Henry Schurman, Germantown, vice-president; B. H. Donne, Breese, secretary; August Klutho, Breese, treasurer. A network of lines through the county will soon be completed.

HARTFORD, CT.—The new exchange at Deep River has been opened by the Southern New England Telephone Company. There will be four new circuits into Essex and two into Ivoryton, relieving the congested conditions that have existed in the service in that territory. There will also be five new trunk lines into Saybrook and one for Middletown. The new exchange will have forty-six lines, carrying 146 subscribers at the outset. The district will comprise Deep River, Winthrop, Chester, Hadlyme in East Haddam, and fourteen stations in the town of Lyme.

SPOKANE, WASH.—Official announcement is made by Robert M. Tucker, president of the Empire Electric Company, that the plant for the Home Telephone Company in Spokane will be completed as rapidly as possible. The building will be 70 by 100 feet, four stories high, of reenforced cement faced with white pressed brick and terra-cotta trimmings. It will cost $70,000, in addition to which amount the company will expend $300,000 for equipment. The company is an independent concern, and will have connection with the Puget Sound country and various towns and cities in the Inland Empire.

BIG FALLS, MINN.—Big Falls now has telephonic communication with the outside world through the medium of a local telephone exchange in connection with a long-distance line constructed by the Northwestern Telephone Exchange Company. Charles Swedback secured the franchise for installing a local telephone exchange. Long-distance connection with Bemidji and other towns through the Northwest was desired by local business men, and an appeal was made to the northwestern people to build a line that would connect with the Big Falls exchange. The long-distance line extends northward from Bemidji only as far as Blackduck at present.

LOS ANGELES, CAL.—The Home Telephone Company, of Santa Barbara, has organized an affiliated company for the purpose of building a line to Santa Maria. This will be a part of the long-distance system to San Francisco, and the city of Santa Maria will be occupied also by a local exchange. The articles of incorporation of the Home Telephone and Telegraph Company, of Santa Barbara county, have been filed with the county clerk. The company is incorporated for $200,000, of which $10,000 has been subscribed, twenty shares each by Paul O. Tietzen and Robert E. Easton, of Santa Maria, and by George S. Edwards, Harry W. T. Ross and Edward F. R. Vail, of Santa Barbara.

Digitized by Google

ELECTRIC LIGHTING.

TALLAPOOSA, GA.—An electric light plant has been placed in operation in Tallapoosa.

CANTON, OHIO—Extensive additions to the lighting system of Canton have been completed.

ST. PAUL, MINN.—Fulda capitalists will put in an electric light plant at Howard, S. D.

FREMONT, OHIO—The Yaryan Company has received 150 new arc lamps, which it is installing in the city streets.

FRANKLIN, N. Y.—An electric light plant is to be installed at Franklin, the work to be completed by November 1.

COMPTON, CAL.—A new electric light plant, under the management of G. R. Fulton, is to be established at Compton.

CINCINNATI, OHIO—The city council has confirmed the lease of the Cincinnati Gas and Electric Company to the Union Gas and Electric Company.

ELLENVILLE, N. Y.—The village board of trustees has granted to Dwight Divine & Son, a franchise to erect poles within the village to convey electric light, power and heat.

LADYSMITH, BRITISH COLUMBIA—The proposed by-law for the borrowing of the sum of $35,000 for the purpose of installing an electric light plant in Ladysmith was defeated.

LORAIN, OHIO—Dissatisfied with the lighting service of the local illuminating company, the board of public service is contemplating the establishment of a municipal lighting plant.

WEST SENECA, N. Y.—At a meeting of the West Seneca town board, a franchise was granted to the Niagara, Lockport & Ontario Power Company, for twenty-five years. The company has contracted to furnish electric lights to the village at $56 each per year.

GRASS VALLEY, CAL.—This city is contemplating the advisability of installing a municipal lighting plant. It is estimated that such a plant would cost about $80,000. At present the city is paying $4,000 per year for lights.

BUTLER, N. J.—Butler is to have an electric lighting system. At a meeting of the mayor and council a franchise was granted the Bellman & Sanford Electric Lighting Company, of New York, to install a plant in the borough.

SULPHUR, I. T.—The Sulphur Light and Power Company is about to issue $50,000 bonds for the purpose of enlarging its plant. The company has been in operation for about a year, and has grown rapidly, necessitating the proposed enlargements.

WEISER, IDA.—The Idaho Light and Power Company, the new organization which contemplates installing electric lights in Payette, Weiser and Ontario, is now pushing the work of securing the remainder of the right of way for its power ditch. The power-house will be located about four miles above Payette.

EDWARDSVILLE, ILL.—Deeds have been filed transferring the property of the Edwardsville light and power company and the Granite City-Venice Electric Light Company to the Madison County Light and Power Company, the latter company having been recently incorporated by the McKinley syndicate.

COHOES, N. Y.—The Hudson River Electric Power Company has purchased the extensive coal yards and sheds owned by Thomas B. Golden. The land is desired as a site for the erection of a large building which will be used as a transforming station by the company. The structure, it is expected, will cost at least $50,000.

WALLINGFORD, CT.—At a special meeting of the voters, called for considering the advisability of adding to the electric lighting plant, it was voted to appropriate $8,500 for extending and enlarging the plant and to issue bonds to raise $5,000 of that amount, the same to be payable a year from date of issue. Although it was voted to appropriate $8,500, thus making the total amount available for making the improvements $14,000, yet the electric commissioners stated that it was very probable that the total expenditure would not exceed $12,000. Part of the amount that is to be expended will come from the surplus earnings. The new extensions to the plant will consist of a water-wheel, generators and other appliances, in addition to those voted for last April.

PITTSBURG, PA.—Mechanical improvements, aggregating many thousands of dollars, have enabled the Allegheny County Light Company and all subsidiary companies to reduce the prices on electric light furnished commercial and domestic consumers. This reduction ranges from sixteen per cent on business houses to thirty per cent on dwellings, and goes into effect on October 1.

ESCANABA, MICH.—A lighting plant proposition has been submitted to the Escanaba council by A. C. Runyan, president of the Light, Heat and Power Company, of South Haven, Mich. He desires to purchase the municipal lighting plants and offers $70,000 for them, provided the city will grant him a thirty-year franchise, and agrees to furnish arc lights to the city for $65 a year.

BUFFALO, N. Y.—The transmission line by which the Niagara, Lockport & Ontario Power Company will convey Niagara Falls electrical power to the Lackawanna steel plant is nearing completion. It was announced that the steel plant will be using Falls power within thirty days. The steel plant is spending about $200,000 on its electrical equipment. The power will be delivered to the Lackawanna company at 60,000 volts.

BATTLE CREEK, MICH.—The Commonwealth Power Company, which furnishes the electric power for the Battle Creek city electric lines and the interurban lines, is buying the right of way for a new high-tension line from Allegan to Augusta, through Richland, it being an air line. The line will not run on the highway, but the company will buy the right of way across farms, and instead of placing the wires on high poles will suspend them on steel derricks.

BELVIDERE, N. J.—Capitalists of Albany are interested in a project to tap the Delaware river at a point near Smith's Hotel, on the Pennsylvania side of the river, a short distance above Belvidere, and divert the water for electrical purposes, carrying it through a canal four miles to the foot of Big Foul Rift, at which point the power-house will be built. It is reported that the power will be used for trolley and electric lighting purposes. The water will be returned to the Delaware at Rocksburg, N. J.

RICHMOND, KY.—Cincinnati capitalists have secured an option on the Richmond Electric and Power Company until October 1. It is understood that it is the intention of the parties taking this option to extend the wires from Richmond to Berea, which is fifteen miles south, and which has a population of nearly 2,000. The route for the wires will be out the Big Hill pike. They will run through Rogersville, Kingston and Bobtown. All of these places, together with all residences along the way, will be furnished with light.

GRAND RAPIDS, MICH.—Final arrangements have been completed for the organization of a new light and fuel company at Stoughton, Wis., in which Grand Rapids capital is interested. The company will be known as the Stoughton Light and Fuel Company and the following officers have been elected: Andrew Fyfe, president; Henry M. Wallace, vice-president; Raymond B. West, secretary, and Raymond J. St. John, treasurer. The stock issue is $85,000 and the bond issue a similar amount, for which the Michigan Trust Company is trustee.

ALEXANDRIA, VA.—The Alexandria Electric Light Company, to which the franchise for supplying this city with electricity for light and power was recently awarded by the council, is said to have purchased the property of the Osage Manufacturing Company, on South Union street. The property has been involved in litigation for some time past, and, it is stated, has been purchased subject to the approval of the court. The amount paid for the property has not as yet been made public. There are several buildings on the land at present, which may be utilized by the electric company. The new electric plant, which, as has heretofore been stated, is to cost in the neighborhood of $75,000, will, it is expected, be erected and in operation before the end of the present year. Edward E. Mandeville, of Philadelphia, is the secretary of the company, which has been chartered under the laws of Virginia. The award of the franchise was made in the name of Mr. Mandeville, who organized the company.

Digitized by Google

ELECTRICAL SECURITIES.

The stock market for some time has been irregular and indecisive, and with price changes fluctuating over considerable margins. The dealings have been active, resulting in sharp rallies in certain issues, with reactions in others. It is understood that there are a number of large interests behind the bull sentiment, and that sufficient strength will be displayed and maintained to keep the level of the market generally high. Were it not for the restraining force exerted by monetary considerations, it is quite possible that a mild inflation would ensue. The August statement of foreign trade was very good, showing a considerable improvement over the July report. There is no change in the general industrial outlook, business activity continuing to show record proportions, as indicated by railroad earnings, bank clearings and similar data.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 22.

New York:	*Closing.*
Allis-Chalmers common	16¾
Allis-Chalmers preferred	40
Brooklyn Rapid Transit	79½
Consolidated Gas	139
General Electric	165½
Interborough-Metropolitan common	38
Interborough-Metropolitan preferred	77¾
Kings County Electric	160
Mackay Companies (Postal Telegraph and Cables) common	73
Mackay Companies (Postal Telegraph and Cables) preferred	71
Manhattan Elevated	142¼
Metropolitan Street Railway	107
New York & New Jersey Telephone	127
Western Union	86
Westinghouse Manufacturing Company	153

The regular quarterly dividend of 1¾ per cent on the stock of the Metropolitan Street Railway Company is payable October 15. Books closed September 24 and will reopen October 16.

Directors of the Westinghouse Electric and Manufacturing Company have declared the regular quarterly dividend of 2½ per cent on its preferred, assenting and non-assenting stocks, payable October 10 to stock of record September 26. Books closed September 26 and will reopen October 11.

The semi-annual interest on the registered collateral trust 4½ per cent gold bonds of the Interborough-Metropolitan company, and coupon No. 1, from the coupon bonds, due October 1, 1906, will be paid on or after that date, at the office of Windsor Trust Company, 65 Cedar street, New York city. The books of the company for the registration of bonds will remain closed from Friday, September 28, to Monday, October 1.

The income account of the Interborough Rapid Transit system for the year ended June 30, 1906, includes for the first time earnings for a complete year of the subway division. The income account of the system for the previous year included earnings of the subway division only from October 27, 1904, to June 30, 1905. The gross earnings of the system (elevated and subway) for the year were $19,695,594, an increase compared to the previous year of $2,858,224, equal to 16.97 per cent. The total income amounted to $12,010,273, an increase for the year of $2,079,247, equal to 20.93 per cent. After payment of charges, including a dividend of 7 per cent on Manhattan Railway stock, the surplus amounted to $3,168,890, an increase of $748,969, equal to 30.96 per cent. The profit and loss surplus for the year, after dividend payments, was $281,390, against $57,421 for the previous year. As was expected the earnings of the Manhattan elevated division were less than for any year since 1903. The decrease for the year compared to the previous year was $403,572, or 3 per cent. The decrease for the year compared to the earnings for 1904 was $1,392,964, or 9.8 per cent.

Boston:	*Closing.*
American Telephone and Telegraph	137¾
Edison Electric Illuminating	235
Massachusetts Electric	71
New England Telephone	129
Western Telephone and Telegraph preferred	85

Dividend action by American Telephone directors has been deferred until October 2, by which time President Fish is expected back from Europe.

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	70
Electric Storage Battery preferred	70
Philadelphia Electric	8⅜
Philadelphia Rapid Transit	29½
United Gas Improvement	86½

The directors of the Electric Storage Battery Company have declared a dividend of 1¼ per cent from the net earnings of the company, on both common and preferred stocks, payable October 1, to stockholders of record at the close of business on September 25.

The report of the Philadelphia Rapid Transit Company for the year ended June 30 shows as follows: gross, $17,483,144; expenses, $9,153,603; net, $8,329,541; other income, $193,103; total income, $8,522,644; taxes and license, $1,075,216, leaving a balance of $7,447,428. Deducting charges of $7,143,431, there remains a surplus of $303,997, as compared with $108,210 for the previous year. The number of passengers carried was 448,576,785. At the annual meeting of stockholders of the Philadelphia Rapid Transit Company, Henry Phipps was reelected for a term of four years, and August B. Loeb was elected a director to take the place of John M. Mack, resigned.

Chicago:	*Closing.*
Chicago Telephone	118
Chicago Edison Light	145
Metropolitan Elevated preferred	66½
National Carbon common	85
National Carbon preferred	117
Union Traction common	5
Union Traction preferred	20

The Union Traction Company has ordered 200 cars, to cost $1,000,000.

The Metropolitan Elevated directors at their monthly meeting did not act on the dividend.

The Northwestern Elevated has issued its report for the year ended June 30, 1906. The income account shows as follows: gross, $1,948,727; expenses, $705,572; net, $1,243,155; charges, taxes, etc., $962,650; surplus, $280,499, equal to 5.6 per cent on the $5,000,000 preferred stock. The average daily increase in passengers carried was 6,356, equal to 8.65 per cent. The ratio of operating expenses, including maintenance reserve, to earnings was 46.62 per cent. Ratio of operating expenses, maintenance reserve, loop account and taxes to earnings was 62.72 per cent. All the retiring directors were reelected.

DATES AHEAD.

American Electrochemical Society. New York city, October 8 and 9.

American Society of Municipal Improvements. Birmingham, Ala., October 2-4.

American Society of Mechanical Engineers. New York, N. Y., December 4-7.

American Street and Interurban Railway Engineering Association; American Street and Interurban Railway Association. Columbus, Ohio, October 15-19.

Empire State Gas and Electrical Association. New York city, October 12.

Kansas Gas, Water and Electric Light Association. Lawrence, Kan., October 16-17.

Michigan State Electric Association. Grand Rapids, Mich., October 10-12.

National Machine Tool Builders' Association. New York city, October 23-24.

Old Time Telegraphers' and Historical Society. Washington, D. C., October 9, 10 and 11.

Railway Signal Association. Annual meeting, Washington, D. C., New Willard, October 16, 17 and 18.

Digitized by Google

OBITUARY NOTES.

MR. MARTIN F. MURPHY, a financier and business man of Renovo, Clinton county, Pa., died suddenly at Philadelphia, Pa., on September 17. Mr. Murphy was fifty-eight years old, and was reputed to be the wealthiest man in Clinton county. He was one of the pioneer settlers there and one of the founders of Renovo. At the time of his death he was a director of the First National Bank, of Renovo, a director of the Edison Heat and Light Company, owner of the Ridgway Sand and Stone Company, and of the Steam Heat Company, all of Renovo.

MR. P. F. KOBBE, a director of the Westinghouse Electric and Manufacturing Company, died at his country place, "Hillfield," Stockbridge, Mass., on Friday, September 21. Mr. Kobbe had been ill for some time and his death was not unexpected. He was born in New York, October 24, 1842, and was educated in Germany. He served in the Civil War as a member of the Seventh Regiment. He became interested in electricity and was connected with the United States Lighting Company when it was absorbed in 1890 by the Westinghouse company. Mr. Kobbe was then elected vice-president and treasurer of the Westinghouse corporation. He was also identified with the British and French Westinghouse Companies and with other Westinghouse interests. He was a member of the Calumet and Richmond County Country Club and the Society of Colonial Wars. He is survived by a widow and five children.

MR. T. E. HAMBLETON, who for half a century had been a familiar figure in Baltimore business and banking circles, died at his home, "Hambledune," near Lutherville, Md., at 12.50 P. M., Friday, September 21. Mr. Hambleton was called the father of rapid transit in Baltimore. He bought the old People's Line at auction and spent large sums of money in bringing it up to the requirements at the time. He next induced the Widener-Elkins syndicate, of Philadelphia, to become interested in Baltimore, and finally brought about the amalgamation of all the street car lines. Another big project in which Mr. Hambleton was actively interested was the building of the West Virginia Central & Pittsburg Railroad and the Piedmont & Cumberland Railroad, the financing of both properties being handled by his house, the banking firm of Hambleton & Company. These properties are now owned by the Gould interests. Mr. Hambleton also financed the various Baltimore gas companies, which have since been consolidated. He was seventy-seven years of age, and a native of Maryland.

PERSONAL MENTION.

MR. FRANK D. LAWRENCE, the well-known president of the F. D. Lawrence Electric Company, Cincinnati, Ohio, was a visitor to New York city last week.

MR. H. MOZEN, of Atlanta, Ga., has succeeded T. M. Sommerkamp, of Columbus, as manager of the Columbus, Ga., exchange of the Southern Bell Telephone Company.

MR. S. L. WHEELER, superintendent of the fire and police telegraph at Springfield, Mass., an old-timer who has been many years in the industry, was a visitor to New York city last week.

MR. E. H. RICHARDS, formerly assistant superintendent of the Boston & Worcester Street Railway Company, has been placed at the head of the Newport, R. I., division of the Old Colony line.

MR. H. E. WELLS has been appointed to look after the interests of the Buckeye Electric Company, Cleveland, Ohio, in the South, and has opened an office in Dallas, Tex., located at 216 Commerce street.

MR. H. H. CARR, of Newport News, Va., has been appointed general manager of the Raleigh (N. C.) Street Railway Company, this being the initial step in a movement to generally rehabilitate the system.

MR. THOMAS M. KEELEY, formerly superintendent of the Michigan United Railways, has been appointed general manager of the Michigan Heat and Power Company, with headquarters at Lansing, Mich.

MR. CHARLES E. BROWN, of the Central Electric Company, Chicago, Ill., was a visitor to New York city last week. Mr. Brown reports a busy summer and expectations of a heavy demand for all kinds of material for the fall and winter.

MR. GEORGE A. COLE, of the John A. Cole Company, 776-770 Folsom street, San Francisco, Cal., was a visitor at Niagara Falls during the recent electrical gathering there, and since that time has been in New York and other eastern cities.

MR. PAUL LUPKE has been appointed editor of the Question Box of the National Electric Light Association, and has already begun the preliminary work. Mr. Lupke was in charge of this department and presented a particularly efficient report to the Atlantic City convention. It is believed that the 1907 Question Box will be far in advance of its predecessors.

DR. JOHN TROWBRIDGE, professor of physics at the Jefferson Physical Laboratory, Harvard University, who for a number of years has been a painstaking laborer in research work, and who has contributed many valuable essays and treatises on the subject of electrical and physical phenomena, celebrated his seventy-ninth birthday at his home in Arlington, Mass., on September 18. Dr. Trowbridge is in the best of health.

MR. GEORGE GRAY WARD, vice-president and general manager of the Commercial Cable Company, was a passenger on the Pacific Mail steamer Mongolia, which went on a reef on Midway Island in the north Pacific, on Sunday, September 16. The steamship was about to land passengers at Midway Island when she went aground. The passengers were taken off the ship and landed on the island, and on the morning of September 21 the vessel was floated. Mr. Ward will very likely reach San Francisco via the transport Buford, which was due to arrive at Midway on September 21.

MR. G. R. NEWCOMER, district manager for the Middle West for the Brilliant Electric Company, Cleveland, Ohio, has been appointed assistant to General Manager E. J. Kulas, with headquarters at Cleveland, Ohio. The business of the Brilliant Electric Company has been so great during the past season that this rearrangement of the personnel is necessary. M. E. V. Hennecke, the direct representative in charge of the tantalum and "Gem" lamp department, has been in the Far West for some time, and is meeting with remarkable success in the placing of large orders for these high-efficiency lamps.

INDUSTRIAL ITEMS.

THE RUST BOILER COMPANY, of Pittsburg, Pa., has secured the order for the boilers for the United States Steel Corporation's new plant at Gary, Ind., the order being for sixteen 400-horse-power Rust water-tube boilers.

THE A. & W. ELECTRIC SIGN COMPANY, Cleveland, Ohio, will send its illustrated catalogue to parties interested in electric sign propositions. This company has designed a system of sign lighting for which many features of economy and utility are claimed.

THE BALL ENGINE COMPANY, Erie, Pa., has published a handsome souvenir catalogue dealing with its achievements during the past twenty-five years. The story is entitled, "A Quarter of a Century Building High-Grade Steam Engines and Nothing Else."

THE H. KRANTZ MANUFACTURING COMPANY, 160-166 Seventh street, Brooklyn, N. Y., will be pleased to send a copy of bulletin No. 19 to any one interested in switchboards, switches, panel-boards and outlet boxes. This bulletin gives dimensions, illustrations and prices on type H knife switches, fuse blocks and terminals made by the company.

THE SAFETY ARMORITE CONDUIT COMPANY, Pittsburg, Pa., has hit upon a neat advertising souvenir in the form of a match safe decorated with a celluloid strip which forms a ten-year calendar. This souvenir is neat in appearance, of practical value as a match receptacle, and of great utility as a ready-reference calendar.

THE L. B. ALLEN COMPANY, INCORPORATED, Chicago, Ill., is distributing a handsome series of blotters to the various jobbing houses and also to prospective customers. These include the "International," the "College Girl" and the "Famous Paintings" series. The company will be glad to take up the matter with jobbers who are interested in this form of advertising in connection with its various products, which include Allen soldering sticks, "Sun" solder-

Digitized by Google

ing sticks, "Samson" soldering sticks, Allen soldering paste, Allen soldering salts, Allen commutator lubricant and Allen liquid flux.

THE MARSHALL ELECTRIC MANUFACTURING COMPANY, Boston, Mass., will send samples of its new push-button switch with fibre plate to any interested architects, engineers and contractors, without charge. The company is now carrying in Boston, New York and Chicago over 200,000 sockets, including some thirty different special finishes, and can make prompt shipment from any of these stocks.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., has ready for distribution the following literature: circular entitled, "Twelve Timely Telephone Topics," which is being mailed to the various telephone exchanges throughout the country; booklet "148-AA," covering intercommunicating telephones used in connection with telephone exchanges; bulletin "151-A," covering various types of electric bells, particularly the water-tight and high-voltage bells which the company offers as something new, and also illustrating the new "return call" bell and button; bulletin "154," covering automatic gas lighting apparatus; bulletin "203," describing transmitters, transmitter arms and induction coils; bulletin "301-A and 305-A," covering type E enclosed and semi-enclosed motors and small direct-current motors and dynamos respectively. Any of these may be secured upon request.

THE BLAKE SIGNAL AND MANUFACTURING COMPANY, 246 Summer street, Boston, Mass., announces that the sales of its staples and cleats to the smaller telephone companies, both Bell and independent, are beginning to increase rapidly. These companies are realizing that although the first cost of the staples is greater than that of bare staples, different kinds of tacks or other forms of metallic insulated wire supports, they are economical in the end. The use of the Blake insulated staple prevents numerous short-circuits, grounds in wiring and circuit interruptions which are not only expensive to find, but annoying to the telephone subscriber. The business of the company in these articles has so increased in Canada that an agency has been established there by the Norton System Telephone Manufacturing Company, of Toronto and Halifax.

THE NATIONAL BRAKE AND ELECTRIC COMPANY, Milwaukee, Wis., announces the following recent orders for National air-brake equipments: Chicago City Railway Company, Chicago, Ill.; United Railways of San Francisco, San Francisco, Cal.; Oakland Transit Company, Oakland, Cal.; Spokane Traction Company, Spokane, Wash.; Metropolitan Street Railway, Dallas, Tex.; Rapid Transit Railway Company, Dallas, Tex.; Dallas Consolidated Railway Company, Dallas, Tex.; San Diego Electric Railway Company, San Diego, Cal.; Worcester Consolidated Street Railway Company, Worcester, Mass.; Michigan United Railways, Kalamazoo, Mich.; Twin City Rapid Transit Company, Minneapolis, Minn.; Chattanooga Railways Company, Chattanooga, Tenn.; York Street Railway Company, York, Pa.; Memphis Street Railway Company, Memphis, Tenn.; Birmingham Railway, Light and Power Company, Birmingham, Ala.; Knoxville Railway and Light Company, Knoxville, Tenn.; Pensacola Electric Terminal Railway Company. All orders for the above roads have been taken within the last thirty days, during which time this apparatus has been on the market and approximate 400 equipments.

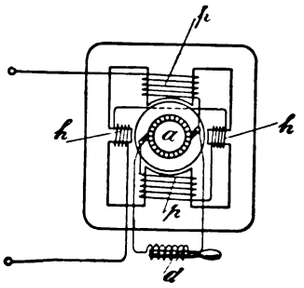
Record of Electrical Patents.

Week of September 18.

831,071. SAFETY DEVICE. George H. Hill, Montreal, Quebec, Canada, assignor of one-half to Michael Joseph Doherty, Montreal, Canada. Filed July 7, 1902. A circuit-breaker having two current coils, one for each side of the circuit, which, through relays and a third coil, actuate the breaker.

831,089. GRAB-BUCKET. John A. McGrew, Columbus, Ohio. Filed August 10, 1905. The scoops are operated by motors mounted on the bucket-hood.

831,101. DEVICE FOR SINGLE-PHASE COLLECTOR-MOTORS WITH COMPENSATION WIRING. Rudolf Richter, Wilmersdorf, near Berlin, Germany, assignor to The Siemens-Schuckert Werke G. M. B. H., Berlin, Germany. Filed November 21, 1905. A circuit of variable reactance is connected in parallel with the armature of an alternating-current commutator motor.



831,101. DEVICE FOR SINGLE-PHASE COLLECTOR-MOTORS WITH COMPENSATION WIRING.

831,131. MULTICONDUCTOR CABLE. Walter C. Yeatman, Chicago, Ill., assignor to American Telephone and Telegraph Company. Filed June 13, 1903. A four-stranded conductor, the two pairs of strands being twisted in opposite directions.

831,168. INSULATOR. Arthur J. L. Lembeck, Sioux City, Iowa, assignor of one-half to John P. Wall, Sioux City, Iowa. Filed November 26, 1904. Two heads are provided placed at right angles.

831,180. FREQUENCY METER. Edward McGarvey, Bellefonte, Pa. Filed December 7, 1904. A meter of the vibrating reed type.

831,186. ELECTRIC HEATING UNIT. Earl H. Richardson, Ontario, Cal., assignor to Pacific Electric Heating Company, Los Angeles, Cal. Filed December 19, 1905. A method of winding, giving substantially uniform thickness and length to the heater unit.

831,226. ELECTRIC CUTOUT. Frank B. Hinkson, New Castle, Pa. Filed March 25, 1905. The cutout is closed by the static pressure of a water pipe and opened when this becomes dynamic.

831,244. COMBINED MECHANICAL AND ELECTRIC MOTIVE POWER FOR TRAINS. George G. Schroeder, Washington, D. C. Filed April 17, 1905. The prime mover is geared to one axle and an electric motor to another, a dynamo being provided which may be driven by the engine.

831,269. STORAGE-BATTERY ELECTRODE PLATE. Thomas A. Edison, Llewellyn Park, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. Filed March 5, 1903. A plate for use in alkaline electrolyte, the pockets for the active material being made of metal of two thicknesses.

831,274. ELECTRIC SPARKING MECHANISM FOR EXPLOSIVE ENGINES. Hiram A. Frantz, Cherryville, Pa. Filed January 9, 1905. A sparker operated by a rocker-arm within the cylinder.

831,282. ARC LAMP. Alvin Hausold, Allegheny, Pa., assignor to Keystone Electric and Manufacturing Company, Pittsburg, Pa. Filed January 12, 1906. A method of constructing a carbon support.

831,284. PROTECTIVE DEVICE FOR VENTILATING-FANS. Robert A. Ilg, Chicago, Ill., assignor of one-half to Theresa Ilg, Chicago, Ill. Filed February 3, 1905. The motor is entirely surrounded by a hood which provides ventilation.

831,288. TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Filed November 22, 1905. An improved system of simple telegraphy.

831,302. AERIAL ELECTRIC TRACKWAY. George G. Schroeder, Washington, D. C., assignor to Industrial Motor Company. Filed May 29, 1906. The track is supported so as to allow oscillatory and longitudinal movement.

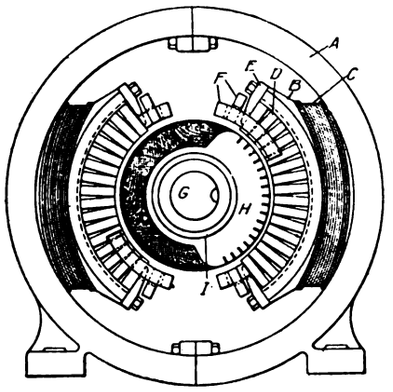
Digitized by Google

831,304. ELECTRIC CONTROLLER. Charles C. Shedrick, Sherbrooke, Quebec, Canada. Filed August 12, 1905. Makes use of rocking contactors actuated by electromagnets.

831,311. LAMP SHADE AND PROTECTOR. Gregory Strootman, Buffalo, and Henry J. Caner, Rochester, N. Y. Filed January 26, 1906. The shade has a double-cone or hour-glass shape.

831,326. ELECTRIC FIXTURE. John H. Dale, New York, N. Y. Filed May 20, 1905. A bracket with a threaded adjustable clamp for taking different sizes of conduit.

831,327. POST AND BOX FOR CABLE TERMINALS AND THE LIKE. Benjamin F. Daly, New York, N. Y. Filed December 15, 1905. A post with a hollow base.



831,442. INDUCTOR-ALTERNATOR.

831,338. INSULATOR. Monroe J. Glick, Westfield, Ill., assignor to Jackson Rardin and Timothy Rardin, Westfield, Ill. Filed October 2, 1905. Two intercommunicating slots are provided, arranged at an angle.

831,348. TELEPHONE-RECEIVER SUPPORT. Frank F. Howe, Marietta, Ohio. Filed March 31, 1906. Provides adjustable supports for both receiver and transmitter.

831,355. TELEGRAPHIC TRANSMITTING DEVICE. Isidor Kitsee, Philadelphia, Pa. Filed June 21, 1906. Two opposing unequal sources of current are provided with means for shunting the stronger.

831,364. SELECTOR OR LOCKOUT FOR PARTY LINES. Alexis Marchand, Buckingham, Wash., assignor of one-half to James B. Valentine, Bridgeport, Wash. Filed September 5, 1905. Revolving contacts may be locked in position so as to cut out any subscribers.

831,376. RAILROAD SIGNALING. Petrus J. Portman, Amsterdam, Netherlands. Filed July 6, 1905. A source of current and a signal are provided on the vehicle, signals being communicated through auxiliary conductors.

831,383. PROTECTOR FOR INCANDESCENT GLOBES. Charles Schmidt, Allegheny, Fredrich Wunderlich, Pittsburg, and James A. Thibodeau, Turtle Creek, Pa. Filed January 12, 1906. A soft cap for protecting incandescent bulb tips.

831,396. PROCESS OF SEALING EVACUATED VESSELS. Willis R. Whitney, Alplaus, N. Y., assignor to General Electric Company. Filed March 8, 1905. Openings in the glass vessel are closed by metallic caps, pressed on when the glass is plastic.

831,400. ELECTRIC VAPOR LAMP. Howard I. Wood, Schenectady, N. Y., assignor to General Electric Company. Filed July 21, 1902. A switch connected to an auxiliary electrode is placed within the tube.

831,401. VAPOR ELECTRIC APPARATUS. Howard I. Wood, Schenectady, N. Y., assignor to General Electric Company. Filed March 31, 1904. All electric connections are made through one end of the tube.

831,404. CONTROLLING SWITCH. Henry P. Ball, New York, N. Y., assignor to General Electric Company. Filed February 23, 1905. The controlling switches automatically lock one another.

831,412. TROLLEY WHEEL. John Brown, Camden, N. J. Filed December 16, 1905. Auxiliary wheels provide two extra grooves.

831,430. INCANDESCENT LAMP SOCKET. James J. Hartley, Schenectady, N. Y., assignor to General Electric Company. Filed April 27, 1905. A method of construction.

831,434. WATER-PURIFIER. Frank B. Hinkson, New Castle, Pa., assignor to Hinkson Electric Liquid Purifying Company, Pittsburg, Pa. Filed October 7, 1905. An electrolytic purifier.

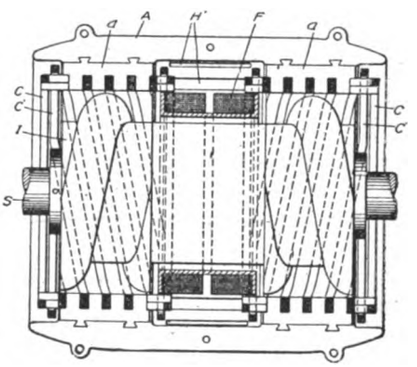
831,442. INDUCTOR-ALTERNATOR. Charles A. Kelsey, Pittsfield, Mass., assignor to Stanley-G. I. Electric Manufacturing Company. Filed July 6, 1905. The armature coils and revolving inductors are arranged helically.

831,446. ALTERNATING-CURRENT MOTOR. Marius C. A. Latour, Paris, France, assignor to General Electric Company. Filed January 21, 1905. The brushes are lifted from the motor commutator at a given speed without changing the electrical connections.

831,451. SYSTEM OF MOTOR CONTROL. Charles E. Mandelick, New York, N. Y., assignor to Sprague Electric Company. Filed December 19, 1905. A motor circuit controlled by a relay permits the operation of a number of controllers.

831,467. TROLLEY HEAD. William H. Pfrimmer, New Albany, Ind., assignor of one-sixth to Jacob W. Roberts and one-sixth to David E. Jones, New Albany, Ind. Filed November 2, 1905. Provided with rotating disc guards, spring-mounted.

831,475. INDUCTOR-ALTERNATOR. David B. Rushmore, Schenectady, N. Y., assignor to General Electric Company. Filed October 5, 1905. The inductor has two helical projections and the armature coils are laid in helical slots.



831,475. INDUCTOR-ALTERNATOR.

831,478. METERING SYSTEM. Ernest Schattner, Schenectady, N. Y., assignor to General Electric Company. Filed August 19, 1905. The action of the damping system is controlled by a centrifugal governor.

831,482. ELECTRIC HAMMER. Robert Smith, Middletown, Ohio. Filed August 8, 1905. The blow is delivered by a spring compressed by means of an electromagnet.

831,490. ELECTRIC CIGAR LIGHTER. Julius C. Tournier, Schenectady, N. Y., assignor to General Electric Company. Filed September 25, 1905. A method of construction.

831,509. TROLLEY. Jacob T. Haudenshield, Scott township, Allegheny county, Pa. Filed November 10, 1905. The wheel is mounted on an oscillating form.

831,525. COMPOSITE TELEPHONY AND TELEGRAPHY. Harry O. Rugh, Chicago, Ill., assignor to Western Telegraphone Company, Minneapolis, Minn. Filed January 13, 1903. A shunt is placed around the telephone, having low resistance, but high impedance.

831,526. SIGNALING APPARATUS. Harry O. Rugh, Chicago, Ill., assignor to Western Telegraphone Company, Minneapolis, Minn. Filed January 8, 1904. Makes use of a polarized relay for controlling the signal bell.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 14. NEW YORK, SATURDAY, OCTOBER 6, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON
NEW ENGLAND OFFICE, M. W. BARBER, Mgr., DELTA BLDG., 10 Post Office Sq.

LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
- Popularizing Electricity . . . 531
- Mechanical Brakes for City Railways . . . 531
- Wireless Telegraph Conference . . . 532
- The Binnacle a Cause of Error in a Compass . . . 533
- The Radium Controversy . . . 533

American Electrochemical Society . . . 534
Removing Oil from Exhaust Steam, by Albert A. Cary . . . 534
The Railway System of the Sernf Valley, Switzerland . . . 535
A New Italian Insulator . . . 537
The Recent Controversy on Radium, by F. Soddy . . . 538
The Use of the Telephone in the Permanent Seacoast Defenses of the United States, by M. C. Sullivan . . . 540
Wireless Telegraph Work in Reporting the Roosevelt Cup Races . . . 541
Illuminating Engineering Society . . . 542
The Telharmonium Demonstrated before the New York Electrical Society . . . 542
Municipal Ownership . . . 543
Trial of the New York Central Electric Train . . . 543
Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw . . . 544
Congestion in the Patent Office . . . 547
The Railway Signal Association . . . 547
Meeting of the American Institute of Electrical Engineers . . . 548
The Boston Rejuvenation of the Sons of Jove . . . 549
Organization of the Home Telephone Company, of Detroit . . . 549
Effect of Iron in Distorting Alternating-Current Wave-Form, by Frederick Bedell and Elbert B. Tuttle . . . 550
English Overhead Transmission Lines and Distribution Mains . . . 554
Standard Symbols for Wiring Plans . . . 554
An Electrolytic Rectifier . . . 554
Boston & New York Electric Railroad Company . . . 554
Notes on Colloids, by Alfred Lottermoser . . . 555
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 556
METHODS OF GETTING NEW BUSINESS . . . 558
Rules for Wireless Telegraphy in Time of War . . . 560
"Wood Preservation" . . . 560
Annual Report of the New York, New Haven & Hartford Railroad . . . 560

INDUSTRIAL SECTION:
- Goulds Electric Mine-Sinking Pump . . . 561
- The Multiple-Voltage System of Motor Control in New England Cloth-Printing Establishments . . . 561
- A New Capstan Cable Jack . . . 562
- A 250-Volt, Double-Pole Rotary Flush Switch . . . 562
- The Manufacture of Storage Battery Plates . . . 563
- A San Francisco "Branch Office" . . . 563
- A Large Installation of Gas-Engine-Driven Generators for Traction Purposes . . . 563
- Gasolene-Electric Apparatus for Moving a Drawbridge . . . 564
- Electrical Developments in Japan . . . 564

CURRENT ELECTRICAL NEWS . . . 565
Record of Electrical Patents . . . 571

Copyright, 1906, by Electrical Review Publishing Co.

POPULARIZING ELECTRICITY.

The topic attracting the most interest among those dealing in electrical apparatus and energy is the ways and means of increasing the use of this agent, thereby not only increasing the business of the power-houses, but of the manufacturing companies as well. Very many plans have been suggested, and many are being tried, with more or less success. One having a good deal of interest is reported from Brussels. It seems that Mr. R. Goldschmidt, of that city, has established a free laboratory and museum of electrical apparatus. Here are on exhibition all kinds of appliances, set up so as to demonstrate their action. In the laboratory facilities are available for carrying out all kinds of tests. The originator of this idea has even gone further, and provides means for scientific study in certain branches of physics and chemistry. This is an original idea which, if properly used, will undoubtedly help greatly in spreading the use of electrical methods; but it will probably be found almost as difficult to induce people not prompted by idle curiosity to avail themselves of the facilities here offered as it would be to get them to adopt electric lights or motors at once. No doubt there will be a number of men or companies who will be very glad of the opportunities thus offered, but since the apparatus can almost always be secured with a guarantee, to many this will be preferable to making tests under conditions not actually those to be fulfilled. For the laboratory to be successful it must itself be widely advertised. The same is true, to a greater or less extent, of any exhibition. For instance, an exhibit of electrical appliances undoubtedly helps in increasing the use of them, but to accomplish the most good the exhibit itself must be made popular. The necessity for advertising is not avoided though the immediate object of attention is changed.

MECHANICAL BRAKES FOR CITY RAILWAYS.

It is rather strange that a wider use is not made of mechanical brakes on city street railway systems. The development of suburban and interurban lines on which heavy cars are run at high speeds has made necessary the adoption of some form of braking other than the simple hand brake, but except, perhaps, on those city lines which extend into the suburbs, the hand brake seems to be the standard equipment, in spite of the fact that many of the city cars in size and weight compare with the high-speed interurban cars. Exception should be made to this statement with respect to certain cities where mechanical brakes are generally used, but the old method, which was adequate for horse-cars, still persists in some of our most important towns.

The reason for this is not a lack of a satisfactory mechanical brake, for there are both electric and air-brake systems suitable

Digitized by Google

for city cars. These appliances are not in an experimental state. They have been thoroughly developed and tried. Nor would there seem to be any difficulty in training the city motorman in the use of these appliances, since he is certainly not in any way less capable than the motorman on the interurban car. It may be urged against them by the railway companies that they are expensive, both to install and to maintain. This is true, if comparison be made simply with the hand brake; but it may be said with equal justice that the motor equipment costs more than horses. Improved methods of traction making it possible to run heavier cars and to make higher speeds certainly call for improved safeguards. The additional expense is compensated, in part at least, by an improved service and a reduction in the number of accidents.

A valuable feature of the mechanical brake is that it reduces the strain, both physical and mental, upon the motorman. It requires the exercise of considerable strength to stop a heavy car with a hand brake, and certainly the man who is tired physically can not be as alert as one who is less fatigued. He will then run his car with less thought to the comfort of the passengers, and is much more likely to have accidents. As an instance where this feature is well realized we may point to the systems in St. Louis, where the cars are equipped with air brakes, and the motorman is provided with a seat which he uses when in the outlying parts of the system, discarding it only when his car reaches the busy down-town section.

This question of the use of mechanical brakes has been under investigation by a committee of the Congress of the International Union of Tramways and Short Railways, which met recently in Vienna. The committee consisted of two experienced tramway men who have had this subject under study for several years. Their report was in favor of a mechanical brake, but the two members could not altogether agree upon the type of brake most suitable. Mr. Scholtes, director of the Nuremburg-Fürth Tramways, looked at the matter from the statistical point of view. He believes that when, on account of the weight of the cars, or the use of trailers, or when, for any other reason, the hand brake can not be safely employed, a mechanical brake should be adopted, and, in general, this should be an electric brake. On the other hand, Mr. E. R. Bjorkegren, chief engineer of the Grosse Berliner Strassenbahn, while agreeing with Mr. Scholtes as far as the use of mechanical brakes is concerned, thinks that the air brake is the more satisfactory, mainly because it acts more quickly than the electric brake and therefore gives the motorman more confidence. Both members of the committee agree that the electric brake costs less to install and to maintain than the air brake. It may, however, involve certain other disadvantages. For example, when the current utilized is drawn from the motors acting as generators, the average load on the motors is increased. If, on the other hand, the current is drawn from the line, the brake may be put out of commission when the supply from the line is interrupted. The air brake also has its weak points. But the important thing is not whether the mechanical brake should be operated electrically or by means of compressed air, but that such brakes should be more widely used, and that, with the standard type of car found to-day on city streets, the whole dependence should not be placed upon a short lever worked by hand. The electrical equipment of the heavy city car may consist of two fifty-horsepower motors, put on mainly to enable the car to start rapidly. But although it may occasionally be much more important to stop suddenly, the old hand-operated mechanism is still largely depended upon.

There is another feature, too, in the use of the mechanical brake which is seldom found when the hand brake only is employed—that is, the provision of an emergency brake. Not infrequently this emergency brake is itself a hand brake placed there for use when the mechanical equipment fails. It is not expected to be brought into service for sudden emergencies, such as preventing a collision. In that case, if the mechanical brake fail, there is probably little time to do anything else, but it is a great safeguard in case the mechanical device breaks down on a grade. In a similar situation the motorman on the car equipped only with hand brakes must depend upon his motors if the hand brake fails. It may be contended that the latter type of brake is less liable to trouble than are the mechanical brakes, but they do fail sometimes, and when they do, not only is there no supplementary brake, but the motorman is apt to be physically in a poor condition for meeting emergencies.

The situation as regards the braking of city cars is similar to that existing a short time ago in connection with the signaling on interurban lines. Cars were operated at steam railroad speeds without any particular signal system, and this often done on highways, which aggravated the troubles, for it was dangerous not only to those using the railway, but to others simply passing along the highway. In both cases we have developed the motive power more rapidly than our safeguards; or, rather, we have been more ready to avail ourselves of the former than of the latter, for there are to-day both signaling systems and braking devices which are entirely satisfactory.

WIRELESS TELEGRAPH CONFERENCE.

A conference representing thirty-one governments assembled at Berlin on Wednesday of this week to endeavor to reach some understanding in the use of this means of communication. The conference was called together by the German government, which took the initiative in this matter because the Marconi Company has refused to exchange messages with stations equipped with the Slaby-Arco apparatus, the system used by that government. In 1903 a similar conference was held, in which, however, only eight governments took part, these being the United States, Germany, Great Britain, France, Italy, Spain, Russia and Austria-Hungary. A protocol was agreed upon and signed at the earlier conference by the delegates of six of the governments, those from Great Britain and Italy not signing, because of contracts between their government and the Marconi Company. But little good has come of this agreement, as the Marconi Company still adheres to its old policy and receives messages only from stations and vessels equipped with Marconi apparatus. It was for this reason that the Marconi apparatus was removed

Digitized by Google

from the Nantucket lightship in 1904, as the company refused to accede to the request of the government at Washington to receive messages from German vessels. The conference now in session will probably last for a number of weeks. No doubt many important matters will come up in addition to the one at present causing the most friction, but it is, of course, impossible to indicate in the least the probable trend of action.

At another conference, held the latter part of September at Ghent, the use of wireless telegraphy in time of war was taken up and a number of articles adopted which will be found on another page of this issue. In general, these articles concern only the belligerents, but one of them may cause great inconvenience to non-combatants. This is the one which gives belligerents the right to prevent the transmission of Hertzian waves by a neutral state over the high seas within the sphere of their military operations. The high seas—that is to say, waters lying beyond the three-mile limit—have always been considered free to all, but this article would deny non-combatants the right to make use of wireless telegraphy if the fleets of the states at war should choose or happen to come within range of the sending stations. At the present time, when no attempt is made to direct Hertzian waves, an unfriendly fleet might deny the right of a neutral state to send messages along its own coast or even inland, because the waves, which spread out in all directions, might be thought to interfere with the fleet's own apparatus. In other words, two quarreling countries might take it upon themselves to throw out of service a system of communication of world-wide importance, and it would be intolerable if this should be allowed to become the general practice. Wireless telegraphy is becoming of too much importance to put it under this limitation.

THE BINNACLE A CAUSE OF ERROR IN A COMPASS.

A recent accident to a yacht which ran on a reef near Portland harbor warrants a suggestion to owners of yachts. The facts are: before starting on a cruise the compass was adjusted, but the vessel was sailed by day and in clear weather, until, from a certain buoy in Massachusetts Bay, a course was laid to Portland harbor, and when the threatened fog fell the boat could be steered only by compass, and breakers were heard near Portland Head, where the vessel ran on a reef, from which it was removed without injury, and later reached Portland harbor.

It was apparent that the compass was in error, and on the return trip a course was laid out from Portland harbor to outside of Cape Ann, some fifty miles distant, and it became evident that steering on this course would bring the boat several miles to the westward and on the rocks of Cape Ann.

At the home port, the evidence of this error in the compass was submitted to the expert who had adjusted it a short time previously, and on reexamination the compass was found to be correct.

After this was completed and the brass binnacle cover holding the glass panels, which had been removed for the test, was replaced, it was noted that the compass moved. On further examination it was found that this "brass" cover was magnetic, and that this was due to its lower edge being a bead spun over a ring of large iron wire.

Is it not possible that other binnacle covers may be made in a like dangerous manner and be a source of peril in navigation? Some time ago the story was related that it was found the compass on a vessel lighted by electricity was in error when the circuit was charged. It was found that the wires were coiled in such a manner near to the binnacle as virtually to make a galvanometer, but the deviation of the needle was so great that no one was deceived, although at first the cause may not have been apparent.

For boats illuminated by electricity no further suggestion is necessary, as the person in charge of the electric lighting plant can readily make the tests; but for other boats not so equipped the test may be easily made when the vessel is stationary by removing the binnacle cover and noting if holding it in different positions around the compass affects the direction of the needle.

THE RADIUM CONTROVERSY.

On another page of this issue an exceedingly interesting summary of the recent controversy on radium, made by Mr. Frederick Soddy, is reprinted from *Nature*. Mr. Soddy is one of those who have taken a very energetic part in advancing our knowledge in the new field of radioactivity, but, in his summation of the situation, he takes a fair stand. He points out that while a number of men eminent in science did or were ready to take part in the controversy and uphold the new idea, the opposition was left practically to Lord Kelvin, among the physicists, and Professor H. E. Armstrong, among the chemists. The greater body of younger men seem to have been too thoroughly impressed with the evidence in favor of the new ideas to set them aside lightly.

The controversy, has, however, had one desirable result: it has established a better understanding, and will probably result in the designation of radium, for a time at least, as a compound, without the descriptive term, "chemical," the reason being that there is no question that helium is given off from what appears to be pure radium.

Mr. Soddy naturally lays a great deal of stress upon the large amount of experimental evidence in favor of the disintegration theory and the fact that no experiment as yet conducted fails to conform to this idea, and he urges those who are inclined to doubt to undertake some experimental work themselves. Nothing original need be attempted: all that is necessary is to repeat experiments which have been very completely described. This advice is reasonable, for it is not fair to those who have expended so much time and labor in acquiring knowledge for one who knows nothing about it at first hand to condemn entirely the work of the other, no matter how greatly the results differ from his own ideas. He should at least repeat the other's experiments before denying the results.

Digitized by Google

American Electrochemical Society.

The following provisional programme has been issued for the tenth general meeting of the American Electrochemical Society, which will be held in New York city next week. The members of the society have been invited to join the committee of the Perkin memorial celebration in a banquet to be given Sir William Perkin at 8 o'clock on Saturday evening, October 6.

On Monday, October 8, at 9 A. M., a meeting of the board of directors will be held at Columbia University. At 10 A. M. there will be a session for reading and discussion of papers and an experimental lecture. At 2.30 P. M. there will be a lecture by Charles Baskerville, Ph.D., on "Use of the Ultra-Violet Light in the Laboratory and in Practice," at the chemical laboratory of the College of the City of New York.

Tickets will be provided by the local committee for visiting numerous points of interest on Monday afternoon, including several large power-houses, the electrical testing laboratories, the Pennsylvania Railroad tunnel under the Hudson river, the Weston Instrument Company and the Edison laboratories at East Orange, N. J.

On Tuesday, October 9, at 9.30 A. M., there will be a session for reading and discussion of papers, and a lecture on pyrometers, with an exhibition of commercial instruments. On Tuesday afternoon the members of the society and guests will be conducted to the plant of the American Smelting and Refining Company, near Maurer Station, N. J.

The following papers are announced for presentation at this meeting:

"Formula for the Electromotive Force of a Helmholtz Concentration Cell," by Henry S. Carhart.

"An Aluminum and Magnesium Cell," by G. H. Cole and H. T. Barnes.

"The Decker Primary Battery," by F. B. Crocker.

"Visible Migration of Particles Between Electrodes," by Carl Hering.

"Some Factors Affecting the Distribution Law," by H. E. Patten.

"Melting Points of Some Cryolite-Alumina Mixtures," by Francis R. Pyne.

"Double-Decomposition of Zinc Sulphate and Sodium Chloride," by P. B. Sadtler and W. H. Walker.

"Some Small Laboratory Appliances for Electric Fusion and Other Work," by S. S. Sadtler.

"A Thermo-Electric Pyrometer for General Industrial Applications," by F. F. Schultz.

"Copper Cathodes in Nitric Acid," by J. W. Turrentine.

REMOVING OIL FROM EXHAUST STEAM.[1]

BY ALBERT A. CARY.

Separation of oil from condensed steam has been a problem of great moment, and many methods and devices have been used to effect its removal, all of which may be classified in the six divisions in the first of which baffle plates or screens are used, the exhaust steam being thrown against these surfaces and allowed to pass, while moisture and free oil cling to the plates and are separated. In the second method, the steam delivered by the engine is sent through filters, generally composed of coke or some other loose material, while in the third process the steam is exhausted from the engine through a series of pipes having their lower ends immersed in water, which is supposed to wash out the oil and allow the steam to pass to its place of exhaust.

A fourth method makes provision for the steam exhausted from the engines to be projected upon the surface of a large tank of water, where the oil attaches itself to the water surface, while the steam is allowed to pass on to its point of exhaust. The fifth method allows the steam with its charge of oil to be condensed and then carried to a skimming tank, where the oil is supposed to rise to the surface of the water and float off, while the cleared water is drawn from a point some distance below the surface. In the last of all the methods purification is effected by passing the oil-charged condensed steam through various filtering mediums, such as blankets, sponges, straws, excelsior, etc., and depending upon their oil-retaining properties to clear the water of its contained oil.

Recently a new process has been devised which provides for the introduction into the water of a small percentage of a special material, the nature of which is at present a secret, which has a great affinity for oil. As this material is stirred throughout the condensed steam, it takes up the oil in the same way that blotting paper takes up ink. Tests thus far made show that the separation of oil from water by this process is absolute and complete.

Oil is present in exhaust steam in three different forms: first, as a vapor; second in finely subdivided particles of oil; third, in the form of a coating around the small particles of condensed water existing in exhaust steam. In all of the processes of oil separation, excepting the last described, it will be seen that it may be possible to ensnare and filter out the finely divided particles of oil floating in the steam and also the minute particles of water with their oil coating, but it is difficult to take care of the vaporous portion of the oil, which has proved most troublesome to the users of such devices. When oily steam is condensed, oil is found existing in the resulting water as a free oil, little clots of which, either separately or combined, float to the surface of the water.

Few persons understand the exact nature of the emulsion, but if a sample of the emulsified oil and water be placed under a powerful microscope and a polarized light be thrown through it, one will see an enormous number of small globules of water having their outer surfaces coated with the thinnest imaginable films of oil showing beautifully iridescent, as the rays of the polarized light pass through them.

Almost any one has noticed the effect of a drop of oil falling upon the surface of water. This drop may be very minute, but it will extend over a large surface of the water, forming a film so thin as to be almost immeasurable. With a million of little globules of water carrying such a thin film of oil upon their surfaces, it is no wonder the oil is difficult to filter off, especially when one considers the great tenacity with which oil clings to the surface of water.

Conceiving the idea that a substance might be obtained which would have a greater attractive force for the oil than the surface of water, the inventor of the new process discovered the material already mentioned. So effective is this material that the quantity used for oil extraction is but one-twentieth of one per cent of the weight of the water itself, and after being introduced into the water, it has proved so light and feathery that a little stirring causes it to diffuse itself throughout the volume of oily water. This extreme lightness and ability to diffuse itself throughout the water soon causes the material to get in contact with all of the oils, which seems to leave the water suddenly and attach itself to the material. Thus, in a few minutes the water becomes cleared and all that is needed to produce a liquid as clear as crystal is a rapid filtration of the oil and water with its contained oil-absorbing material. Samples of water obtained from various power stations and subjected to this treatment have shown no trace of oil in the filtrate when analyzed by the most delicate chemical means. The material has such a capacity for oil that it can be used several times before a new charge is required and, further, the cost of the original material is small.

[1] Abstract (*Engineer*) of a paper read before the American Society of Refrigerating Engineers.

Digitized by Google

The Railway System of the Sernf Valley, Switzerland.

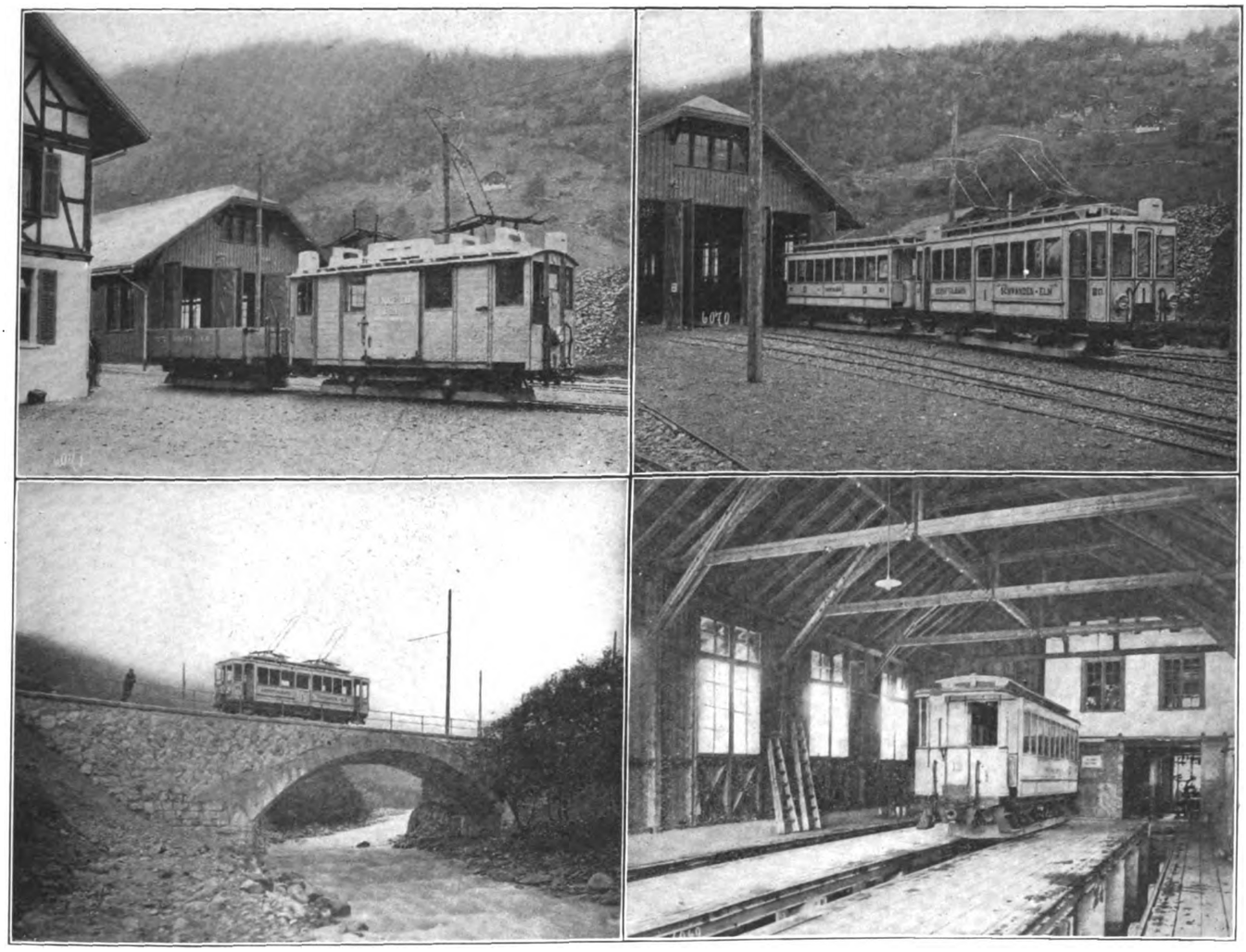
By Franz Koester.

TO SECURE better communication between the towns of Elm and Schwauden in the Sernf Valley, Canton of Glarns, Switzerland, an electric railway system was put in operation in August, 1905. On account of the numerous curves and grades in this mountainous district, the former in some cases being as short as thirty-five to sixty-five feet radius and as it was desirable to have no curves of a radius smaller than 160 feet, it was necessary to do a large amount of cutting and filling. Besides this a number of sections of the streets were built on made ground, with walls three or four feet high, by the land-owners. As some of these streets were only seventeen feet wide and in many instances retaining walls had to be repaired, the process of laying the tracks proved no small undertaking. In some cases the roads had to be widened up to twenty-three feet. As the tracks were built on the side of a mountain down which much snow fell during the winter, they were built as close to the valley side of the street as possible, in order to facilitate the removal of snow from the tracks by merely pushing it into the valley. In a good many cases, however, as stated above, the two tracks took up the entire road. Eleven small bridges were built of iron and stone, some of the spans running up to sixty-two feet. Proper drainage was secured by small transverse tunnels emptying into the valley.

The rails are of the flange type in cities and street crossings, while at other points they are of the Vignoles type, laid in lengths of fifty feet and weighing fifty-five pounds per metre. All joints are suspended with iron fishplates on both sides. Iron ties are used throughout. As is common on the Continent, the road had to be protected by fences, there being 2.16 miles of iron and 5.5 miles of wooden fencing.

As the whole system was installed with the idea of keeping the first cost down to a minimum, the car barns and other buildings are correspondingly simple. For the accommodation of the power plant, storage battery, car barns, etc, an old factory was altered. In Engi-Hinterdorf and Matt restaurants were equipped independently from an inn and waiting room. In Elm there has been erected a waiting station, freight house and car barn with two tracks, provided with cleaning pits.

The passenger cars are arranged for second and third-class fares, the former having a capacity of six and the latter



SERNF VALLEY RAILWAY SYSTEM—FREIGHT MOTOR CAR. CAR BARN AND PASSENGER CARS. NEW BRUMBACH BRIDGE. INTERIOR OF CAR BARN.

Digitized by Google

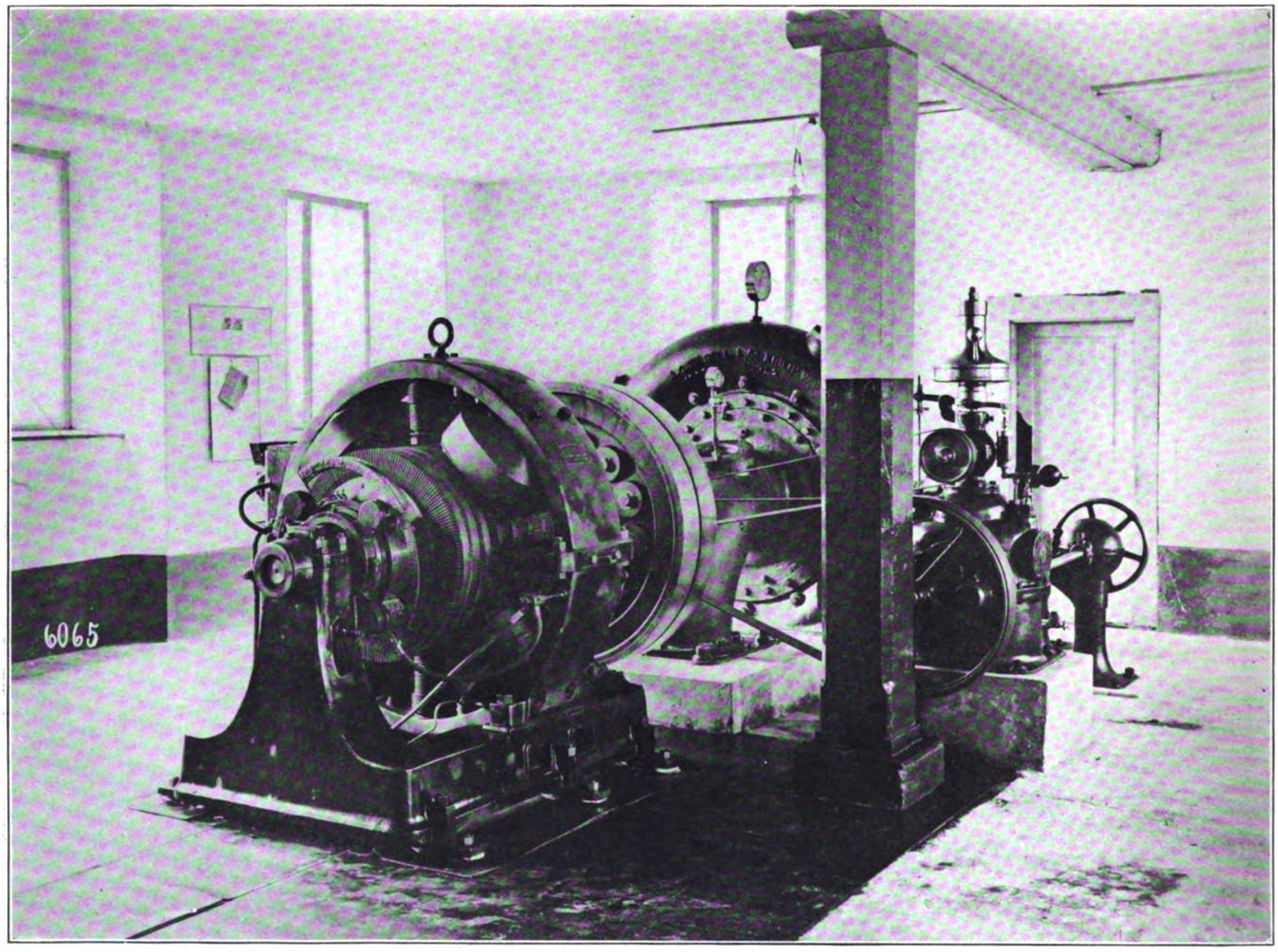
twelve seats with an additional room for twelve standing. The second-class passengers enter at the middle of the cars, which are thirty feet long and have two axles thirteen feet apart. There are also a few trailers, also with two axles thirteen feet apart, which have seats for forty passengers. There are a number of freight cars, some of the box and some of the flat type. The two-axle type of cars was chosen, as the company did not wish to operate heavy cars in the winter on account of the light traffic. The cars themselves were built by the Augsburger and Nürnberger Maschinenfabriken, while the electrical equipment was supplied and installed by the Oerlikon Company, of Zurich, Switzerland. The cars are equipped with two sixty-five-horse-power motors, and as they are light in weight a speed of from eleven to twelve miles per hour is reached on the steepest grades, while on the level an average speed of fifteen miles per hour is easily maintained.

A series-parallel system of control is employed, and one motor alone may be operated. An electric solenoid brake is used. An automatic cutout switch is mounted on each platform and may be thrown by hand. Fuses are also installed as an additional precaution. Each motor-car is equipped with two sliding bows and an air-brake on the Boecker system, the sand-box being pneumatically operated. The air-compressor is mounted directly against the motor frame and is driven by spur gearing from the main motor axle.

For the operation of this railway a small plant was erected near the road, and the water of the Muehlebach was utilized. The maximum water supply available is 2,100 cubic feet per second, while the minimum is 175 cubic feet per second, with a head of 138 feet.

The supply water is led through a small tunnel, 165 feet long, to a collecting basin which is equipped with screen sluice-gates and overflow. From here a penstock 1,836 feet long and 3.28 feet in diameter leads down the mountain slope to the power-house, while the tailrace discharges in the stream Sernf, 230 feet away.

There are at present two vertical spiral turbines of 680 revolutions per minute, generating 200 horse-power each. Each turbine is direct-connected to a continuous-current generator of the Oerlikon type, the turbines themselves being manufactured by Theodor Bell and Company, of Kriens, Switzerland.



SERNF VALLEY RAILWAY SYSTEM—INTERIOR OF POWER PLANT.

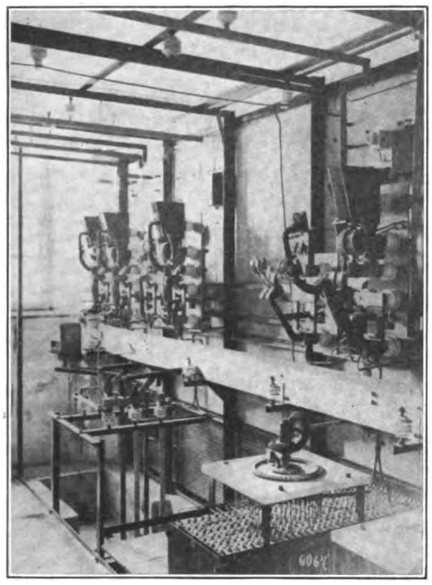
The turbines are provided with delicate governor mechanisms and an oil cataract working upon a servo-motor.

The generators are rated at 135 kilowatts at 800 volts and are of the four-pole, shunt-wound, interpole type, there being four auxiliary poles located between the main poles. The general appearance of these machines is well shown in the illustration herewith. A storage battery of 200 ampere-hours capacity has also been installed.

The switchboard consists of five panels, three for generators, one being spare, one

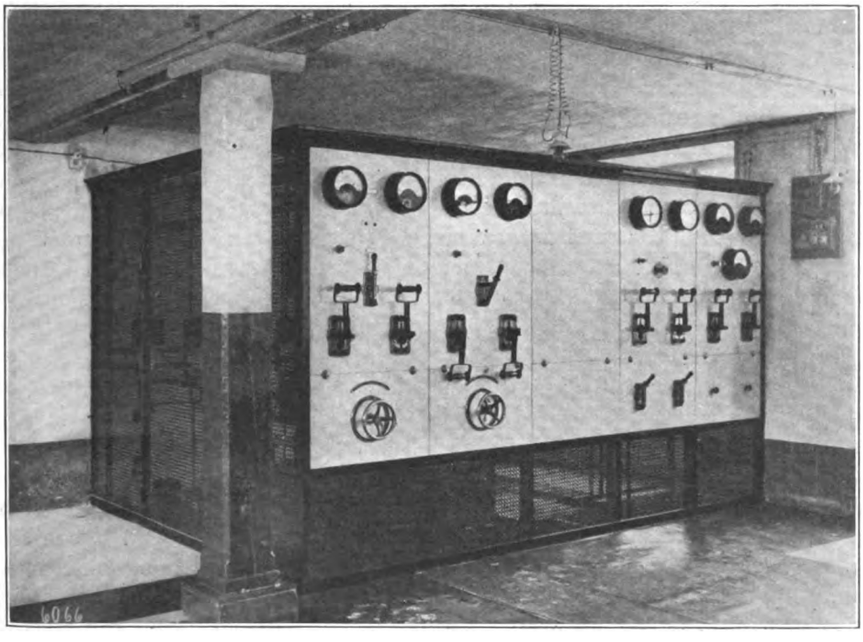
Digitized by Google

for the battery and one for the feeders. A voltmeter, an ammeter, two switches and a rheostat hand-wheel, together with a carbon switch, are mounted on each



REAR OF SWITCHBOARD, SERNF VALLEY RAILWAY SYSTEM.

generator panel, while an automatic cut-out switch is mounted on the generator. On the battery panel are mounted an ammeter, a voltmeter and two switches, one being an automatic cutout, and a hand-wheel for charging and discharging the



SERNF VALLEY RAILWAY SYSTEM—SWITCHBOARD.

battery. The battery is divided into two parts, connected in multiple on charging and in series when discharging. The last panel is devoted to the feeders. An ohmmeter is so connected on this panel as to make it impossible to close any switch on whose circuit there is a dead ground.

As the power plant is connected directly on the side of the car barn, there is also a repair shop handy.

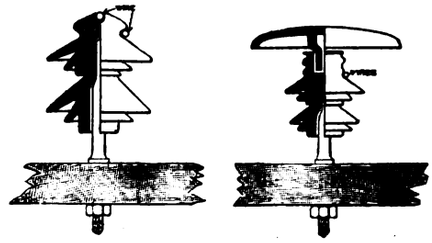
The trolley wires have a section of fifty square millimetres and are carried on wooden poles suspended from wrought-iron pipe brackets. In the direction of Elm a feeder system of 4.2 miles is run, consisting of copper wire, seventy square millimetres in cross-section. On account of the heavy snow-storms which frequently occur in the valleys, the poles are placed only 100 feet apart.

As will be seen, this road operates at infrequent intervals in a very sparsely settled district, where, while it is the only available means of locomotion, the demands made upon it are not great, and therefore it was necessary to employ the cheapest material possible consistent with satisfactory operation.

A New Italian Insulator.

A new Italian insulator designed by Signor Guido Semenza is being shown at the Milan (Italy) exhibition. One of the troubles encountered in high-tension plants in Italy has been the breaking down of the insulators during heavy rains. To guard against this trouble it has been usual to make the upper petticoat with very large diameter to enable it to protect the lower part of the insulator. The conductor is carried on this head. This necessitated making the whole of this petticoat of the same insulating material which forms the chief part of the insulator, and it had to be made with just as much care as the lower petticoats. This type of insulator is shown in Fig. 1. The recent tendency to increase the working pressures has made it necessary to increase correspondingly the diameter of the upper petticoats, which resulted in a great increase in cost. It was to get over this difficulty that Signor Semenza designed the insulator shown in Fig. 2, which is taken from the *Electrical Review* (London), August 31.

In this insulator the wire is fastened below the upper petticoat. It is therefore unnecessary for this petticoat to be strong enough to resist perforation; it



FIGS 1 AND 2.—A NEW ITALIAN INSULATOR.

need only be watertight and sufficiently hard to resist mechanical shocks and rough usage in transportation. It is therefore made of a form of terra-cotta, which is neither so costly nor so breakable as porcelain or glass. Since the point of attachment of the wire in the Semenza type is somewhat lower than that in the old type, the strain moment of the wire is greatly reduced, which makes allowable a reduction in the thickness of the insulator and in the diameter and cost of the iron bolt; and since this upper petticoat or umbrella is not connected in any way with the pin, complications due to increased capacity are avoided. It is found possible to use a much lighter insulator of the Semenza type in order to secure the same breakdown voltage.

It is claimed that there is a saving of from thirty to forty per cent for an equally safe installation by using the Semenza insulator, with pressures from 35,000 to 50,000 volts. For higher voltages up to 80,000 or 90,000 it is thought that a saving of fifty per cent will be effected. One of the reasons for the excellent performance of this insulator is said to be the fact that the wire is at no time in touch with the stream of water running over the surface of the effective petticoats of the insulator.

Digitized by Google

THE RECENT CONTROVERSY ON RADIUM.[1]

BY F. SODDY.

The recent correspondence on the subject of radium, started in the *Times* (London) by Lord Kelvin, has, after lasting nearly a month and causing widespread interest, apparently closed without any very definite conclusion being reached. Whatever opinion may be formed of the merits of the controversy, all must unite in admiration for the boldness with which Lord Kelvin initiated his campaign, and the intellectual keenness with which he conducted, almost single-handed, what appeared to many from the first almost a forlorn hope against the transmutational and evolutionary doctrines framed to account for the properties of radium. The weight of years and the almost unanimous opinion of his younger colleagues against him have not deterred him from leading a lost cause, if not to a victorious termination, at least to one from which no one will grudge him the honors of war. If peace and tranquility now result, and a measure of agreement is arrived at between conflicting views, it will be a result which all concerned will heartily welcome. The most ardent believer in the truth of the new doctrines can not be other than satisfied that every feature and assumption that is admittedly speculative should be clearly recognized as such and separated from that which is not, if thereby the experimental foundations of the science of radioactivity are freed from further wordy and unprofitable controversy. There seems now to be a reasonable prospect that this has been secured.

Lord Kelvin's opening challenge (August 9) was broad and sweeping. He took exception to the statement, made by the writer in opening the discussion on the evolution of the elements at the British Association at York, that the production of helium from radium has established the fact of the gradual evolution of one element into others, and denied that this discovery affected the atomic doctrine any more than the original discovery of helium in cleveite. The obvious conclusion was that both cleveite and radium contained helium. He also stated that there was no experimental foundation for the hypothesis that the heat of the sun was due to radium, and ascribed it to gravitation.

The challenge was taken up on the other side successively by Sir Oliver Lodge, the Hon. Mr. Strutt and other well-known authorities, and it soon became apparent that for argument, at least, Lord Kelvin on his side had to rely practically on himself alone. Professor Armstrong, it is true, immediately enrolled under Lord Kelvin's banner, and entered the lists with an embracing criticism of physicists in general, whom, he declared, are strangely innocent workers under the all-potent influence of formula and fashion. He made the statement that no one had handled radium in such quantity or in such manner that we can say precisely what it is, and throughout put the word radium in inverted commas.

Whether or no his opponents are all as innocent and ignorant as Professor Armstrong imagines, the fact remains that, except for this *ex cathedra* utterance and a leading article, argument against the accepted view there was little or none except that contributed by Lord Kelvin himself. Professor Armstrong's letter merely served to provide Sir Oliver Lodge with justification for his favorite theme, which appears to be that whereas chemists have an instinct of their own for arriving at their results, reason is the monopoly of the physicist, whose results the chemist usually manages to absorb in the end. No better argument against the unfairness of this could be provided than by the history of radioactivity itself, which owes at least as much to the chemist as to the physicist. Professor Armstrong is almost alone among chemists, as Lord Kelvin is among physicists, in his hostility to the new doctrines.

Mr. Strutt in two letters (August 9 and 21) asked what became of the heat generated by the radium admitted to be present in the earth, and recalled the independent evidence of several workers of the continuous renewal of helium from radium. Sir Oliver Lodge directed attention to the magnetic reflection of the α-particle as evidence that material particles are expelled from radium, and in his letter laid perhaps undue weight on the evidence, which is still far from complete, that the α-particle is an atom of helium. The vagueness of this argument, and the fact that the letter raised a doubt whether Lord Kelvin had sufficiently examined the published evidence, a doubt which Lord Kelvin himself promptly dispelled, was the subject of a leading article in the *Times* of August 18. The writer of that article attacked the evidence for the production of helium from radium, using some well-known arguments. The minute quantity of emanation was graphically likened to a bubble rising through a glass of whiskey and soda, and it was held that the results were vitiated by the well-known changes the spectra of gases undergo under the prolonged action of the current, due to occlusion by the electrodes and selective conduction rather than to any transmutation. It may be here remarked that the same arguments were set forth in full by Himstedt and Meyer as a preliminary to their experimental examination of the question, yet Himstedt and Meyer, as the result of their own experiments, were finally forced to the conclusion that helium is in fact produced from radium.

Lord Kelvin in his replies (August 20 and 24) made it clear that he accepted as a fact the continuous evolution of helium from radium, and this admission narrowed very much the issue involved. In reply to a statement of Strutt that if all the helium is removed from radium after an interval a further supply can be extracted, Lord Kelvin remarked simply that the "if" of the statement was wrong. This point was dealt with by the present writer (August 31), who considered the argument could be definitely answered. For helium is produced from the emanation of radium, about which no question of its being really reproduced can exist. For the removal of the emanation is marked by changes in the radioactivity, notably by the β rays, which vanish when the emanation is removed. The recovery of the radioactivity occurs at a definite rate, and is concomitant to the reproduction of emanation, which can at any time be again extracted as before. As there is no question of the radium creating helium, the only point open for argument is the exact character of the decomposition by which it and the emanation which gives rise to it are formed. As there was no further reply to this criticism, it may be taken that the main point of the disintegration theory, that there is a continuous change in the radioactive matter accompanying the radioactivity, is unanswerable.

On the important question as to the character of the decomposition by which the helium is formed, Lord Kelvin in his later letters favored a view very different from that of mere occlusion, which the original analogy to cleveite suggested. He quoted a statement of Professor Rutherford in favor of regarding radium as a chemical compound of helium and other elements, and suggested that radium might be made up of one atom of (?) lead and four of helium. In a final letter (September 4) Sir Oliver Lodge pointed

[1] Reprinted from *Nature*, September 20.

Digitized by Google

out that this was the key of the position. Is radium a compound or an element? It is satisfactory that, after so much fencing with the question, so simple an alternative has been arrived at. Perhaps the most significant thing about the view that radium is a compound is the silence of the chemists. Surely a chemist might fairly be supposed to know whether a change is what is called a chemical change or not, and the fact that it has been left to a physicist to adopt this view seems fair comment. Not even Professor Armstrong has yet accepted it.

On the second point of his challenge, the denial that the heat of the earth is due to radium, Lord Kelvin naturally had an easier task, for matters connected with the interior of the earth must necessarily remain speculative. If radium did not decompose under the conditions prevailing in the interior it would emit no heat, and would not tend to diminish in quantity, accounting perhaps, although with some difficulty in view of the wide distribution of radium in surface rocks, for the continued existence of the substance at the present time. A. S. Eve, in a vigorous letter (August 28), stated that he had confirmed the estimate of Mr. Strutt of the amount of radium in the earth's crust by a new method, in which the penetrating radiation from the earth's surface was used as the basis of measurement. Although, of course, in view of the evidence of the independence of radioactive changes upon their environment, it is more of an assumption to suppose that in the interior of the earth radium does not decompose than to take the opposite view, yet clearly here, at any rate, there is plenty of room for legitimate differences of opinion. On the other hand even the opponents of Mr. Strutt's view can not deny the potentialities of radioactivity, and the part it might play in cosmical processes under favorable conditions.

The theory that radium is a compound, waiving the qualification chemical, will no doubt serve sufficiently well for the present as a point of common agreement. As Sir Oliver Lodge remarked, there is no necessity that the question be settled offhand. As a stepping stone to further conclusions, it offers advantages to the conservative and cautious. It expresses a bare minimum of established fact which even the most sceptical are unable to invalidate. This minimum, briefly stated, is that radium is undergoing a continuous change intimately connected with its radioactivity, and that in this change helium is produced, and an enormous but definite amount of energy liberated. Whether anything more is known about transmutation now than formerly, whether lead could change into gold or gold into silver with an emission of energy similar to that evolved from radium, whether this or similar energy plays the large share that has been attributed to it in cosmical processes, are questions which may be legitimately discussed and left open, if only for the reason that they are far from decided. They are all admittedly steps into the region of hypothesis.

But what a miserable fraction, even of the known facts, this minimum is! Ostensibly an explanation of radioactivity, it begins and ends with the fact of a gradual evolution of helium from radium. The numerous other products of radium, the volatile emanation and its non-volatile products, known by their characteristic radioactivity, much as minute quantities of ordinary gases and solids are known by their characteristic spectra, the slower-changing later products, of which polonium is one, and is chemically as reminiscent of tellurium as its parent is of barium, remain still to be systematically accounted for. On the important subject of the nature of the α, β and γ rays, and their origin, the view is silent! The fact is ignored that radioactivity is, to use Mme. Curie's happy expression, an atomic property, that is, is independent of the particular state of chemical combination of the radio-element. Radium resembles in the closest possible manner barium, a completely inactive element in the same family, of the periodic table, both in chemical nature and in the series relationships of its spectrum. Barium is an element, radium is a compound; but whether uranium and thorium are elements or compounds is undecided. Again, the emission of energy, greater a million-fold than that evolved in any previous material change, remains a mystery in company with the discrepancy between the physical and geological estimates of the age of the earth. The constancy of ratio between the quantities of radium and uranium in all natural minerals is another experimental fact unexplained.

It is the glory of the accepted view that it harmonizes and correlates all the preceding problems, offering a simple and unstrained physical explanation of each, capable of being tested by quantitative experiment. In addition, it reaches out in every direction in broad, bold predictions, a few of which, like the production of helium from radium and the constancy of ratio between uranium and radium in minerals, have been brilliantly confirmed by experiment, while the majority simply await more refined experimental methods of attack. Of what other theory could the remark be made, which is attributed to Professor Rutherford, that when a single experimental fact is established which does not conform to the disintegration theory it will be time to abandon it? The theory would have to be fundamental indeed to pass this test.

The secret of the vague hostility to the new doctrines which the recent controversy has shown to be widely felt is to be found probably in the impossibility of forming from words or reading the least idea of the really startling character of some of the new discoveries. This is particularly true of perhaps the most wonderful of them all, the radium emanation. Even Lord Kelvin in one of his letters speaks vaguely of emanations, while Sir William Crooks, at least until quite recently, employed the word, also in the plural, as a generic term for the radiations. Give a scientific man a few milligrams of radium in solution and ask him to perform for himself some of the stock experiments with the emanation, for example, its condensation by liquid air, the concentration on the negative electrode of the active deposit formed by it, the steady decay of its powers after removal from the radium and the growth of new emanation by the radium, kept, let us say, in another building or another country; then the radium emanation passes from being a phrase to a fact which no theory can safely ignore. The same is equally true of thorium X, radium C and the numerous other successive products of radioactive change.

It would be a pity if the public were misled into supposing that those who have not worked with radioactive bodies are as entitled to as weighty an opinion as those who have. The latter are talking of facts they know, the former frequently of terms they have read of. If, as a result of the recent controversy, it has been made clear that atomic disintegration is based on experimental evidence, which even its most hostile opponents are unable to shake or explain in any other way, the best ends of science will have been served. The sooner this is understood the better, for in radioactivity we have but a foretaste of a fountain of new knowledge, destined to overflow the boundaries of science and to impregnate with teeming thought many a high and arid plateau of philosophy.

Digitized by Google

THE USE OF THE TELEPHONE IN THE PERMANENT SEACOAST DEFENSES OF THE UNITED STATES.

BY M. C. SULLIVAN.

As the telephone has revolutionized methods of communication in social and commercial life over a goodly portion of the civilized world, it is not at all surprising to find it rapidly revolutionizing the methods of communication in the seacoast defense service.

The change that has been brought about in the permanent seacoast defenses of the United States by the use of the telephone and other electrical devices in the last fifteen years is marvelous. No similar period in the history of these defenses provides a record of such progress. Not only is this period far beyond previous times in the vast engineering improvements effected, but it is an era which is doing more for the final banishment of war from the civilized portion of the earth than anything that was done in all the years during which organized armies have figured as essential elements of national development.

As the result of electrical methods of communication the old romantic pictures of smoke beacons by day and bonfires by night have passed out of use for signaling purposes, as the old smooth bore gun and the wooden frigates have as destructive engines of war.

It is no exaggeration to state that never before in the history of the world has rapid means of transmitting intelligence assumed the importance in relation to national defense as it has to-day. Because of the increased speed and greatly condensed destructiveness of modern ships of war, it is more than likely that the smallest delay in the transmission of orders or information may determine the result of an engagement or indeed decide the fate of a nation.

As minutes are nothing in seacoast defense operation, the unit of time being the second, it goes without saying that every division of the fort must at all times be within constant and reliable communication with the fort commander, in order that in preparing for action and during action he may be in such close touch and control as to direct every detail and issue and notify commands throughout his entire zone of operations as the exigencies of action may dictate.

The telephone in skilled hands makes it comparatively easy to accomplish this for the far-trailing stations stretched along the edge of the sea guarding against surprise and linked to each other and the forts form an unbroken line of communication. Thus the isolation of the coast has been dissipated by the telephone as wireless telegraphy has done it on the ocean, so, that the men at the guns instead of being compelled to spend hour after hour on duty guarding against surprise in the uncertainty that the next minute may be the critical one which tends to diminish their fighting efficiency are enabled to husband all of their power for the crucial test.

THE USE OF THE TELEPHONE IN PERMANENT SEACOAST DEFENSE.

The one great advantage which the new guns mounted on disappearing carriages in modern implacements have over those on ships is the accuracy of which they can be fired either by night or day. It is estimated that without an adequate range-finding system these guns would be deprived of two-thirds of their value by day and of all or nearly all their value at night.

The poor showing made by the Russian coast artillery guns at Port Arthur against the Japanese fleet is explained by quoting from Marteshev, the Russian general of artillery, that when the ranges were 10,000 or 12,000 metres his artillery did not shoot at all, or at best fired without results. With our system of range-finding it would be impossible for hostile vessels to remain at 10,000 or 12,000 metres from our batteries of twelve-inch guns or mortars for two or three hours and not be destroyed.

The system of range-finding and fire-control used in our coast defenses is of interest to the electrician, inasmuch as its successful operation is entirely dependent on electrical methods of communication.

The general plan or layout of the "horizontal base range-finding system," which enables the guns to be fired with such effective results at extremely long ranges, requires two points of observation located at considerable distance apart, the distance between the two points forming an imaginary base line at each end of which observers with azimuth instruments, as illustrated herewith, make simultaneous observations on the same target. The length of the base line being known and the angles at which the target is observed read from the azimuths, the data for a triangle is secured and worked out as follows: At the primary station is located a large plotting board on which the waters it is intended to control are laid down to scale. On this board, at each point corresponding to the two range stations, movable arms are pivotly attached. The stations being connected by telephone enables the reading from the secondary station to be transmitted to the plotting board so rapidly that a miniature triangle is formed, and the apex of this

Digitized by Google

triangle is of course the exact position of the target.

In actual practice an operator stands beside the plotting board with his hands on the arms which correspond to the primary and secondary stations. At the instant the reading comes from the secondary station over the telephone he merely swings the "secondary" arm to the angle indicated. The angle of the primary instrument being read off, he performs a similar function with the "primary" arm. The intersection of the two arms gives the exact position of the target at a glance; this operation is repeated every twenty seconds for one minute. The

A Field Party Using Telephone in Conjunction with Plotting Board.

three readings serve to give the course of the target and its speed. At times more readings are taken, but such is the accuracy of the work that three readings usually suffice.

The target being located, the guns are directed by telephone from the plotting board, the degrees in azimuth and range only being given, unless it should be necessary to add other tactical information.

When the guns are laid in accordance with instructions given they are fired by the battery commander from his station near the plotting board.

As might be expected, there is little of the so-called glory of war in this kind of fighting. The romance and picturesqueness of standing at the guns exposed to the enemy's fire inviting the soldier to brave and valiant conduct has been superseded by the exact requirements of electricity and mechanism.

To the humanitarian who hopes for the final banishing of war from the earth there is something pleasing to contemplate in all this improvement, for the more scientific war becomes, the less interest it is liable to possess for the majority of mankind, for the war spirit of all time past has been rendered attractive to man generally because of the sense of adventure, the romance of glory to be won through individual achievements, and the pomp, circumstance and uncertainty heretofore inevitably incidental to its prosecution.

Wireless Telegraph Work in Reporting the Roosevelt Cup Races.

During the recent races for the Roosevelt cup, off Halfway Rock, Marblehead, Mass., the Stone system of wireless telegraphy was utilized by the Associated Press, the Publishers' Press and several Boston and New York newspapers, with distinguished success. Arrangements were made with the Stone Telegraph and Telephone Company to install wireless sets on the Eastern Yacht Club committee's tug Mercury and in the yacht clubhouse at Marblehead. Apparatus of a semi-portable description was furnished by the Stone company, and installed in these two places in approximately two days' time. The Mercury was equipped with two flagpoles approximately twenty-five feet high and thirty feet apart. A horizontal antenna, consisting of ten wires eight inches apart, was suspended between the two masts and brought down into the engine room, where the wireless apparatus was temporarily located. Power was furnished by a 1.5-horse-power Holtzer-Cabot alternating-current generator giving sixty cycles and 110 volts. The voltage of this generator was cut down by resistance in the field until it delivered approximately 200 watts direct to the primary coil of the high-potential transformer. At the Eastern Yacht Club house a fifty-foot mast was erected and placed seventy-five feet from the automobile garage, in which the temporary apparatus was located. Two widths of chicken netting, six feet wide and seventy-five feet long, were brought from the top of this mast to the roof of the garage, which was approximately twenty-five feet above the ground. Ground connection was provided by spreading two widths of chicken netting on the ground under the elevated area, thus giving an electrostatic connection with the earth. The power used in the yacht club station was supplied by the Marblehead Electric Lighting Company, being the ordinary 110-volt, sixty-cycle alternating current employed for town service. The Western Union and Postal Telegraph lines were run into the Eastern Yacht Club house to handle the press work and were in close proximity to the wireless telegraph set. During the time that the races were under way the Boston navy yard station, which was approximately fifteen miles distant, was doing considerable business with the Portsmouth navy yard station and the Cape Cod station, and also with warships which were at times within five miles of the race course. The average distance of the committee's tug from the yacht clubhouse was twelve miles. The navy department at its stations had a wave-length of 450 metres. The tug, yacht club and the experimental Stone station at Cambridge, twenty miles distant, were set on a wave-length of 300 metres. Under these circumstances it was found that at no time was there any interference with either the navy department or with the yacht club and the tug, owing to the high degree of selectivity of the Stone system.

The features of this service were the high speed which was maintained and the use of a device developed by Sewall Cabot, superintendent of the Stone Company, whereby the receiving operator may instantaneously interrupt the sending operator in case of a failure to get a word or a figure correctly. The method employed is for the receiving operator to repeat the

Digitized by Google

letters B K, followed by the first letter of the last word correctly understood. The sending operator hears part of the letters B K at some time when his key is up between the dots and dashes transmitted, and this is a signal for him to stop transmitting and to listen to what the receiving man wishes to say to him. It is in exact analogy in the working out from a traffic standpoint with the manner in which traffic is handled for a duplexed wire circuit at the present day.

The service was speeded up so that it was possible for traffic to be put through at a rate such that at no time was a reporter's copy held up over ten minutes, due to matter which had been previously filed and not sent. The reporters who were writing running stories of the race as it took place filed their copy in amounts averaging about eighty words, and in this way it was possible to deliver running stories of the race at the newspaper offices in Boston and New York at times which averaged about twenty minutes from the time at which the event reported actually occurred. In the case of turning times, which it was very important for the papers to get quickly for the purpose of bulletins, these were given "flash" preference and were delivered to the newspapers approximately three minutes after the noted times of turning.

At no time during the race was the wireless service out of commission, even for a period as long as one minute. The largest number of words sent at one time was 4,120, on September 8. The total average words sent per minute was 22.9, and the average actual number of words, as shown by numerous five-minute tests, was twenty-four. The maximum average number of words per minute was thirty-three.

Illuminating Engineering Society.

A meeting of the Illuminating Engineering Society will be held in the Edison Auditorium, 44 West Twenty-seventh street, New York city, at 8 P. M. Friday evening, October 12. Two papers will be presented on the general subject of "Data of Indoor Illumination," one by J. E. Woodwell, inspector of electric lighting plants, United States Treasury; and the other by E. C. White, illuminating engineer, Winnipeg, Manitoba.

At this meeting the membership of New York city and vicinity will be organized as the New York section of the society.

The membership of the society now exceeds 600, and sections have recently been organized in Philadelphia and Pittsburg. The above-mentioned papers will be presented before these sections and before the Chicago and New England sections of the society, which were organized last spring.

The Telharmonium Demonstrated before the New York Electrical Society.

The two hundred and sixty-first meeting of the New York Electrical Society was held at No. 1414 Broadway, New York city, on the evening of Wednesday, September 26. The feature of the evening was the first public Cahill telharmonium concert. The beautiful reception room which the New York Electrical Music Company has provided was the scene of a very lively gathering of ladies and gentlemen, and during the subsequent demonstration of the remarkable powers of this instrument many expressions of appreciation and commendation were heard.

PARLOR WHERE TELHARMONIUM DEMONSTRATION IS CONDUCTED. THE RECEIVERS ARE LOCATED IN THE HANGING CLUSTER IN THE FOREGROUND AND IN THE FLOWERING CLIMBER IN THE BACKGROUND.

The new president, G. Herbert Condict, called the meeting to order, and in a few words introduced the subject of the evening and its exponent, Oscar T. Crosby. Mr. Crosby, said the president, when he last appeared before the society, had addressed the meeting as an explorer returned from a comparatively unknown land—far-away Thibet. At this time, however, Mr. Crosby would present another subject dealing with an exploration into a hitherto undiscovered realm. For the telharmonium system Mr. Condict predicted a remarkable development, and emphasized his belief that it would take its place as one of the notable electrical contrivances of the age.

Mr. Crosby's address abounded in wit, humor, technique and lucid explanation. Notwithstanding the crowded condition of the room, it being necessary for a great number of those present to stand during the entire evening, the graceful manner in which Mr. Crosby delivered his remarks took away the tedium of waiting for the musical demonstration to begin. Mr. Crosby explained, for the benefit of the non-technical who were present, the phenomena of the telephone circuit, showing how the voice tones acting upon the diaphragm of the transmitter set up varying currents in the circuit, causing the diaphragm at the receiver to vibrate in unison with the diaphragm at the transmitting end. Even those who were familiar with the telephone as a means for reproducing speech were amazed at the volume and intrinsic clearness with which the musical tones of every register were reproduced. It is the intention of the company to arrange its circuits for multiple distribution, so that restaurants, music halls and other public places, as well as private residences, may be served music of every character, all of which will emanate from a central music station, the analogy of which is aptly represented in the present distribution of electrical energy for incandescent lighting.

Following Mr. Crosby's introduction

Digitized by Google

and explanation, the following programme was rendered:

Flute
Cornet
Clarinet
Oboe
French Horn
MR. EDWIN PIERCE

Rossini, Oboe Solo from Overture of William Tell
Mendelssohn, Song Without Words. Op. 102, No. 3.
Schumann, Träumerei
Grieg, Humoresque, Op. 6, No. 3
MR. CARL SCHULZ

Haydn, Rondo
MR. HENRY W. GEIGER

McDowell, "Thy Beaming Eyes"
Burleigh, "Jean"
Jamison, "Lullaby"
MISS FLORENCE FISKE
Accompanied by MR. FRANKLIN HARRIS

Illustrations:
Dixie, with fife and drums
Scotch Air, with bagpipes
MR. HAROLD SMITH

Thomé, "Under the Leaves"
Beethoven, Trio, Op. 55
MR. EDWIN PIERCE

Godard, Berceuse
MESSRS. SMITH AND GEIGER

Old Songs:
Ave Maria, Bach-Gounod
MESSRS. PIERCE AND SCHULZ

Goltermann, Andante from 'Cello Concerto
MESSRS. SCHULZ AND HARRIS

At the conclusion of the musical entertainment Professor A. F. Gans addressed the meeting, and on behalf of the New York Electrical Society extended a vote of thanks to Dr. Thaddeus Cahill, the inventor, his brothers, who as co-workers developed this ingenious electrical musical instrument, and to Mr. Crosby, for the excellent entertainment which had been accorded to the members.

Municipal Ownership.

One of the most interesting and instructive papers delivered at the recent Thousand Islands convention of the Association of Edison Illuminating Companies was presented by Arthur Williams, and entitled "Municipal Ownership."

Mr. Williams points out very intelligently the conditions and possibilities which have led up to the present agitation for municipally operated public utilities and the danger that exists unless the proper educational methods are adopted to force back this popular demand. The fact is particularly noted that there has been inadequate presentation of the corporation's side of the argument in seeking to enlighten and win public opinion. The great public has been likened to a jury, which can give a verdict only on the evidence before it. Thus a poor case, fully presented, may prevail over a good one where the presentation is insufficient. One rarely finds "the side of a corporation fully and fairly presented, its cause pleaded or its position explained, the hidden conditions brought to light, the overlooked or forgotten elements of cost revealed, the experience of other communities compared. Were these things done, how different might be the direction of public opinion."

"Public action," says Mr. Williams, "by private corporations should be carefully considered and well directed. It should be united, since the cause of one is the cause of all, and the conditions controlling one surround all. While united and cooperative, it should be individual, personal, direct and local.

"Educational publicity without, and the attainment of higher ideals within, are conceded as the effective ways of meeting this movement. No others are needed, no others should be wanted. Quick, perhaps, to see the defects in others, we should apply a magnifying glass with searchlight rays to our own methods and relations with the public.

"A first essential is that courteous, considerate treatment which the public so thoroughly appreciates and enjoys. Compare what we can do with the brusque indifference of the employés in almost every department and office of a municipality. Our own methods, instead of resembling them, should stand out in marked contrast. The beginning should be with the directors and president and it should extend through the entire organization to the office boy and janitor.

"The quality of the service should be as nearly perfect as modern invention, construction and operation can make it. Bad, indifferent, or poor service should be corrected at any cost. More should be given, not less, than the public has been led to expect. What we are to the public makes good opinion or bad, friends or opponents.

"Good service means not alone the kind of light we supply—it includes everything relating to the affairs of the company. The manner with which poles are erected and wires are strung; with which streets are opened and the pavement again laid; the promptness with which customers' wants are met; with which service interrupted is restored; the convenience and promptness with which the public may become users of electric current.

"The complaint bureau of a public service corporation can not be too highly rated. Every complaint made gives an opportunity to make a new and lasting friend—the kind it pays to have—one who has been cured of a grievance. It is not that a rebate has been made or an employé discharged, but the manner in which the complaint is received and the evidence of careful consideration that counts with the public.

"Another very important consideration is the treatment which private corporations accord to their employés. There is probably little question but that a large percentage of those whose votes must be relied upon in any municipal ownership or socialistic movement are the employés of public service corporations. In 1903 there were more than one million three hundred thousand employés in the service of American steam railways alone; the number is undoubtedly greater to-day. Thus in this single service alone are more than ten per cent of the voters of the country.

"With all other considerations the prices of our companies must be included. Not only should they be as low as circumstances justify, but as simple and as readily understood. Differential are not preferential rates. But this it is sometimes difficult to make the public understand.

"One method of charge for public service—gas and electric—now receiving a great deal of attention might be mentioned—the English sliding scale, recently adopted by the gas companies of Boston. The method seems to contain elements in satisfying the public which no other rate system thus far devised appears to have accomplished. After assuring to the company a fair return upon its investment, and the public a maximum price beyond which it shall not be charged, the further profits are divided in ratios agreed upon, between the public and the company.

"England's municipal indebtedness, according to the last available figures, now amounts to £2,345,000,000 and there is evidence of a strong counter-movement looking to the material curtailment of the functions of the municipalities.

"Lord Avebury in a recent address pointed out that the capital expenditure in the electric lighting undertakings alone now amounts to £27,000,000 upon which last year a 'profit' was claimed of £339,000; that only one per cent was allowed for depreciation, which he called absurd. If as little as two and one-half per cent had been set aside for depreciation, he says, this item alone would have amounted to £673,000 and 'would have turned the so-called profit into a heavy loss.' He also pointed out that of forty-eight municipalities working tramways only thirteen contribute to the rates; seventeen make no depreciation allowance and only eleven make over two per cent."

Trial of New York Central Electric Train.

On Sunday, September 30, a trial was given two of the electric locomotives built for the New York Central & Hudson River Railroad, drawing a train of seven cars through the Park avenue tunnel. Under electric operation it is said that the train moved very smoothly, without jerks or starts, and quickly attained full speed, making the run from Highbridge to the Grand Central terminal without any trouble. The trial was attended by representatives of the New York Central and the General Electric Company, and also by representatives from other railroads.

Digitized by Google

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW, F.I.C., ANALYTICAL CHEMIST AND ELECTROCHEMIST.

IV.—Practical Applications of the Test Results.

Engineers who have never made use of the results obtained by laboratory tests of fuel, either in relation to their supplies of fuel or in the working of their boilers, are disposed to be somewhat scornful as to the value of fuel testing to the practical engineer. In their view, the results obtained from steam-raising trials are alone worth depending upon. That this view is superficial and incorrect is proved by the fact that engineers who have adopted fuel testing as an aid in the work of boiler management rarely relinquish it, and as their knowledge of its usefulness extends, they place more and more reliance upon the laboratory test results and less upon the steam-raising trials, in forming their comparative judgments of different fuels. When one remembers that the essential conditions obtaining during steam-raising tests are never exactly the same; that all fuels are treated alike although different fuels demand different methods of firing and different treatment as regards draught, to obtain their maximum evaporative effect; and that the fireman or engineer who is in charge of the boilers may very probably be receiving a bonus or present from one of the fuel-supplying firms, this loss of confidence is not surprising. The value of comparative steam-raising tests as a guide in the placing of fuel contracts, or in the control of the fuel supplies, is in fact greatly overrated, and the larger number of these tests as they are at present carried out are not worth the time and expense entailed in obtaining them.

In the following pages the author will deal with three practical and scientific applications of the test results as obtained in the laboratory examination of fuels, and will show how these can be utilized in:

1. Placing fuel contracts.
2. Controlling the fuel supplies.
3. Checking the evaporative efficiency of the boilers.

1. Placing Fuel Contracts—Contracts for the delivery of large quantities of fuel involving the expenditure of many hundreds of pounds ought always to be based on the laboratory test results, for the reasons already given. The sampling and testing of each sample load of fuel should be conducted as described in articles ii and iii, both approximate and calorific tests being carried out.

If possible a bomb calorimeter should be employed for the latter tests, since in this case the results obtained are reliable for all classes of fuel. Steam-raising tests can, of course, be made at the same time; but the author has given reasons for doubting the value of these unless much more scientifically carried out than is usual at present. The laboratory test results of the various sample loads of fuel are then grouped as shown in Table i. If the contract is to be based solely on cheapness, the decision is easily made by comparison of the figures given in column 10. These figures are obtained by dividing the calorific value multiplied by 2,240, by the price per ton in pence of the fuel delivered in the bunkers. As a rule, however, the percentages of ash and of volatile matter will have some influence upon the choice of fuel. Having eliminated from the list those which are unsuitable owing to high ash contents or to too high a percentage of volatile mater, the selection from those remaining in the list of the fuel which yields the greatest number of calories per penny of cost is an easy matter. Provided that correct conditions of stoking and draught are employed in burning the fuel under the boilers, the fuel which gives the greatest number of calories per penny of cost will prove the most economical in actual use.

That wide variations exist in the value of different fuels when judged by this method is proved by the following figures, based on actual tests and prices:

South Wales steam coals.....
- No. 1, 68,544 calories per penny of cost.
- No. 2, 89,600 calories per penny of cost.
- No 3, 128,128 calories per penny of cost.

Lancashire bituminous coals
- No. 4, 119,168 calories per penny of cost.
- No. 5, 148,512 calories per penny of cost.
- No. 6, 193,088 calories per penny of cost.

The calorie used in this table is the pound centigrade unit; and the above figures must be multiplied by 1.8 to obtain the corresponding value in British thermal units. If burnt under "proper conditions" to obtain the maximum efficiency, it is therefore evident that the coal marked No. 6 in the above list would prove the most economical in actual use, for it yields double the heat units of No. 1 or 2, per penny of actual cost. If burnt in furnaces designed for South Wales steam coal, with a small combustion area, it is, however, possible that this No. 6 coal would not show this superiority; and

TABLE I—APPROXIMATE ANALYSES, CALORIFIC VALUES (CALCULATED AND OBSERVED), PRICES AND COMPARATIVE COSTS OF VARIOUS ENGLISH AND WELSH COALS.

	1.	2.	3.	4.	5.	6.	7.	8.	9.		10.
General Description of Coal.	Particular Description of Coal.	Per Cent Moisture.	Per Cent Ash.	Per Cent Coke.	Per Cent Volatile Matter.	Per Cent Fixed Carbon.	Calorific Value (Observed).	Calorific Value (Calculated).	Price per Ton Delivered in Bunkers. s.	d.	Calorific Value per Penny of Cost.
Hard South Wales coals	Standard Merthyr	1.21	8.85	84.50	15.50	75.65	7,942	7,950	21	0	70,784
	Cwmmer Main	1.46	10.00	87.50	12.50	77.50	7,935	7,855	17	3	85,792
	Dynevor Duffryn	1.25	8.10	84.10	15.90	76.00	7,987	8,028	19	1	77,952
	Pontardawe smokeless	2.66	8.40	97.90	12.10	79.50	7,875	7,995	17	3	85,120
	Ocean steam coal	3.13	13.95	87.00	13.00	73.05	7,590	7,511	15	10	89,376
	Loughor & Mynydd Newydd	2.20	17.03	86.00	14.00	68.95	7,360	7,545	9	6	144,480
	Werfa	1.34	14.95	90.00	10.00	75.05	7,331	7,405	11	11	128,128
Soft bituminous coals	North Hetton	2.51	13.80	69.00	31.00	55.20	7,590	7,347	11	10½	119,168
	Bowley washed slack	2.76	5.85	67.40	32.60	61.55	8,365	8,123	10	6	148,512
	Wigan	4.94	16.85	69.90	30.10	53.05	7,192	7,089	8	3	162,624
	Wigan & Skelmersdale	6.76	16.50	71.20	28.80	54.70	7,245	7,203	8	4	162,176
	Digby bright peas	10.44	6.50	63.50	36.50	57.00	7,935	7,703	7	9	191,072
	Shipley peas	7.72	7.75	66.00	34.00	58.25	7,891	7,764	7	11	185,920
	Marchay rough slack	7.80	3.05	64.70	35.30	61.65	8,314	8,214	8	8	178,976
	Manners peas	7.44	10.75	66.40	33.60	55.65	7,675	7,490	7	5	193,088

NOTE—(1) The results in columns 3, 4, 5, 6 and 7 are all based on the sample dried at 110 degrees centigrade.
(2) Columns 7, 8 and 10 give the calorific value in centigrade units.
(3) The first five samples are from a South Coast electricity supply station, and the costs delivered in bunkers are correspondingly high.

[1]All rights of reproduction and translation are reserved. Copyright, 1906, by John B. C. Kershaw.

Digitized by Google

the author must once again emphasize the necessity for adapting the furnace design, dimensions and methods of firing to the type of coal which is to be burned in it, if good results are to be obtained. The discrepancies which occur between the laboratory test results and those obtained in actual practice are due to the neglect to observe this essential condition for obtaining good results under the boilers. The subject of furnace design and control of the combustion process, however, is somewhat outside the scope of this series of articles, and readers must refer to the book named below for an adequate discussion of it.[1]

Having selected a fuel from the small or large number of which sample wagons have been submitted for trial, it is advisable that the contract should be based upon the results of the laboratory tests, and that some kind of a sliding-scale relation between calorific value and price should be arranged. The exact details of this will vary in the individual cases; but the specification reproduced below is an example from actual practice of a fuel contract based on laboratory tests, with such a sliding-scale arrangement between calorific value and contract price of the fuel. The fuel in this case was a South Wales steam coal, delivered at 9*s.* 7*d.* per ton.

SUPPLY OF LARGE WELSH SMOKELESS STEAM COAL.

SPECIFICATION AND CONDITIONS.

1. Quality—To be large Welsh smokeless steam coal, free from dust, to contain not more than fifteen per cent of small, and to have a minimum calorific value of 13,300 (thirteen thousand, three hundred) British thermal units per pound of coal, as measured by a calorimeter approved by the borough electrical engineer.
2. Tests—During the continuance of the contract, tests will be made once every week from samples delivered during that week, and if the mean of four tests during any month show that the calorific value is below the standard, the rate per ton paid to the contractor for the whole of the coal delivered during that month shall be less than the contract price as set forth in the "price schedule" attached hereto.
3. Right to Reject Inferior Coal—Notwithstanding condition No. 2, the council reserves to itself the right to reject any portion of the coal delivered, the tests of which show that the calorific value is less than 13,300 British thermal units per pound of coal.
4. Engineer's Decision to Be Final—Should any dispute arise as to the accuracy of tests, weights, quantity of dust or small, quality, or other matters whatsoever, the decision of the borough electrical engineer shall be final and binding.

PRICE SCHEDULE.

Scale of reduction in price for lower calorific value than 13,300 British thermal units.

Per Pound.	At Pit's Mouth.	Delivered.
For a minimum of 13,300 B. T. U., the contract price....	..	9*s.* 7*d.*
Below 13,300 but not less than 13,200, a reduction of 5*d.* per ton.....	..	9*s.* 2*d.*
Below 13,200 but not less than 13,100. a reduction of 10*d.* per ton.....	..	8*s.* 9*d.*
Below 13,100 but not less than 13,000, a reduction of 1/3*d.* per ton.....	..	8*s.* 4*d.*

Clause 4 of this contract is obviously unfair to the colliery company since an independent chemist or fuel expert ought to be appointed as referee in case of disputes. But otherwise the specification has much to recommend it.

Another method of working out the price variation for differences in calorific value has been recently adopted by the city of Chicago in the purchase of 200,000 tons of coal. The standard price in this case was $2.30 per ton of 2,000 pounds for a coal testing 13,000 British thermal units in the undried state. Allowing for the moisture and cost of removing the ash, this worked out to 100,000 British thermal units for one cent. If the British thermal unit per cent came out above or below this limit, the price of the coal varied accordingly; the principle underlying the contract being that in all cases one cent should purchase 100,000 British thermal units of heating value in the fuel. Thus at times the seller, and at times the buyer, was favored by the price variation, and the price asked and paid for the fuel was an absolutely fair one.

The author believes that in time this last-described method of buying fuel will apply to all large fuel contracts. The present method is grossly unscientific and unfair alike to the buyer and seller, and the sooner it is replaced by another the better it will be for all concerned.

In drawing up fuel contracts it would also be well to stipulate that the moisture and sulphur contents shall be kept well within the percentage shown by the test of the sample wagon. Owing to various causes, the percentage of moisture and sulphur in coal and slack may at times rise to a very high figure; and apart from the foolishness of paying from 7*s.* to 10*s.* per ton for this water and sulphur, there is the question of the heat which will be carried off to the chimney when the water is converted into steam in the furnace of the boiler. As regards ash contents, it would also be well to reserve the right to reject deliveries of fuel showing a percentage much above that embodied in the contract. But the increase in ash will always be accompanied by a corresponding diminution in thermal value, and the variation in ash contents is therefore covered by the sliding-scale arrangement based on the result of the calorific tests.

Though the freedom to reject coal below the stipulated thermal value may be reserved to the buyer as in Clause 3 of the contract printed above, in most cases it is least troublesome to accept delivery, and to claim the deduction in price under the sliding-scale arrangement. Otherwise much trouble and expense may be entailed in connection with reloading and railway charges.

2. Controlling the Fuel Supplies—The laboratory testing of fuel can be employed most usefully to check the quality of the supplies of fuel from day to day and from week to week. When the contract has been based upon calorific value, this testing is, of course, essential. If the contract has not been based upon the results of the laboratory test of the sample wagon, no automatic reduction in price can follow should this laboratory examination of the daily and weekly samples yield bad results. But the fact that the deliveries of fuel are being regularly sampled and tested will be known to the colliery company supplying the fuel, and will cause it to be more careful in the selection and sorting of the fuel sent. Complaints also based on the results of laboratory tests will receive more attention than those based merely on firemen's complaints or upon a manager's inspection of the fuel. As already stated, there is good reason to suppose that the firemen and sometimes the engineer in charge have a financial interest in keeping the fuel contract to one particular firm. Therefore, neither their silence nor their complaints can be accepted with any degree of security. Most engineers in charge of boiler plants, when attempting to make changes in their fuel, have experienced the apparent stupidity or obstinacy of their firemen, and have had reason to suspect their impartiality as regards the fuels with which they are conducting trials. Even in the absence of contracts based on calorific value, it is therefore well to have this independent check upon the character of the fuel supply; for a fireman receiving doles or presents from the colliery company is not likely to become very active in complaining of this fuel when the deliveries fall off in quality. As a check therefore upon the supplies, the author advises daily sampling of the fuel either in the wagons and trucks, or during discharge into the storage bins. When sampling fuel in trucks or wagons it is necessary to make allowance for the fact

[1] "Smoke Prevention and Fuel Economy," by Booth and Kershaw.

Digitized by Google

that the jolting of railway or road transit causes all the fine coal and dust to fall to the bottom of the mass. To obtain a fair sample of coal from a railway truck is therefore a matter of some difficulty, and in most cases it will be easiest to sample the fuel during discharge. Coal conveyed in canal barges, or by river to the works, does not undergo a similar mechanical separation into large and smalls, and in such cases the load of fuel can be sampled if necessary in the barge.

In all cases, however, the fairest sample can be obtained during discharge, and where conveyers and automatic weighing plants are in use, it is a comparatively simple matter to arrange that every fifth, tenth or twentieth bucket shall be tipped into a sample storage bin. If fuel from more than one colliery is being delivered and used at one time in the works, it will, of course, be necessary to have an equal number of sample storage bins.

At the end of each day, the fuel in these bins is crushed and sampled in accordance with the instructions given at the end of Article I, and the one-pound samples are sent to the laboratory or to the fuel expert for examination and test. It will not, as a rule, be necessary to carry through a complete approximate analysis and calorific test as described in Articles II and III, with each of these daily samples; the determination of the moisture and ash in each being sufficient to enable one to check roughly the quality of the coal being supplied under the contract. The daily samples are, however, retained each in their own sample tin, and once a week or oftener an average sample is made up from these by weighing out 50 or 100 grammes of each and by thoroughly mixing the same on the sampling plate or on a sheet of glazed paper. A complete approximate analysis and calorific valuation is then carried out with this sample. Upon the results of these weekly tests complaints to the colliery company as to the quality of the supplies, and the variations in price of the fuel delivered under the contract are based.

A book should be kept for entering up both the daily and weekly fuel tests. The results obtained during the delivery of coal under any one contract will prove of great value in fixing the terms for the next contract. Special samples of single wagons or trucks of fuels that appear to be of bad quality should be taken occasionally, for at times the colliery company may become slack in its supervision of the sorting and cleaning of the coal brought up from the pit and as already pointed out, much dirt and shale can be sometimes sold as fuel. The author has tested fuels containing only six per cent of ash from the same pit that produced slack testing up to twenty-five per cent of ash; and some years ago he was asked to report upon a sample of so-called coal which contained no less than 37.70 per cent of ash.

These figures prove the fallacy of the opinion held by many engineers, that coal from one pit or from one seam is of fixed and unvarying composition when delivered into the trucks; and that it is alone necessary in drawing up fuel contracts to specify the pit or seam from which the supplies are to be drawn.

Fuel, in fact, appears at present to be the only raw material used in large quantities, the sale and delivery of which is still in the majority of instances conducted by rule-of-thumb methods. It is satisfactory to note, however, that in this matter also the methods of the past are being replaced gradually by the more scientific and exact methods of procedure outlined in this article.

3. Checking the Evaporative Efficiency of the Boilers—With the aid of the figures obtained by the calorific test of the average weekly sample of fuel, as described in Section II of this article, it is possible to make out a balance sheet for the working of the boiler plant, and to calculate the evaporative efficiency of the same, with a high degree of exactitude.

By evaporative efficiency is signified the percentage ratio between the total heat value of the fuel, and that utilized in the conversion of water into steam.

The other tests required for ascertaining this efficiency by calculation are those showing the composition and temperature of the exit-gases. The methods of obtaining these will be dealt with in Articles IX to XII of this series; and in this section the method of applying the results will alone be dealt with.

There are four directions in which the heat produced by combustion of fuel in the furnace of a boiler is dissipated.

In the first place, a certain definite and fixed loss occurs by radiation from the exposed surface of the boiler and of the surrounding brickwork. This loss can be roughly ascertained by drawing the boiler fires, closing the steam valve and feed-water valve, entirely cutting off the draught, and by noting the time required for a fall of ten or twenty pounds in the pressure of the steam. As a rule, radiation losses account for from 7.5 per cent to ten per cent of the heat present in the fuel. The figure, when once ascertained for any one boiler, may be used as a constant in all the future heat balance calculations. The second direction in which heat is dissipated or lost in boiler working is with the waste gases passing away from the boiler flues to the chimney. The method of ascertaining and calculating this loss will be described in Article XII of this series. This loss may amount to from ten per cent to thirty per cent of the heat value of the fuel burned.

The third direction of heat loss is by the ashes and cinders. The loss here is twofold, being partly due to the heat carried by the ashes, and partly that due to the unburned carbon in the cinders. Once a week the ashes may be sampled, and the unburned carbon determined by the method used for estimating the amount of ash in the fuel. (See Article II.)

The total heat loss in the ashes and cinders should not exceed five per cent; but it may rise much higher with chain-grate stokers when badly worked, or with untrained firemen and hand-fired boilers.

The fourth direction in which heat is dissipated is through the boiler plates. It is this portion of the heat alone which is the active agent in water evaporation, and gives the evaporative efficiency of the boiler. It is ascertained by adding the three items of loss named above together, and by subtracting the total from the thermal value of the fuel, as determined by the laboratory examination of the same.

The following is an example of this method of calculating the working efficiency of boiler installations:

Fuel—Lancashire slack at 7*s.* 6*d.* per ton delivered in bunkers. Heat units produced per pound by calorimeter test 13,500 British thermal units.

1.	Losses by radiation, etc., ten per cent	1,350
2.	Losses with exit-gases up the chimney (calculated ten per cent CO and gases at 465 degrees Fahrenheit)	2,380
3.	Losses by unburned carbon in cinders and ashes, and heat carried away in same (five per cent)	675
4.	Converted into steam in boilers (by difference)	9,095
		13,500

The efficiency of the plant, therefore, equals 9,095/13,500, or sixty-seven per cent. Items 1 and 3 are based on estimates or upon previous test results; but these two items, under ordinary working conditions, should not vary more than five per cent.

Should the analysis of the exit-gases show that carbonic oxide gas is present, a further entry will be necessary in the

Digitized by Google

above heat balance, to show the thermal units lost by this failure to burn all the carbon to carbon dioxide. Let us take, as an example of this additional calculation, exit-gases containing two per cent, by volume of CO, and eight per cent CO_2. Since carbon, when burned to carbon dioxide, yields the same volume of gas as when burned only to carbon monoxide, the above percentages show that two-tenths or one-fifth of the carbon present in the fuel has escaped complete combustion. Now, as found by the approximate analysis, the percentage of fixed carbon present in the fuel was sixty per cent, and the thermal units liberated when carbon is burned to CO are 10,201 less than when carbon is burned to CO_2 (4,343 and 14,544, respectively).

The loss of heat due to incomplete combustion, in the case under consideration, is therefore:

$0.60 \times 1/5 \times 10{,}201 = 1{,}224$ British thermal units, and the efficiency of the boilers is reduced to fifty-eight per cent in consequence of this incomplete combustion of a portion of the fuel.

This additional loss is a considerable amount, nine per cent, of the total heat energy of the fuel, and the calculation shows the necessity for keeping a close check upon the presence of CO in the exit-gases.

Since the automatic recording instruments now in general use for checking the composition of the exit-gases from steam boiler plants do not record the presence of CO, it is evident that independent tests with an Orsat apparatus ought at times to be made, in order to check the presence or absence of CO. This gas is most likely to be present when attempts are being made to work with a minimum of air and thick fires, in order to attain a high percentage of CO_2 in the exit-gases. Thus, efforts to reduce the heat losses due to excess of air, unless under a chemist's control, may result in very considerable heat losses in another direction. The need for expert scientific control of the testing work is therefore apparent, and automatic testing apparatus, though useful, is not an efficient substitute for the trained chemist.

The subject of gas-testing will be dealt with at length in Articles IX to XII of this series; but it may be pointed out here that, as fuel and gas analysis enables one with ease and a fair degree of accuracy to determine the thermal efficiency of the whole boiler installation, it is deserving of more attention than has yet been accorded to it by engineers in charge of boiler plants. In fact, these test results enable one at a moderate expense to achieve daily or weekly what at present is only carried out at long intervals of time and with much disturbance to the usual routine, under conditions of working which can not be regarded as normal. The money now expended upon special steam-raising and efficiency trials, if expended in the way suggested upon regular testing work would lead, in the author's opinion, to far more valuable results, and to a far better average of efficiency, than is attained under the present system. No doubt, in time, the value of fuel and gas analysis in controlling the work of boiler installations will be fully recognized. This work must be carried out, however, under expert control, for the results obtained from it to be of real value.

Congestion in the Patent Office.

In a recent issue of the New York *Commercial*, Fred W. Barnaclo called attention to the serious situation confronting the patent office at Washington. On the first of this year the patent office had 17,353 applications waiting for action. The *Official Gazette* for September 25 shows that this number has now increased to 23,468. The number of applications received weekly varies from 800 to 1,200, and the average weekly excess over the number issued during the past nine months has been 170.

The difficulty lies in the fact that the force of examiners allowed the patent office is not large enough to handle the great number of applications now coming in; consequently, the office is getting further and further behind in its work. At the present time some departments are back from six months to a year—that is to say, this time must elapse after application is made before the applicant receives notice that his case is under attention.

The only remedy which can be suggested is that Congress grant the commissioner of patents authority to enlarge his force of examiners, so that it may handle the work as it comes in; and some arrangement should be made to enable the patent office to clear up the work now awaiting action. The additional expense of this, it is suggested, might be charged against the $7,000,000 surplus now credited to the patent office in the treasury.

The long delay now occurring in securing patents is a hardship not only to the patentee, but to others interested in his methods or device. Definite business arrangements can not be made satisfactorily on a mere application, and a delay of six months to a year in securing a patent generally means a similar delay in placing the device upon the market. Thus, not only does the inventor suffer, but also those who would profit from his ingenuity. The matter will probably be brought formally to the attention of Congress, and efforts made to secure relief.

The Railway Signal Association.

The annual meeting of the Railway Signal Association will be held at the New Willard Hotel, Washington, D. C., October 16, 17 and 18. Sessions will be held on Tuesday from 10 A. M. to 1 P. M., and from 2 P. M. to 5 P. M.; on Wednesday from 10 A. M. to 1 P. M., and from 2 P. M. to 5 P. M.; on Thursday from 9.30 A. M. until adjournment.

On Tuesday committee No. 8 will make a report on "Standard Specifications for All Electric Interlocking and Material for Construction Work," together with recommendations. There will be a special committee report on "Standard Specifications for Mechanical Interlocking and Material for Construction Work." Committee No. 4 will make a report on "Installation, Maintenance, Etc., of Storage Batteries," and a special committee will report on "How to Remedy Effects of Foreign Currents on Automatic Block Signals," together with recommendations. There will also be presented an amendment to the constitution.

On Wednesday committee No. 12 will report and make recommendations on "Specifications for Rubber-Covered Wire." Committee No. 11 will report on "Oil to Be Used in Signal Lamps," as well as "Design of Lamps." There will be a special committee report on "Interlocking and Block Signals," which will cover recommendations for the various positions and indications which can be derived from the signal operating in the upper quadrant, as recommended by the association at its last annual meeting. Committee No. 1 will recommend specifications for relays, and committee No. 6 will present a progress report on "What Shall Constitute Cost in Estimates for Installation and Record of Maintenance?" Committee No. 3 will make a report on "Circuits for Interlocked Signals," together with history and recommendations.

The following papers will also be presented: "Devices to Keep Railroad Switches from Becoming Clogged with Snow and Ice," by F. Shaw, and "The Optics of Signal Lenses," by William Churchill.

An extensive programme of entertainment has been provided, and a special feature of the meeting will be the reception by President Roosevelt of the entire association at the executive mansion at 2.30 P. M., October 18.

Digitized by Google

Meeting of the American Institute of Electrical Engineers.

The two hundred and ninth meeting of the American Institute of Electrical Engineers was held at the Edison Auditorium, 44 West Twenty-seventh street, New York city, on the evening of Friday, September 28. As this meeting opened the season of 1906-1907, Dr. Samuel Sheldon, the new president, delivered his inaugural address. Dr. Sheldon pointed out the work of the secretary's office and enumerated in considerable detail the manifold duties which the secretary has imposed upon him. Each of the various committees entrusted with the work of the Institute was mentioned and its duties commented upon. Dr. Sheldon made a plea for the maintenance of a high standard of requirement for transfer to the grade of member. The board of examiners receives the applications of all associates who desire transfer, and its work is very much increased because of the loose and indefinite manner of filling out the specification papers on the part of the applicant. The tendency is to refer to members of professional eminence or to those prominent in Institute work, rather than to members who are familiar with the applicant's career and who are competent to corroborate the statements made in his application.

The removal of the executive offices to the new Engineering Building will entail an increased expenditure for carrying on the Institute work. To provide for this the simplest means seems to be to increase the membership. The secretary's staff is able, with slight additional expense, to take care of twice as many members as are now enrolled. The committee on increase of membership will take active measures to bring to the attention of non-members the advantages to be obtained from membership in the organization.

The committees on telephony, local organizations, high-tension transmission and the library committee will all be continued, and the committee on bibliography will have in press probably by next December a chronologically arranged, annotated bibliography of the Wheeler gift. Dr. Sheldon pointed out the labor which is imposed upon the editing committee, and suggested that this responsibility should be delegated entirely to the editor, and the labor performed in the secretary's office.

Professor F. B. Crocker and C. O. Mailloux, on the committee of standardization, represented the Institute at a meeting held recently in England, at which ten nations were represented. An organization of an International Electrotechnical Commission was effected, in which the Institute, as representing the United States, will be entitled to one vote. This commission will probably meet during the coming year. The committee on standardization also has in hand the rearrangement and reclassification of a report which was presented in a preliminary form at the last convention of the Institute.

The committees on National Electric Code, law, papers and finance will be continued, and their work made of greater value, if possible, to the Institute.

As a result of the efforts of the building fund committee, $132,000 has been raised. Of this $94,000 has been paid, and $38,000 is in the form of time pledges. It is hoped and expected that when the new building is formally given over to the united engineering societies during the coming year that the full amount of $180,000 due from the Institute will have been raised. The architect quite recently stated that the building would be ready for occupancy on December 1, 1906.

The first paper of the evening was entitled "The Effect of Iron in Distorting Alternating-Current Wave-Form," by Frederick Bedell and Elbert T. Tuttle. In abstracting this paper, Professor Bedell recited some of the history of the introduction and use of alternating currents, and made frequent reference to blackboard diagrams in elucidating his argument. The essential points brought out in the paper are enumerated in the first two paragraphs, as follows:

"It is well known that in a circuit containing no iron an impressed sinusoidal electromotive force will cause a sinusoidal current to flow, the current lagging behind the impressed electromotive force by an amount depending upon the relative values of the resistance and inductance, which in this case is constant. Assuming inductance alone in the circuit, the sine current which flows lags ninety degrees behind the sine electromotive force, and represents no power, the power-factor (cos 90°) being zero.

"It is also well known that if the conductors of the circuit encircle iron the inductance will no longer be constant. The current resulting from an impressed sinusoidal electromotive force will no longer be sinusoidal, but will be distorted and consist of a first harmonic or fundamental sine current of the same frequency as the electromotive force and harmonics of three, five, seven, etc., times the fundamental frequency."

The purpose of the authors in this paper was to study more fully the relation between the harmonics introduced by iron into the current wave and the hysteresis loop of the iron to which these harmonics are due.

It can be shown that certain harmonics, defined by their amplitude and phase with reference to the fundamental, can be produced by iron; others can not, these latter being excluded as impossible by the determination of some physical limitation. Professor Bedell showed that by changing the phase angle of the harmonic the hysteresis loop would be changed, fattening up to a maximum, then collapsing to a straight line, and expanding again in the opposite direction to a negative maximum.

In attempting to discover a relation between the area of hysteresis loop and the angle of hysteretic advance, a geometrical presentation was given. A vector representation in three dimensions was made use of. The conclusion reached is that an alternating current is distorted when iron is present by the introduction of a third harmonic in advance of the fundamental by an angle, θ, which is greater than thirty degrees, and less than 180 degrees. Taking the fundamental as unity, this harmonic can not exceed a definite value of about 0.192 for $\theta = 30°$ and 0.333 for $\theta = 180°$. The angle, ψ, of hysteretic advance due to the third harmonic can not exceed thirty degrees. From the shape of the hysteresis loop obtained from the third harmonic only it is concluded that iron introduces higher harmonics in addition to the third.

In opening the discussion on this paper Dr. Charles P. Steinmetz said that at first glance the paper presented by Professor Bedell, while an excellent theoretical proposition, appeared to have but little practical value to the engineer. The fact remains, however, that pure science and applied engineering are coming closer and closer together, and he would attempt to show that the theoretical treatment presented in the paper of the evening was of great importance in electrical engineering. Dr. Steinmetz then proceeded to elucidate the characteristics of the effect of wave distortion in alternating-current circuits. He suggested that the change of character in the complex current wave form was due to the change of phase, but that where this wave reached a hump and then decreased it should not be considered that

Digitized by Google

this was the end of the study. Further research, taking into consideration harmonics higher than the triple harmonic, would show that this complex wave is capable of being altered—built up, as it were—so as to carry out the expected phenomena of an increasing current so long as there was an increasing magnetization. Dr. Steinmetz also showed the relations which the distortion would have to a three-phase transmission system, particularly where there might be three transformers grouped either in star or delta. As each of the currents in the circuit would be 120 degrees apart, the current resulting from the triple harmonic would be three times 120 degrees, or 360 degrees apart; and, under certain conditions, this might reach values of no mean order. In fact, dangerous potential surges and short-circuit currents of considerable volume might be present. This reasoning applied, as well, to three-phase generators.

Dr. William S. Franklin followed Dr. Steinmetz in discussing this paper. His remarks, however, were devoted chiefly to calling attention to the fact that engineers and physicists should be very careful to make use of a nomenclature which would bring to mind a picture so closely related to the subject under discussion that there could be no confusion in the mind of any one. In speaking of an harmonic motion what one had in mind was the motion of a swinging pendulum. This was a true sinusoidal motion, and when the expression, "sinusoidal," was used, the definition should be sharply drawn to mean a pure harmonic motion. Again, in making use of vector representations he could hardly favor the use of a third dimension. While he was highly impressed with the utility of vector representations, these should be used only to show the continuous progress of electrical characteristics in the electrical or magnetic circuit. At no time should the vector diagram be used to give a geometrical picture of results. The one great fault which seems to have become common among engineers and teachers is the utilization of ideas, which, while of considerable theoretical value, can not be considered practical. In making use of theoretical considerations it is his belief that but very little consideration should be given to formulæ which would not be applicable to the common measuring instruments in use. Again, he urged that engineers and physicists stop wasting time looking for a mathematical formula which could be applied to the hysteretic loop. He believes that there is no law of nature which will fit this case, and there is no use spending time trying to get something which approximates to it.

Professor Bedell, replying briefly, thanked Dr. Steinmetz for his very able discussion of the subject, and voiced his entire agreement with Dr. Franklin's ideas with regard to trying to apply rational formulæ to irrational conditions.

The second paper of the evening, entitled "The Current Transformer," by Kenneth L. Curtis, was abstracted by Dr. W. S. McAllister, who pointed out the principal points enunciated by the author. Mr. Curtis stated that a current transformer, although mentioned but briefly in electrical literature, is one of the most indispensable of meter auxiliaries. By means of it currents of any magnitude may be measured with accuracy when employing the smallest of instruments. It enables us to use ammeters and wattmeters in circuits of the highest voltages. By the use of current transformers of different ratios we can use meters of the same size and capacity in circuits of widely varying power and voltage, thereby facilitating the calibration and maintenance of the instruments. The paper shows that the factor which prevents a constant ratio of secondary to primary current for all loads is the exciting ampere-turns. The smaller these are in proportion to the total ampere-turns of the transformer, and the lower the power-factor of the exciting current, the more nearly will we approach a constant ratio. Assuming the secondary to have as low resistance and inductance as is practicable, to obtain the best results we must make the magnetic circuit so as to have as low values of reluctance, hysteresis and eddy currents as possible—that is to say, if the secondary has as low resistance and reactance as is practicable, the best current transformer will be the one containing the most iron of the best quality in the form of the thinnest laminations.

Following the reading of this paper, owing to the lateness of the hour, L. T. Robinson briefly described a new instrument which he has been experimenting with. He presented a number of curves and results of tests, which showed that over considerable ranges a difference of less than one-half of one per cent was possible, and over wider ranges the differences were always less than one per cent.

The secretary announced that at the meeting of the board of directors, held during the afternoon, 191 associates were received. There was one transfer to the grade of full membership—George Augustus Wells, Jr., New York city.

The meeting was then adjourned.

The Boston Rejuvenation of the Sons of Jove.

Rejuvenation No. 18 of the Sons of Jove was held at the Revere House, Boston, Mass., on September 20, under the auspices of T. H. Bibber, Jovian statesman. The following officers presided: Jupiter, J. H. Waterman; Pluto, Frank Booth; Neptune, W. L. Adams; Vulcan, Charles B. Burleigh; Mars, W. S. Sisson; Apollo, W. F. Hessel; Mercury, C. B. Roulet; Hercules, Oscar Hoppe; Imps, N. H. Henderson, Albert Mann and S. B. Condit.

The ceremonies were opened promptly at 7.30 P. M., and thirty-one candidates were initiated into the order. Immediately succeeding the initiation the doors to the banquet hall were thrown open and forty-one Jovians took part in the banquet and other entertainment. Music was furnished by Charles F. White, and C. B. Burleigh acted as toastmaster. Responses were made by a number of those present.

A committee of three, consisting of Messrs. Booth, Condit and Hessel, was appointed to form a Jovian lunch club, with the idea of having the brother Jovians meet daily at lunch, the place to be designated later.

It was voted that the success of the rejuvenation was due in a great measure to the earnest efforts of T. H. Bibber, and Mr. Bibber was tendered a standing toast.

Not a little of the success of this meeting was also due to the personal attention given by C. B. Roulet, of Dallas, Tex., and also by Frank Booth, who was warmly congratulated for his work.

Organization of the Home Telephone Company of Detroit.

The following officers and directors have been elected in organizing the Home Telephone Company, of Detroit, Mich.; president, Clarence M. Burton, Detroit; first vice-president, Max Koehler, St. Louis, Mo.; second vice-president, C. Marquard Forster, St. Louis, Mo.; secretary-treasurer, W. B. Woodbury, Detroit; assistant secretary, C. H. Hood, Detroit.

Directors—Henry Koehler, Jr., and A. W. Lambert, St. Louis; C. M. Burton, Detroit; W. W. Hannan, Samuel B. Jeffries, St. Louis; T. A. E. Weadock, Detroit; C. M. Forster, St. Louis; W. B. Woodbury, Detroit; A. N. Edwards, St. Louis; Elias Michael, St. Louis.

Executive committee—C. M. Burton, chairman; W. B. Woodbury, secretary; Max Koehler, A. W. Lambert.

Digitized by Google

THE EFFECT OF IRON IN DISTORTING ALTERNATING-CURRENT WAVE-FORM.[1]

BY FREDERICK BEDELL AND
ELBERT B. TUTTLE.

INTRODUCTION.

It is well known that in a circuit containing no iron an impressed sinusoidal electromotive force will cause a sinusoidal current to flow, the current lagging behind the impressed electromotive force

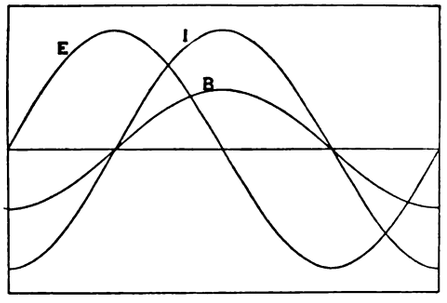


FIG. 1.—SINUSOIDAL CURRENT I AND INDUCTION B, LAGGING 90° BEHIND THE SINUSOIDAL ELECTROMOTIVE FORCE E WHEN NO IRON IS PRESENT.

by an amount depending upon the relative values of the resistance and inductance, which in this case is constant. Assuming inductance alone in the circuit, the sine current which flows lags 90° behind the sine electromotive force and represents no power, the power-factor (cos 90°) being zero.

It is also well known that if the conductors of the circuit encircle iron, the

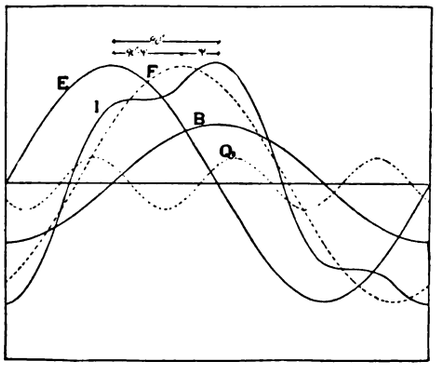


FIG. 2.—COMPLEX CURRENT I AND INDUCTION B, WITH MAXIMUM VALUES 90° BEHIND SINUSOIDAL ELECTROMOTIVE FORCE WHEN IRON IS PRESENT. THE FUNDAMENTAL (F) LINE CURVE OF CURRENT LAGS (90° — ψ) DEGREES BEHIND E.

inductance will no longer be constant. The current resulting from an impressed sinusoidal electromotive force will no longer be sinusoidal, but will be distorted and consist of a first harmonic or fundamental sine current of the same frequency as the electromotive force, and harmonics of 3, 5, 7, etc., times the fundamental frequency.

[1] A paper presented at the two hundred and ninth meeting of the American Institute of Electrical Engineers, New York, September 28, 1906.

One of the first studies of this subject was made by Ryan and Merritt[1] who, from experimental curves of current and electromotive force, determined the hysteresis loop for the iron of a transformer. Steinmetz[2] taking certain hysteresis loops and assuming a sinusoidal electromotive force, has determined the complex current wave for a large number of cases.

The purpose of the present writers is to study more fully the relation between the harmonics introduced by iron into the current wave, and the hysteresis loop of the iron to which these harmonics are due. For example, it can be shown that certain harmonics, defined by their amplitude and phase with reference to the fundamental, can be produced by iron; others can not, these latter being excluded as impossible by the determination of some physical limitation. The condition that hysteresis in iron causes it to absorb rather than to give out energy, at once renders certain harmonics impossible. The fact that the

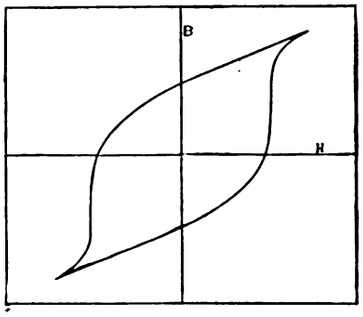


FIG. 3.—HYSTERESIS LOOP CORRESPONDING TO FIG. 2.

current can have a maximum value only coincident with the maximum value of induction in the iron is likewise a limitation. Again, the fact that after saturation the permeability decreases with the increase of the induction is a further limitation.

[1] Transactions, A.I.E.E., vol. vii, p. 1.
[2] Steinmetz, "Alternating-Current Phenomena," chap. x.

In case of a sine electromotive force and a complex current wave due to iron, the harmonics in the current wave (being 3, 5, 7, etc., times the frequency of the electromotive force) can represent no power.[1] Any power must accordingly come from that part of the complex current wave which is of the same frequency as the electromotive force. If this current lagged 90° behind the electromotive force, as it does with no iron present, there would be no power, as has already been pointed out. But the current of fundamental frequency is shifted ahead by an angle, ψ, of hysteretic advance due to the iron, so that it lags less than 90° behind

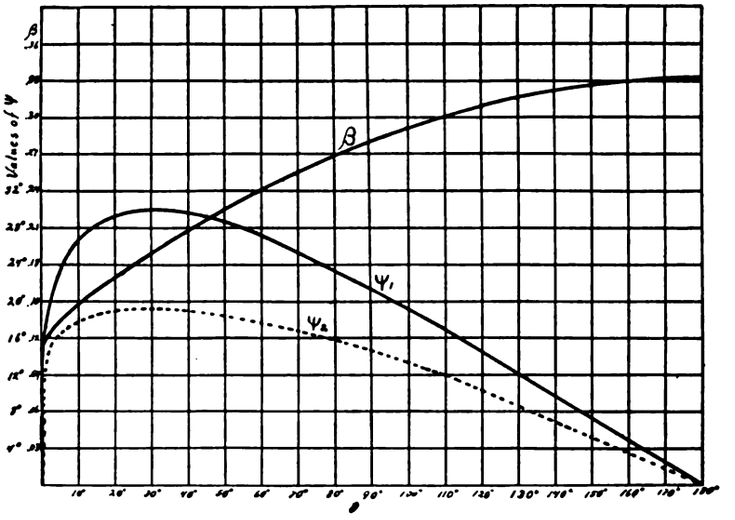


FIG. 4.—LIMITING VALUES OF B (AMPLITUDE OF THE THIRD HARMONIC) AND ψ (HYSTERETIC ADVANCE) FOR VARIOUS PHASE POSITIONS OF THIRD HARMONIC.

the electromotive force; consequently it represents power, this being the power expended in hysteresis.

The current of fundamental frequency which we are to consider might be taken either as the fundamental sine curve, as we analyze the current into components of 1, 3, 5 times the frequency; or, as the equivalent sine curve, which is a sine curve equivalent in its effect to the fundamental and higher harmonics combined. The distinction between the fundamental and equivalent sine curves, which have sometimes been confused, will be taken up more fully later.

A relation will be sought between the

[1] A symmetrical hysteresis loop introduces odd harmonics only. Taking $e = E \sin \omega t$ and current i, the work done per cycle is

$$W = \int_0^{2\pi} e\, i\, dt.$$

For any odd harmonic of n times the frequency, $i_n = I_n \sin n\omega t$. With this value substituted for i, the integral vanishes and $W = 0$.

Digitized by Google

hysteresis loop for any iron and its angle of hysteretic advance.

Finally, consideration will be given to the effect of hysteresis upon the vector representation of alternating currents, and it will be shown that the complete diagram in any problem can no longer be drawn in a plane.

EFFECT OF THIRD HARMONIC.

From Faraday's law,

$$e = -\frac{d\phi}{dt} = -A\frac{dB}{dt},$$

it follows that if the electromotive force[1] impressed upon a coil be sinusoidal, the magnetic flux threading the coil will likewise be sinusoidal, and in phase 90° behind the electromotive force. This is true whether the coil embraces iron or not.

If the coil does not embrace iron, the current likewise is sinusoidal and 90° behind the electromotive force; the flux is in phase with the current, and proportional to it (Fig. 1). We may then write

$$e = -A\frac{dB}{dt} = -L\frac{di}{dt}.$$

The inductance L is constant; and hence the induction B is proportional to current i and magnetizing force H, permeability being constant. The hysteresis "loop," plotted between B and H, becomes then a straight line.

With iron present, inductance and permeability are not constant. The induction B is no longer proportional to the current i and magnetizing force H, and with induction B sinusoidal (due to sine impressed electromotive force), the current i is not sinusoidal, but distorted as in Fig. 2. Since B and H are no longer proportional, instead of a straight line we have the hysteresis loop representing their cyclic variation.

In the following work we shall deal with the fundamental and third harmonic only. The process will be to assume successively definite relative amplitudes and phase positions for these and build up the complex current wave. From this complex wave of current and the sine wave of flux, the hysteresis loop which would cause such a current is determined.

The equation for the current is

$$i = \sin\omega t + \beta\sin(3\omega t + \theta).$$

The amplitude of the third harmonic is β (taking the fundamental as unity) and θ is its phase-angle, $+\theta$ indicating an advance, and $-\theta$ a lagging of the origin of the harmonic relatively to the origin of the fundamental.

Let us take a typical case represented in Fig. 2. The assumed fundamental and third harmonic of the current are represented by dotted curves. Here the amplitude of the harmonic is taken to be

[1] Not including ohmic electromotive force.

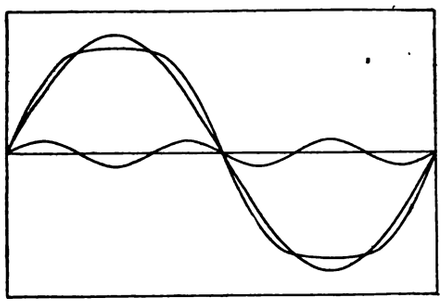


FIG. 5.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 0$. SEE TABLE II FOR DATA FOR ALL CURVES.

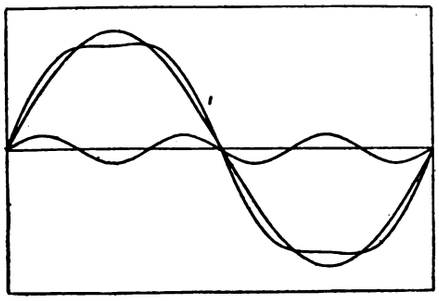


FIG. 6.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 2°$

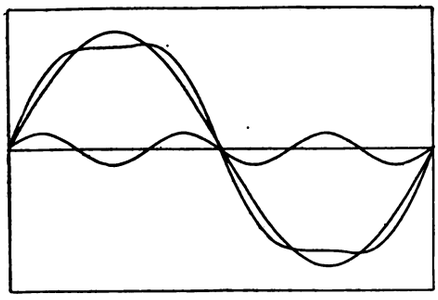


FIG. 7.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 5°$

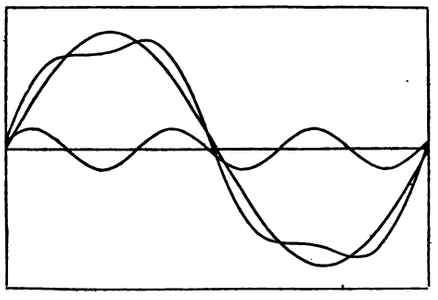


FIG. 8.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 20°$

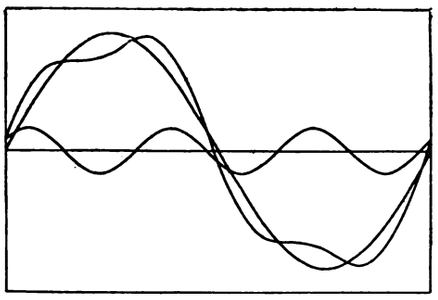


FIG. 9.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 30°$

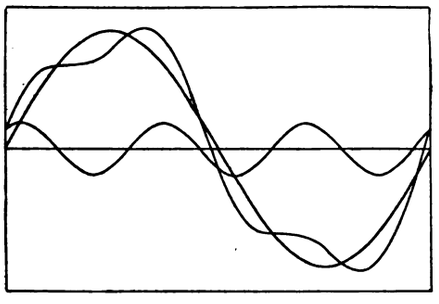


FIG. 10.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 45°$

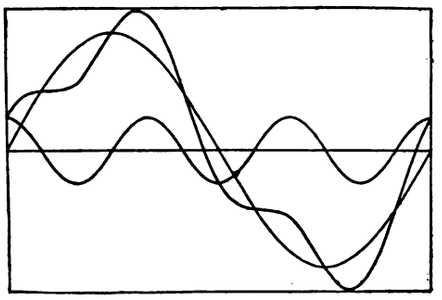


FIG. 11.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 90°$

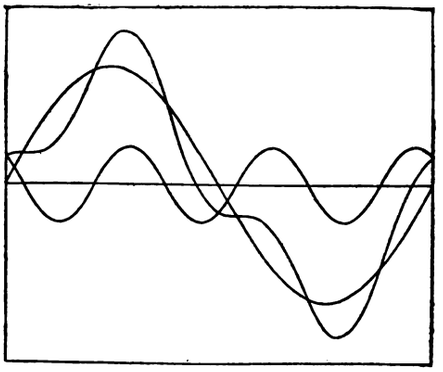


FIG. 12.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 135°$

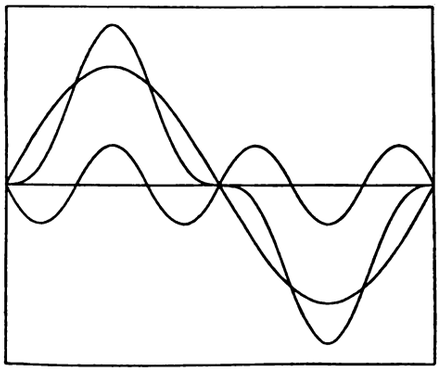


FIG. 13.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 180°$

Digitized by Google

$\beta = 0.22$ (the amplitude of the fundamental being unity) and θ is taken to be $+ 45°$. The maximum of the current wave necessarily coincides in time with the maximum of the induction (for in a hysteresis loop the maximum H coincides with the maximum B). The sinusoidal

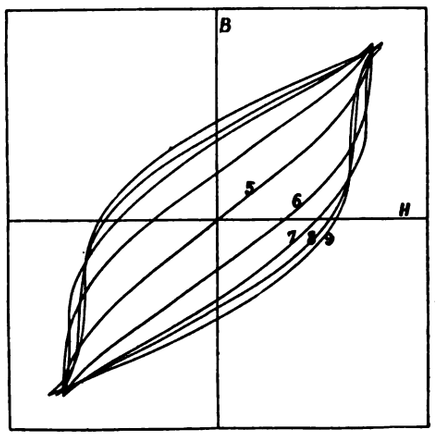


FIG. 14.—HYSTERESIS LOOPS CORRESPONDING TO FIGS. 5 TO 9. $\theta = 30°$ OR LESS.

flux, in accordance with Faraday's law, is 90° behind the sinusoidal electromotive force; accordingly, the maximum of the induction, and hence of the current, is 90° behind the electromotive force. It will be noted, however, that the fundamental of the current wave has its maximum in advance of the maximum of the complex wave by an angle ψ, the hysteretic angle of advance, in this case equal to 29° 23′. The fundamental current wave lags then $90° - \psi$ behind the electromotive force and represents power consumed by hysteresis, with a power-factor $\cos (90° - \psi) = \sin \psi$.

If θ, the phase-angle of the harmonic, is between 0° and 180°, we find that the right-hand side of the complex current

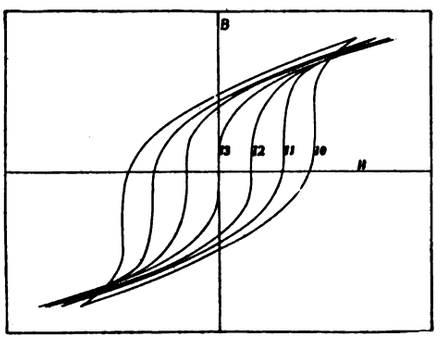


FIG. 15.—HYSTERESIS LOOPS CORRESPONDING TO FIGS. 10 TO 13. θ GREATER THAN 30°

wave will have a hump, as in Fig. 2. The fundamental will be advanced to the left so as to lag less than 90° behind the electromotive force, representing power taken by hysteresis—a possible case.

If, however, θ is between 180° and 360°; that is, if the harmonic is made to be behind instead of in advance of the fundamental, the hump on the current curve will be found on the left, and the fundamental will be shifted to the right so as to lag more than 90° behind the electromotive force, representing power given out by hysteresis—an impossible case. In this case the hysteresis loop would needs be traversed in the reverse direction from the actual counter-clockwise direction and its area would represent work given out per cycle. Fig. 2 turned upside down would represent such a case.

DERIVATION OF HYSTERESIS LOOP.

A hysteresis loop consists in plotting corresponding values of B and H in rectangular coordinates. A hysteresis loop corresponding to the curves of Fig. 2 is correspondingly readily plotted. H is directly proportional to I, and hence the curve for I may be taken as a curve for H. Corresponding values of H and B are taken directly from the curves in Fig.

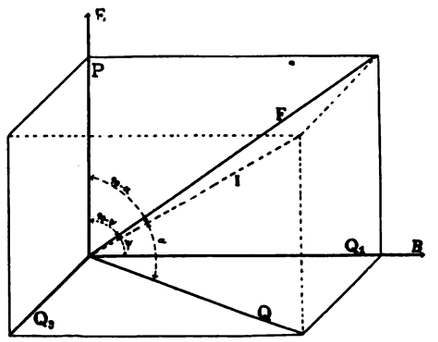


FIG. 16.—VECTOR REPRESENTATION IN THREE DIMENSIONS OF A COMPLEX CURRENT. E IS SINE ELECTROMOTIVE FORCE; F IS FUNDAMENTAL CURRENT; Q_3 REPRESENTS HARMONICS; AND I IS THE EQUIVALENT SINE CURRENT.

2 and plotted in rectangular coordinates to give the hysteresis loop of Fig. 3.

The interpretation is this: we arbitrarily assume a complex current I, made up of a fundamental and third harmonic, Fig. 2. The sinusoidal induction B and electromotive force will then be as shown in Fig. 2. The hysteresis loop which would produce the assumed distortion is shown in Fig. 3.

When $\theta = 0°$, or 180°, the hysteresis loop becomes a curved line; the ascending and descending curves coincide and enclose no area, representing therefore no hysteresis loss, although the permeability varies. These cases are shown by curves 5 and 13 in Figs. 14 and 15. They are impossible limiting cases; the angle θ must accordingly be more than 0° and less than 180°, and positive.

It will be shown later that θ must be greater than 30°, and that all the curves in Fig. 14 (corresponding to values of θ from 0° to 30°) are impossible.

The hysteresis loops derived in this paper from consideration of the fundamental and third harmonic only in the current wave, have an unnatural appearance, particularly near the maximum values. Hence it is concluded that the fifth and other higher harmonics are

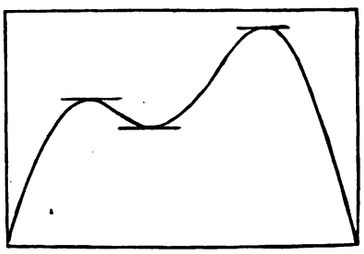


FIG. 17.—TWO CRESTS, ONE TROUGH AND TWO INFLEXIONS.

necessary in the complex wave in order to derive therefrom a more normal hysteresis loop, particularly when saturation in the iron is passed.

LIMITING VALUES OF AMPLITUDE OF HARMONIC, AND OF HYSTERETIC ADVANCE.

It will be found that for $\theta = 0°$ the amplitude β of the harmonic can not be greater than $\frac{1}{3}$; and for $\theta = 180°$, the value of β can not be more than $\frac{1}{3}$, the fundamental being taken as unity. The limiting possible values of β for various values of θ are shown in Fig. 4 and are given in Table I. If β exceeded

TABLE I.

LIMITING VALUES OF β AND ψ FOR VARIOUS VALUES OF θ.

θ	β	ψ
0°	0.111	0°
	0.112	5° 41′
	0.113	7° 59′
	0.116	11° 8′
1° 17′	0.120	16° 20′
1° 45′	0.122	16° 54′
4° 48′	0.133	22° 30′
6° 55′	0.140	24° 28′
8° 34′	0.144	25° 35′
12° 52′	0.156	27° 40′
14° 15′	0.160	28° 15′
17° 37′	0.167	28° 57′
22° 44′	0.178	29° 41′
23° 47′	0.180	29° 47′
30° 39′	0.192	30° 00′
33° 59′	0.200	29° 56′
40° 6′	0.211	29° 34′
45° 14′	0.220	29° 6′
46° 34′	0.222	27° 43′
57° 44′	0.240	27° 28′
60° 42′	0.244	27° 1′
71° 44′	0.260	25° 8′
76° 48′	0.267	24° 9′
87° 47′	0.280	21° 56′
95° 54′	0.289	20° 12′
107° 16′	0.300	18° 4′
120° 40′	0.311	14° 34′
134° 4′	0.320	11° 22′
143° 35′	0.322	10° 23′
157° 18′	0.330	5° 43′
180°	0.333	0°

the limiting value, the resultant current would have two maxima in a half cycle, as in Fig. 17 of the Appendix. This is

Digitized by Google

impossible, as it would mean corresponding maxima in the values of H. This would cause H to have four maxima per cycle, as in Fig. 18, while B has but two.

Curve ψ_1, in Fig. 4, shows the greatest possible values of the angle of hysteretic advance for various values of θ; this curve corresponding to limiting values of β given in curve β. Other values of β

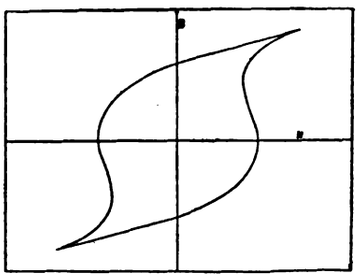


FIG. 18.—HYSTERESIS LOOP CORRESPONDING TO FIG. 17, WITH FOUR MAXIMA FOR H WHICH WOULD RESULT WERE THE LIMITS OF β GIVEN IN FIG. 4 EXCEEDED.

will give a smaller value for ψ as shown in curve ψ_2 which shows ψ for $\beta = \frac{1}{9}$ for all values of θ. It is seen that in no case can ψ be greater than 30°.

For the method of determining the limiting value of β, and also for ψ, as given in the table and shown in Fig. 4, a full discussion of which is given in the appendix, we are indebted to Professor James McMahon.

A year ago M. C. Carpenter, at the suggestion of one of us, plotted a large number of complex curves and hysteresis loops for different values of θ and β, with a view to determining their limiting values by a method of cut and trial; but it proved impossible in this way to get definite results.

DISCUSSION OF CURVES.

The curves in Figs. 5-13 show the complex current wave resulting from a fundamental and third harmonic in various phase positions from 0° to 180°, the amplitude of the harmonic being in all cases the greatest possible according to values for β shown in Fig. 4. The data referring to these curves are given in Table II.

TABLE II.

The amount of shifting to the left of the fundamental (the hysteretic advance), is readily observed in each case, this being ψ. The hysteretic angle ψ increases with hysteresis loss, the power-factor for hysteresis being cos ψ. In Figs. 5 and 13, for $\theta = 0°$ and 180° ψ is 0 and the maxima of the fundamental and complex waves are coincident; hence power consumed by hysteresis is zero.

The corresponding hysteresis loops for all cases are shown in Figs. 14 and 15. Loops 5 and 13, for $\theta = 0°$ and $\theta = 180°$, have no area, which likewise indicates that the power consumed by the hysteresis is zero.

Curves shown in Figs. 5 to 9 are for various values of θ equal to or less than 30°, the corresponding hysteresis loops being shown in Fig. 14. The upward turn of these loops, when θ is less than 30°, shows these cases to be impossible; for they would indicate an increase instead of decrease in the permeability for increasing values of induction beyond saturation. Possible values of θ must accordingly be between 30° and 180.°

(To be concluded.)

DATA RELATIVE TO CURVES IN FIGS. 5-13.

Curve No.	θ	β	α	ψ	I	I′
5	0°	0.111	0°	0°	1.006	0.8890
6	2°	0.122	16° 54′	17°	1.007	0.8832
7	5°	0.135	22° 48′	23°	1.009	0.8833
8	20°	0.172	29°	29° 30′	1.015	0.9250
9	30°	0.193	29° 33′	30°	1.019	0.9624
10	45°	0.220	28° 38′	29° 22′	1.024	0.9868
11	90°	0.283	19° 36′	20° 30′	1.039	1.1850
12	135°	0.321	10° 12′	10° 45′	1.050	1.2950
13	180°	0.333	0°	0°	1.053	1.3330

θ is the phase relation of the third harmonic to the fundamental at the origin.

β is the ratio of the maximum ordinates of the fundamental and third harmonic (critical value).

ψ is the phase difference between the maxima of the distorted and fundamental curves.

$90 - \psi$ is lag of fundamental component of current behind electromotive force.

$90 - \alpha$ is lag of equivalent sine current behind electromotive force.

I and I′ are the maxima of the equivalent sine curve and distorted curve, respectively, the maximum value of the fundamental being unity.

National Electric Light Association.

At a recent meeting of the executive committee of the National Electric Light Association the matter of offices in the United Engineering Building was formally decided. The association will change its headquarters as soon as practicable after the new building is ready for occupancy. There was an unusually full attendance at the meeting, and several important measures were set in motion.

Among the new applications for membership passed upon and approved were the following:

CLASS A.

North Georgia Electric Company, Gainesville, Ga.

Millville Electric Light Company, Millville, N. J.

McCall Ferry Power Company, New York, N. Y.

The Miami Light, Heat and Power Company, Piqua, Ohio.

Laramie Light and Power Company, Laramie, Wyo.

Albany Power and Manufacturing Company, Albany, Ga.

Toledo Gas, Electric and Heating Company, Toledo, Ohio.

Escambia County Electric Light and Power Company, Pensacola, Fla.

CLASS B.

E. J. Fowler, Chicago Edison Company, Chicago, Ill.

J. W. Murray, Allegheny County Light Company, Pittsburg, Pa.

A. S. Allen, Tonawanda Power Company, Tonawanda, N. Y.

G. H. Patten, Chattanooga Electric Company, Chattanooga, Tenn.

Arthur L. Linn, Rochester Railway and Light Company, Rochester, N. Y.

E. A. Phinney, Ouray Electric Power and Light Company, Ouray, Ohio.

Henry Stephenson, New York Edison Company, New York, N. Y.

J. W. Young, McCall Ferry Power Company, New York, N. Y.

H. M. Edwards, New York Edison Company, New York, N. Y.

Charles S. Shepard, New York Edison Company, New York, N. Y.

William S. Dupont, Public Service Corporation of New Jersey, Newark, N. J.

James T. Whittlesey, Public Service Corporation of New Jersey, Montclair, N. J.

J. Kennedy, Public Service Corporation of New Jersey, Weehawken Heights, N. J.

Edward J. O'Beirne, Gainesville Electric Railway and Light Company, Gainesville, Tex.

CLASS D.

Michaelis & Ellsworth, New York, N. Y.

Roderick J. Parke, Toronto, Canada.

The Lundin Electric and Machine Company, Boston, Mass.

Condit Electrical Manufacturing Company, Boston, Mass.

The Shelby Electric Company, Philadelphia, Pa.

CLASS E.

James D. Ellsworth, Michaelis & Ellsworth, New York, N. Y.

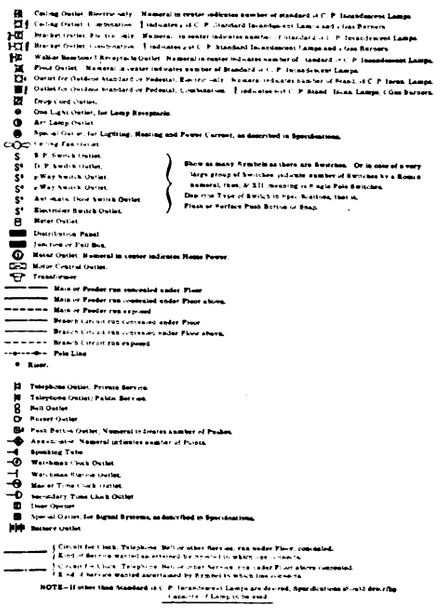
Digitized by Google

English Overhead Transmission Lines and Distribution Mains.

While the methods of installing electrical apparatus in Great Britain are carefully supervised by the Board of Trade, this body has not yet adopted any special regulations for high-tension transmission systems, and work of this character therefore conforms to the rules for ordinary voltages, though extra precautions are taken. The electrical engineer contends with a good many difficulties in England, one of these being that of obtaining the right of way. The transmission line is seldom straight, but twists and turns according to the fancy of the owners of the property across which it passes. As an example of the character of work now being done in transmission line construction the line of the Lancashire company is described. This company has a considerable length of 11,000-volt overhead conductors in service, carried on wooden poles. In erecting the wire it is drawn up so that there is a factor of safety of five at a temperature of twenty-five degrees. This includes also an allowance for wind pressure equivalent to fifty miles per hour. The average span is fifty yards, and the poles are of the A type—that is, two poles bolted together at the top, but separated slightly at the bottom. The average height is thirty-two feet, six feet of this being in the ground, and the average diameter five feet from the butt is about twelve inches. The cross-arms are of oak, five inches by four inches, and a brace eight by eight inches and six feet long is fastened to the bottom of the pole. Where a road is to be crossed, a wire netting is placed below as a protection. No line is allowed to cross a road at an angle of less than sixty degrees, and in many cases the crossing must be by means of underground cables. On straight lines strain poles are erected every half mile. For turning angles two poles are employed, carefully braced and guyed. Each conductor is attached to the strain poles by three insulating shackles. The two ends of each line are cross-connected, the connecting wire being bound to an ordinary insulator. The insulator is of the triple petticoat type, made in two parts. For taking off branches four poles are erected, braced together, and the conductors are attached in the same manner as for strain poles. The branch is taken off from a higher set of cross-arms, connection being made by vertical drops to the main wires. For changing from overhead to underground work, or the reverse, a three-headed box is employed, into which the cable is brought through a lower opening. It is spread out and attached to the three overhead conductors, and the box is then filled with an insulating compound. The three heads are protected by special porcelain insulators and caps, and a copper hood soldered to the conductor. The conductors themselves are about thirty inches apart. The entire construction is very solid and has been so satisfactory that it will probably be employed for still higher voltages.—*Electrical Engineer (London), September* 14.

Standard Symbols for Wiring Plans.

At the July meeting of the National Electrical Contractors' Association a set of standard symbols for wiring plans was adopted and recommended. This set of symbols was devised after



SYMBOLS ADOPTED BY THE NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

numerous conferences with the architectural and engineering interests of the country. The fact is appreciated that these symbols will conflict with some of those now in use. The committee under whose direction these symbols were devised considers, however, that the particular shape of the symbol is not an important factor so long as it is reasonably simple. In designing the system this point was carefully considered, and the symbols most used will be found easy of execution, those generally in use having been adopted as far as possible.

An Electrolytic Rectifier.

A United States patent was granted on September 11 to Franz Pawlowski for an electrolytic rectifier. The novelty of the rectifier lies in the use of a solid electrolyte which is conducting while cold. This material is hemisulphide of copper (CuS). To bring the substance into a suitable state it must be carefully prepared, which is done by melting a mixture of sulphur and copper, or by subjecting sheet copper to the action of sulphurous vapors without admission of air. This produces a hard crystalline hemisulphide which resists the action of the air and water and melts only at about 1,000 degrees centigrade. The sulphide is equally conductive for all directions at ordinary temperatures. The rectifier consists in placing a sheet of copper coated in this way in contact with a sheet of aluminum. The surface of the latter must be brought into intimate contact with the sulphide, for transfer of current takes place only where such contact exists. Before the rectifier is ready for use it must be formed, which is done by passing an alternating current through it so as to produce rather violent sparking. As the formation of the aluminum plate takes place, the insulating coating in this case being a sulphide, the sparking decreases and finally stops. Such a device acts as an electric valve, allowing the current to pass through only from the aluminum to the sulphide of copper, though combinations of cells may be employed for rectifying both half-waves. The action is electrolytic, the products being dusts of copper and aluminum. This, if formed in large quantities, would be prejudicial to the working of the device, but it is said that, under ordinary conditions, the formation of dust is negligible.

Boston & New York Electric Railroad Company.

Announcement is made that the Boston & New York Electric Railroad Company intends to build a high-speed electric line between Boston and New York. The road will be built first as far as Providence, and it will then be continued on to New York. The entire road will be double-tracked on a private right of way completely fenced in. It is expected that the line will be entirely without grade crossings.

The application for a charter in Massachusetts is made by the following: A. B. Leach, James G. Campbell, William O. Blaney, Elwyn G. Preston, S. W. Reynolds, Harry M. Howard, Edward C. Sherburne, J. Walter Sanborn, Daniel W. Howland, John F. Crocker, Leroy S. Brown, Charles H. Adams, H. Staples Potter, James M. W. Hall, F. A. Kennedy, Theodore N. Vail, B. P. Cheney, Frank B. Priest, Charles D. Sias, Robert J. Edwards, James Duane Livingstone, Edward F. Woods and George N. Talbot.

Digitized by Google

NOTES ON COLLOIDS.[1]

BY ALFRED LOTTERMOSER.

The essence of a solution is that the dissolved substance should be evenly distributed throughout the entire volume of the solvent. The dissolved substance exerts a pressure, in consequence of which it diffuses itself throughout the solvent in opposition to the force of gravity; consequently, the dissolved substance behaves like a gas, which also fills any space quite evenly, but the rate of diffusion of a gas is immensely greater than that of a dissolved substance. Consequently, the laws which relate to the behavior of gases, which have been chiefly discovered by the work of van't Hoff, apply equally to dissolved substances. But soluble substances are known which possess a very small, and, indeed, almost negligible, power of diffusion; and for these substances the laws relating to gases would seem to be no longer valid. Graham first studied this matter, and he called substances of the first kind "crystalloids," since on removal of the solvent they remain behind in the crystalline state; whereas he called the substances with small power of diffusion "colloids," since glue may be considered to be a typical instance of this class. Substances of this latter class remain behind in the amorphous condition after removal of the solvent, and consequently the words "colloidal" and "amorphous" are to some extent identical. Still, a sharp line of distinction can not be drawn between colloidal and crystalloid substances, seeing that multitudinous substances are on the border line.

Assuming that the laws for gases hold good, it is possible from the diffusion-capacity, or osmotic pressure, to determine the molecular weight. According to this, the molecular weight in the case of colloids would be of the order of 10^4, and even much greater than this. Supposing that the laws for gases are assumed to hold good, we must suppose that we are dealing not with single but with complex molecules. The only other alternative is to give up the idea of solution and to introduce a new conception, as Graham did —*viz.*, that of the "hydrosol," according to which the colloid is evenly distributed throughout the solvent in an extremely fine state of division. Then the question arises as to whether it is possible to see these small particles. This question may be regarded as settled, and answered in the affirmative. It is, however, impossible to see the slightest sign of any want of homogeneity in hydrosols, even under the most powerful microscope; but Tyndall's experiment provides us with another optical method. If a beam of light, after being concentrated by a lens, is allowed to pass into a fluid and is then observed by the eye in a direction at right angles to the direction of the light, the beam will only appear to be invisible in that case in which the fluid is homogeneous—*i. e.*, when nothing is present which is capable of diverting the rays in any way from their path. Most solutions are of this nature, and are optically "empty." In hydrosols, however, the path of the rays is at once visible in a more or less brightly illuminated streak. This shows that small particles are present which reflect or divert a part of the rays, or, in other words, rays are diverted from their path and directed into the eye, which is looking in a direction at right angles to the path of the beam. If dust is sprinkled in a fluid, it is at once noticeable in the shape of bright particles, but these particles are a million times greater than those of a hydrosol, and consequently the latter can not be recognized in this way as separate entities. But if the above experiment is repeated under the microscope, in the way that Zsigmondy and Siedentopf suggested, it is possible to see separate particles, though it is not possible to define their shape. The metal hydrosols, which are interesting to us at the moment, were examined with great care under the ultra-microscope, as the instrument constructed by Zsigmondy was called. In most cases the particles can be seen to be in a state of lively motion, and form a picture of the greatest beauty. It is possible to determine the size of the particles, which can be seen in the brightest sunlight down to linear dimensions of $5\mu\mu$ ($1\mu\mu$ = 0.000001 millimeter). And obviously it is possible to see particles which are below this limit, seeing that Nature makes no leaps; such particles are no longer visible in the ultra-microscope as separate particles but give the impression of an evenly but weakly illuminated field of vision. On the other hand, solutions are known which are not optically "empty," and show the Tyndall phenomenon; and this shows, as I have already said, that no sharp distinction can be drawn between hydrosols and true solutions. Similarly it is not possible to define hydrosols in a purely mechanical way and to limit them to oozes, or suspended particles, which can be distinguished under the microscope. It is true that these oozes of clay or ultramarine possess none of the properties of true solutions; they do not possess the property of diffusing themselves, but then it is possible gradually to increase the size of the particles of a hydrosol until we can microscopically perceive their magnitude, in which case this hydrosol has completely lost all the properties of solutions.

It can, therefore, cause no surprise when we find that hydrosols and suspensions have many properties in common. If an electric current is passed through a suspension or a hydrosol, and even if the resistance is very great, the particles will be seen to be displaced with regard to the fluid; they are electrically opposed to the solution carrying a charge, and the direction of their displacement depends in general on the chemical nature of the particles. Therefore it is natural that the direction of their migration should be influenced by the addition of various substances, and in this respect electrolytes produce a very marked effect. (According to the electrolytic dissociation theory of Arrhenius, electrolytes are understood to be substances which cause the solution to conduct by splitting up into electrically charged particles called ions—*i. e.*, the wanderers— which give up their charges at the anode and cathode.) The effect on the direction of migration of the ions is most clearly seen in the case of very dilute solutions; but it is not possible to go minutely into this aspect of the problem. In more concentrated solutions the electrolytes produce such an effect on suspensions and hydrosols that the minute particles coagulate together and form more complex structures. The most important point to be noticed is that the effect of an electrolyte is made up of those of the two classes of ions: that ion which has an opposite charge to that of the particle in suspension, or to that of the hydrosol, exerts a precipitating influence, the extent of which depends on the nature of the ion; whereas the ion which has a similar charge tends to prevent the precipitation partially or entirely.

Although, indeed, the particles move with the electric current, as has been already mentioned, yet the hydrosols, and more particularly the metals, show only a very slight power of conductivity. This is probably due to the presence of ions. A precipated gel, which has been obtained by drying or by electrolytic action, is a non-conductor, or at any rate a very poor conductor, as Barus and Schneider have found in the case of silver. This is not surprising, seeing that they consist of small disconnected particles, even although they are immensely larger than hydrosols.

[1] Appendix to an article by Dr. C. R. Böh on modern forms of electric incandescent lamps which appeared in *Elektrotechnischer Anzeiger*, abstracted from the *Electrician*, London.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Friction and Lubrication.

Some interesting and valuable experiments, conducted some years ago by B. Tower for a research committee of the Institution of Mechanical Engineers, of Great Britain, but which have not been widely published, are described here by Professor G. F. Charnock. The work was carried out with a belt-driven shaft of steel, provided with a journal four inches in diameter and six inches long. Upon the upper side of the journal was fitted a gun-metal step, the arc of contact being rather less than half the circumference. Various means of lubrication were provided, the best being a bath of oil. The results of the experiments were that the friction is nearly constant under all loads, within ordinary limits, and it does not increase in direct proportion to the load, according to the ordinary laws of friction. The coefficient of friction with bath lubrication varies inversely as the pressure; or, in other words, the friction of the bearing is altogether independent of the pressure upon it. This is provided the pressure does not exceed 400 to 600 pounds per square inch. The coefficient of friction is inversely proportional to the temperature. The friction increases with the velocity apparently nearly as the 1.5 power. The coefficient of friction varies with the lubrication used, and was found by Tower to be least for olive oil and lard oil. Sperm oil comes next, followed by mineral oil and mineral grease.—*Abstracted from the Mechanical Engineer (London), September* 1.

Oerlikon Single-Phase Locomotives.

A new locomotive equipped with single-phase commutator motors has been constructed by the Maschinenfabrik Oerlikon, of Zurich, Switzerland, for experimental trials on the Seebach-Wettingen line. The locomotive is carried on two four-wheel trucks, one motor being mounted on each truck, and geared with a ratio of one to 3.1 to an intermediate shaft, which shaft is coupled to both axles by means of a side bar. Thus, all four axles are driven. The bearing of the crank pin of the intermediate shaft is allowed a certain amount of vertical motion. The current-collecting apparatus is that recently brought out by the Oerlikon Company. It consists of a curved tubular rod of steel, on which brass rubbers are placed. These rods are mounted on a swinging frame, there being two collectors on each locomotive, enabling them to be placed in contact with the wire when it is on either side of the track or at any point over the locomotive. The locomotive is lighted by twenty-volt lamps having thick filaments, which give a fairly steady light on the low frequency of fifteen cycles. The locomotive weighs forty-three tons, of which 23.5 represent the weight of the mechanical part. Each motor weighs 3.4 tons, and is rated at 200 horse-power at 650 revolutions. It can start a train of 250 tons up a gradient of one in twelve and one-half, and attains a speed of twenty-eight miles an hour without any sparking at the brushes. It consists of a laminated field with an armature of the ordinary direct-current type. The field is provided with main salient poles as well as auxiliary poles. The exciting current for the auxiliary poles is connected through a non-inductive resistance to a series transformer. The main poles are provided with compensating windings in grooves, which may be short-circuited on themselves or placed in series with the main circuit. The motor has eight main poles, and its normal speed is about three times that of synchronism. It operates equally well at a frequency of twenty-five cycles.—*Abstracted from the Electrical Review (London), September* 14.

Accurate Speed, Frequency and Acceleration Measurements.

The various methods which have been used for measuring speed are discussed here by Dr. C. B. Drysdale. The older methods are held to be crude, and were discarded some time ago for an electrical method employing a Faraday disc. In this a magnetic field was set up by two circular iron cheeks attached to the poles of a permanent magnet, thus forming a narrow circular space, within which a copper disc revolved. Contact was made with the outer surface of the disc by means of a few drops of mercury placed in the lower part of the circular opening. A voltmeter gave indications of the speed. Although simple, this apparatus was unsatisfactory, due to the uncertainty of the contact resistance. An improved form using an inductor generator with a hot-wire instrument has been suggested, but such instruments are generally not altogether satisfactory. After having tried a number of electrical and mechanical methods, Dr. Drysdale has returned to the use of the electrically driven tuning fork. He believes that apparatus of this kind is, on the whole, the most satisfactory. The chief objection is the difficulty of calibration. When vibrating rods are used each rod must be independently checked. He describes a method which he has employed for measuring speeds. A tuning fork of known pitch has attached to its prongs two slotted screens, which alternately open and close as it vibrates. This is mounted opposite the shaft of a small motor, upon the end of which is attached a black and white disc having a geometrical design, and the inner design is a white square surrounded by a black pentagon, which is in turn surrounded by a white hexagon. Without the latter is a circle of thirty triangular white points on a black circle. Viewing this disc through the slits of the tuning fork the square appears single for speeds of 1,500 and 3,000 revolutions; double for 750 and 2,250; triple for 500, 1,000, 2,000 and 2,500. The pentagon is seen single for 1,200, 2,400 and 3,600 revolutions; double for 600, 1,800 and 3,000 and triple for 400, 800, 1,600, 2,000, 2,800 and 3,200. The hexagon appears single for 1,000, 2,000 and 3,000 revolutions; double for 500, 1,500 and 2,500 and triple for 333.3, 666.7, 1,333, 1,667, 2,333 and 2,667. Each 100 revolutions is checked by the thirty-pointed figure. For the calibration of speed indicators this device is the most perfect and convenient that can be employed. It is possible to maintain its speed steady during the test and there is no need for using an electrically driven tuning fork. In this way speeds may be determined to an accuracy of one part in 10,000. If it be desired to determine intermediate speeds a conical roller may be attached to the motor and the disc caused to roll upon this. This device enables speeds to be read off directly with an accuracy of one-tenth per cent.—*Abstracted from the Electrical Review (London), September* 7.

Digitized by Google

Notes on Glow-Lamp Standards and Glow-Lamp Photometry.

It is advisable in photometric work to use a flame standard when measuring flames, and an incandescent lamp as a standard for work with such lamps. The latter practice has a number of useful advantages, one of these being the fact that by connecting both standard and test lamp to the same circuit, the effect of variations in voltage is, to some extent, compensated for. But J. S. Dow points out here that this method of compensation is not perfect, since, as a rule, two incandescent lamps, even of a similar class, are not affected in exactly the same way by a given change in pressure. To illustrate this, a comparison is given between two 100-volt lamps at voltages from eighty-seven up, and it is shown that a change of one per cent in the difference of potential causes a change of about one-quarter per cent in the ratio of the two lamps. When comparing Nernst, tantalum or osmium lamps with an incandescent lamp, the exact regulation of the pressure is much more essential. It is shown that a change of one per cent in the voltage will make a difference of as much as two and one-half per cent in the ratio of a tantalum and a carbon incandescent lamp. Another source of error is due to the fact that the filaments are frequently not placed symmetrically within the bulb, so that the centre of illumination is not the centre of the lamp. For this reason it is advisable to use as standard lamps those having a horseshoe type of filament, and to place these with the plane of the filament at right angles to the photometric bench. The fact that the centre of illumination and the centre of the lamp may not agree makes it desirable to adopt a certain distance between the lamps when comparing them. One point requiring attention in the photometry of incandescent lamps is accurate measurement of the voltage, for the candle-power varies about as the seventh power of the voltage. For this reason, in tests made at the Reichsanstalt, the current is measured, and not the voltage, the candle-power varying only as the fourth power of the current. Another effect which should be guarded against is a sort of hysteresis. If the lamp be burned for a time at a voltage higher than the normal, the candle-power is increased temporarily, and returns to its original value only after a considerable time. It was found that two 100-volt, fifty-candle-power lamps with large bulbs, which had been tested at ninety-five volts and had been run accidentally at about twice this value for a few seconds, showed an increase of four and one-half and seven per cent in their candle-powers, respectively, when burned at the normal working potential of ninety-five. This increase in candle-power was maintained for two or three hundred hours, and then began to die away. At the end of a month they were still about 2.2 and 4.2 per cent above their former values. This hysteresis effect is of importance in aging lamps intended for secondary standards. If burned at a voltage above that for which they are intended they should not be calibrated for some time after. Another factor affecting the candle-power of incandescent lamps is the temperature of the photometer room. Fleming found that a change of nine degrees centigrade might produce a change of one per cent in the candle-power of an incandescent lamp. It is thought that a study of the new metallic-filament lamps may lead to some improvements in the construction of incandescent standards. The tantalum lamp, for example, varies in candle-power only as the fourth power of the voltage. For this reason it is distinctly better as a standard than the carbon lamp. —*Abstracted from the Electrician (London), September 14.*

The Advantages and Disadvantages of Different Systems of Tramway Brakes.

A translation is given here of two reports submitted by M. Scholtes, director of the Nuremburg-Für h Tramways, and E. R. Bjorkegren, chief engineer of the Grosse Berliner Strassenbahn, to the Congress of the Union Internationale de Tramways et de Chemins de Fer d'Intérêt Local. These gentlemen constituted a committee, but were unable to come to similar conclusions, and therefore submitted independent reports. That of M. Scholtes is rather statistical and shows that out of 7,500 equipments 3,673 were electric brakes, 2,316 hand-brakes, the remainder being air-brakes. Examining the cost of operation of compressed air and electric brakes, the advantage is found to be in favor of the latter. The cost of installation and maintenance is also in favor of the electric brake. M. Scholtes therefore concludes as follows: In the choice of a braking system all the particular circumstances of the service should be taken into account. The application of the three systems—the hand-brake, the electric brake and the air-brake—should be carefully studied. Braking should take place without shocks. The equipment of the car should include two systems of brakes completely independent of one another. The brakes in general use should be such as not to cause fatigue to the driver. When, on account of the weight of the cars, on account of trailers, or on account of the difficulties of the route, the hand-brake can not rationally be employed, a mechanical brake should be used, preferably an electric brake. If the use of an electric brake for general purposes necessitates certain inconveniences, such as, for example, choice of too large a motor or too much graduation in the starting resistances, in such a case it would be well to employ a compressed-air brake. The use of the latter system would be a necessity in the case of the cars being heavy or running at a high speed, or in the event of trains including more than two trailers. M. Bjorkegren, while coming to the same determinations as M. Scholtes so far as the cost is concerned, holds that statistical studies are of minor importance in such questions. The main thing is to obtain a brake which will be the most reliable under all possible conditions. The disadvantage of the electric brake is that it does not act instantaneously, as does the air-brake, and it, therefore, does not give the driver the same confidence. Although the electric brake is cheaper to install and costs less to operate and maintain, when it is a question of running cars or trains consisting of heavy vehicles, he believes that air-brakes are to be preferred. He modifies the conclusions of M. Scholtes's report as follows: in the choice of a system of brakes all the particular circumstances of the case should be considered. The application of each of the three systems—the hand-brake, the electric brake and the air-brake—should be carefully studied. The brake for general use should allow for braking without shock, and should not cause fatigue to the driver. It should, at the same time, be suitable for use in case of emergency, and as such should work sufficiently rapid and with certainty. In addition to this brake for general use the equipment of the car should include a second auxiliary brake. When, on account of the weight of the cars, the use of trailers, or on account of the route, the hand-brake can no longer be rationally used as a service brake, a mechanical brake should be used, preferably an air-brake.—*Abstracted from the Electrician (London), September 7.*

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

ORGANIZATION AND CONDUCT OF A NEW-BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.[1]

BY W. RANDOLPH SWEANY.

The foundation of a new-business department, like everything else, depends upon its setting. The public expects to have its patronage appreciated, therefore it is necessary to be in a position to handle in a business-like manner any request coming from the consumer. Complaints should receive the same polite attention as orders for service. The greatest advertisement is a satisfied consumer. Except in rare cases, the operating man of the central station company is not qualified to treat with the consumer. In some instances they feel antagonistic owing to frequent reflections on the quality of service furnished. For companies of the size this paper concerns, it is not always found practicable for the head of the new-business department, generally known as the contract agent, to devote his time to the office, in which case for the convenience of the consumer and the public, an office presided over by one with a thorough knowledge of the business, together with keen commercial instincts, should be established for handling orders, complaints, etc. It is not advisable to associate the title complaint department with this office, as it is too suggestively inviting. As the business grows this office should be brought under the control of the person in charge of the new-business department, as it is necessary that this officer should be thoroughly in touch with the established business in order to intelligently prosecute a successful business-getting campaign.

The sale of electricity should be conducted along the same lines as any other staple, manufactured product. The number of solicitors employed in the new-business department, theoretically, should be governed by the greatest number that can individually earn a profit on themselves. This can be readily figured out.

Herewith is set forth a diagram showing a practical organization, with the line of connection and intercommunication.

[1] In the prize contest inaugurated by the Cooperative Electrical Development Association, this paper received an honorable mention.

The organization as shown on the diagram is composed of eight men, all of whom are productive. The contract agent is responsible for the growth of the business. He is assisted by seven others: one general office and publicity man, two special, and four district solicitors.

In cities with a population of 40,000, drop out two district solicitors from the number shown in the above diagram. Where the population is 30,000, drop out two district solicitors and the contract agent, the manager or superintendent assuming the contract agent's duties. With a population of 20,000, drop out two district solicitors, the contract agent, and combine the duties of the power and new-building agent with that of the sign and heating, etc., agent. For cities with a population of less than 20,000, the manager or superintendent can assume the duties of the contract agent and office man, and the soliciting force be composed of a special power and sign, etc., agent, and two district solicitors. If found necessary to further reduce the force owing to limited territory, one or both district solicitors can be dropped, retaining the special power, etc., agent.

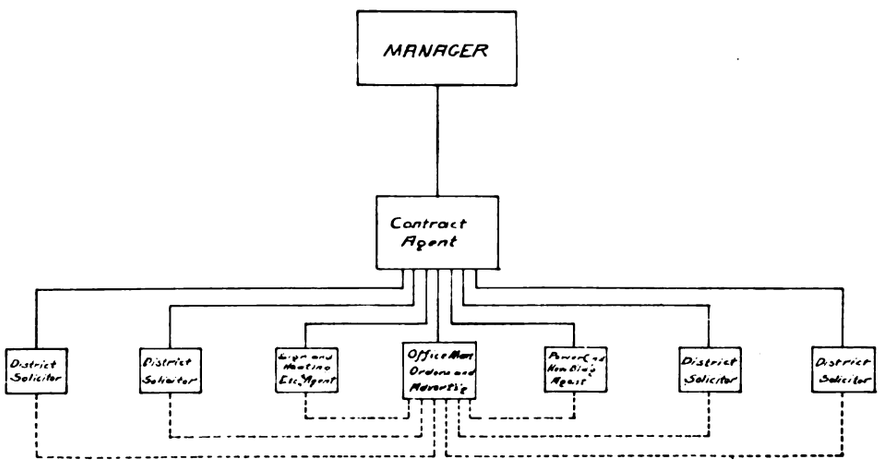


DIAGRAM SHOWING ORGANIZATION OF NEW BUSINESS DEPARTMENT.

The possibilities of a central station company's business are too great to neglect, by curtailing in the soliciting department. If economies must be practiced, first look elsewhere.

The qualifications of a successful contract agent are too numerous. He should have a technical and practical knowledge of electricity and mechanics in general, disciplinary ability, and extraordinary business capacity, combined with a strong personality; he must be able to inspire confidence, not only in the prospective consumer, but in the men under him. It is through this latter channel that he will obtain the best results. His duty is to keep himself and the solicitors abreast of the latest developments in the application of electricity. The entire contract department should assemble at least two evenings a month, to bring out talking points, review business secured, and talk over new plans. Interest must not be allowed to lag. He should as far as possible become acquainted with the company's consumers, keep in touch with all civic organizations, new developments and improvements. In addition to supervising the work of the solicitors and the publicity department, he should personally handle all the large contracts, or what might be termed the wholesale end of the business.

The position of office man, in charge of orders and advertising, should be filled by one conversant with the requirements of a general mercantile business: he should have at least an elementary knowledge of electricity and should be posted on the class of service furnished and the location of the company's lines. On him will fall the clerical work of the department, keeping records, compiling data, issuance of orders, and last but not least, the publicity or advertising work.

The power and new-building agent, shown in the diagram, should be selected

Digitized by Google

with great care and be of the highest grade obtainable. His qualifications are set forth in the following diagram:

Qualifications of Special Power and New-building Agent.	Technical training. Practical shop experience. Ability to estimate cost of operation under all conditions. Ability to draw up general specifications. Settled age. Good judgment. Salesmanship. Good character. Attention to detail. Persistence.

The duty of this special agent is combatting isolated plants, and handling all power propositions on installations of five horse-power and over; also close acquaintance with architects and builders, draughting of specifications on wiring, installing of light, power and heat; in general, soliciting all power business, together with contingent lighting. This agent starts with the building permit.

Should the city in question be a manufacturing centre, a district solicitor should be dropped and an extra special power, etc., agent employed.

The sign and heating, etc., agent, shown in the diagram, should have all the qualifications of a good salesman; no technical knowledge is necessary, yet he should understand the elements of electricity, appreciate the advantages of advertising, and be able to exploit same; his best education is experience, and if he is of the right sort his value grows with it. He should understand and be able to make mechanical drawings and have ability in free-hand sketching. The plain electric sign letter is not suitable in all cases; the majority of merchants prefer original and individual design in their signs. In addition to his duties as sign agent, he should introduce small motor-driven exhaust fans, coffee mills, meat choppers, etc.; also electric irons, coffee percolators, urns, griddles, etc.

The four district solicitors should have all the qualifications of the sign agent and, in addition, possess a practical knowledge of illumination. The lack of this knowledge will retard the sale of electric lights and generate the dissatisfied customer quicker than anything else. Each of these solicitors should be placed in a fixed territory and should be selected so that he is suited to the class of people he comes in contact with. It is better not to change territories if the solicitors meet all the requirements.

IN GENERAL.

A space in the general office, and the show-windows, should be devoted to display, demonstrating the different applications of lighting, small motors, and heating and cooking appliances; this will greatly assist in making popular devices that improve the day load.

The central station, to enjoy the business that belongs to it, should advertise. This is frequently done ineffectually and much money wasted. At a moderate expense a very effective, productive publicity can be maintained. A follow-up system of letters, interspersed with attractive folders with cuts and descriptions, will reach people not seen by the solicitors. Such things are bound to create a desire. When this is accomplished the consummation of the trade is left to the solicitors. These letters and folders can be bought from advertising concerns engaged in this line of business at less cost than if designed by the central station company and turned out by local engravers and printers. Such of these that go to consumers can be enclosed with the monthly bill, saving postage. It is best not to be too general in advertising; drive one thing at a time. The consumer using electricity for lighting only presents a good opportunity for the advertising department; signs, small motors, heating and cooking devices can be constantly brought to his attention, their application and usefulness shown.

In connection with the display part of the business, the central station company should be able to demonstrate the uses of each device it exploits. Although the sign business presents many difficulties, a business arrangement with one or a number of electric sign manufacturers is preferable. It pays to sell signs, heating and cooking appliances, sewing-machine motors, etc., from samples shown in the display room.

Only by sticking to system can the best results be obtained. A great many solicitors are prone to hit only the high places. Make a directory for the office, of consumers and prospective consumers, classify the business, see that all are approached, not once, but many times. Keep a card file of calls and results. Call on the old consumers; find out if they are satisfied; if not, suggest some appropriate change.

For the convenience of solicitors, loose-leaf books that can be carried in the pocket should be provided. These books should contain rules, formulas and data on all subjects pertaining to their business, such as the average consumption of lamps, motors, etc. Percentage of average load to connected load in different businesses, cost of all current-consuming devices, cuts showing the proper distribution of light, etc.

Regarding the necessary forms in the new-business department, a check on the solicitors, their calls and appointments is best kept by the card-file system. For the solicitor, a calendar is used for appointments. The following is a form for calls and results from which is taken a monthly or bi-monthly summary, showing business secured, business lost, its cause and prospective business:

DUPLICATE

CONTRACT DEPARTMENT CALL REPORT No.....

THE..... ELECTRIC CO.

Date..... .....M.....190...

Saw M..... *Address .....*

Previous appointment..... *Heard of from.....Seen at.....*

Present installation..... *Business .....*

Called in reference to..... .....

.....

.....

.....

.....

.....

.....

..... *Date of next appointment.....*

Disposition ....

Complaints ....

Expense incurred..... *Collections .....*

Agent ..... *Checked by.....*

The remuneration of solicitors should be on a fixed-salary basis and not salary and commission. The right sort needs no extra incentive. If he is entitled to an increase and the business justifies it, give it to him; if not, drop him if he is dissatisfied. Either the company or the

Digitized by Google

solicitor gets the worst of it on a commission basis. The interest must be mutual.

RATES.

It is not meant in this paper to refer to rates other than to say they are, of course, the largest factor concerned in regulating the amount of new business secured. They should be as simple as possible, published, not concealed, and with the exception of sign and show lighting, which can be placed on a switching circuit under control of the company, should be entirely on a meter basis.

Electricity is a mysterious force, and, as the steady-going public dislikes unknown quantities, a campaign of education is necessary, which, if properly and systematically carried out, will surely bring the desired results. The public is simply waiting to be taught the advantages the use of electricity offers. With it can be supplied light, power and heat, in innumerable ways. This the general public understands only in a vague manner. At least one of the three commodities is indispensable to every human being. The desire being created owing to the necessity, the advantages can be readily shown. Believe in it yourself, and you will inspire confidence; present it properly, and business must follow. Advertise! Solicit!

Rules for Wireless Telegraphy in Time of War.

At the closing session of the Institute of International Law, held recently in Ghent, Belgium, the following articles relative to wireless telegraphy were voted:

The regulations governing wireless telegraphy in time of peace are applicable in principle in time of war. Belligerents may prevent the transmission of Hertzian waves by a neutral state over the high seas within the sphere of their military operations.

All persons taken prisoners while receiving or transmitting wireless messages from belligerent territory or between different sections of a belligerent army are not to be considered spies, but are to be treated as prisoners of war, unless their operations were carried on under false pretenses.

Carriers of dispatches received by wireless who make use of concealment or ruse in their work will be regarded as spies.

Neutral ships and balloons proved to have been used to furnish an adversary with information helpful in the conduct of hostilities may be removed from the zone of hostilities and the wireless apparatus on board seized and sequestrated.

A neutral state is not obliged to prevent the passage across its territory of Hertzian waves destined to a country at war. A neutral state has the right to close or take over the wireless telegraphy station of a belligerent operated in its territory. Every prohibition in the matter of wireless communication made by belligerents must at once be communicated to neutral governments.

"Wood Preservation."

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In your issue of August 25 last, a very interesting notice appears, abstracted from the *Transit* of Iowa, on the subject of wood preservation. We venture to think that some of the conclusions arrived at are open to criticism, particularly the advantages which are supposed to accrue from steaming or the seasoning of wood in water. In regard to the former, while the steaming process may usefully coagulate the albuminous matter in the sap it also decomposes many of the natural juices of the timber, thereby injuriously affecting its strength as well as providing nourishment for fungal attack. Wood thus treated is "dead," and although rapid drying is accomplished the wood is neither seasoned nor preserved. In regard to seasoning by immersion in water, there are some advantages in connection with this method, but at the best it is incomplete, and in addition to seriously discoloring the wood, shakes are often developed, and, as the pores of the wood remain open, dry rot afterwards easily sets in.

The methods for preserving wood, afterwards referred to in this notice, have been more or less largely used and they certainly have some merit.

As it has been long recognized that effective wood preservation can only be accomplished by thoroughly impregnating the wood, the substance to be utilized must be antiseptic, fairly liquid or soluble, and inexpensive.

A process has recently been introduced into this country which seems to meet these requirements; the basis of the solution used is sugar. Professor G. S. Boulger, F. L. S., etc., whose name is well known in the States through his manual "Wood," says of this process: "Sugar, especially beet sugar, is a simple, stable carbohydrate, incapable, in the absence of soluble nitrogenous matter, of nourishing septic organisms. When in solution it has a high boiling point, and has been shown experimentally to have a greater power of diffusion through the wood than water has. Some of the sugar is so absorbed by the tissues of the wood as not to be readily parted from them; and, as at the same time it is not visible under the microscope in the interior of the wood, either as crystals or as drops of syrup, it is probably in some such loose molecular combination with the walls of the histological elements of the wood as water is in the walls of living cells. Its high boiling point gives it a penetrating power which enables the pressure employed in so many other processes to be dispensed with; and, while to some extent mechanically filling up the pores of the wood, it produces no grittiness, and even improves the surface of the wood for paint or polish."

This process is being adopted in this country for the treatment of all kinds of woods from paving blocks to the finest furniture woods. By it timber can be seasoned in a few days from being cut down and rendered equal, if not superior to that which has been "naturally" seasoned for years.

THE POWELL WOOD-PROCESS SYNDICATE, LTD.,
E. R. SCAMMELL, Secretary.

London, England, September 26.

Annual Report of the New York, New Haven & Hartford Railroad.

The annual report of the New York, New Haven & Hartford Railroad for the year ending June 30, 1906, has been issued. The gross earnings from operation were $52,984,322; the operating expenses, $35,222,586; net earnings, $17,761,735; income from other sources, $2,175,757; total income, $19,937,493; net income, after deducting taxes, rentals of leased lines and interest, $10,186,377. After paying dividends there was a surplus of $3,713,288.

President Mellen announces, concerning the work of electrifying the Harlem end of the New York division, that the actual initiation of electrical operation will be delayed on account of slow deliveries of material, but the electrical operation should begin before the close of the present year.

Concerning the reduction of fares, President Mellen is quoted as follows: "On January 13, 1906, the directors authorized a reduction of local passenger fares to a maximum of two cents per mile, figured in multiples of five. We are justified, from the returns at hand, in stating that the business has been stimulated to such an extent that an increased income, both gross and net, is assured as a result of the policy."

Concerning the opposition in Massachusetts to the ownership by the company of the securities of certain street railway companies in that state, President Mellen states that a sale was made on June 25 of such securities to the New England Investment and Security Company. Mr. Mellen declares that "it was useless to continue the investments and be a target of attack and misrepresentation that would have been the result."

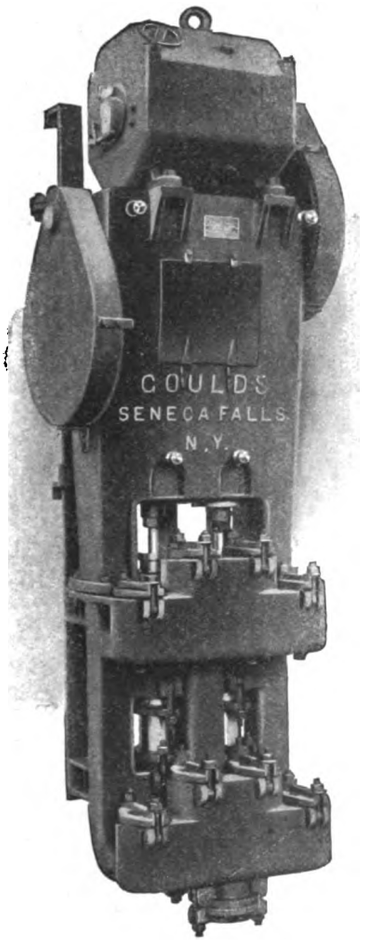
Digitized by Google

INDUSTRIAL SECTION

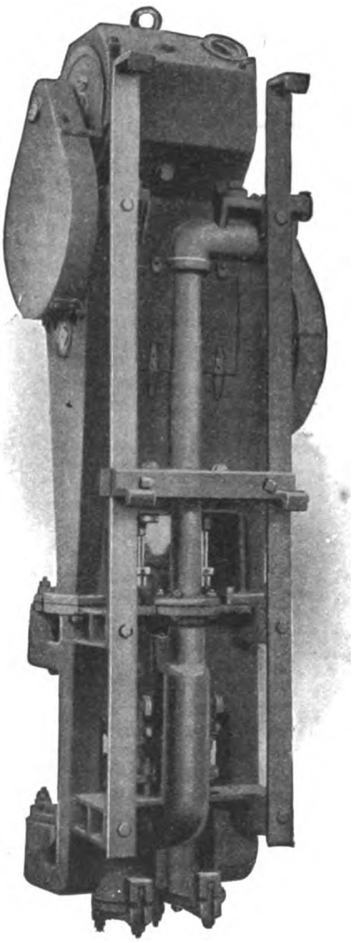
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Goulds Electric Mine-Sinking Pump.

In many applications to mine sinking the electrically driven pump has been utilized to great advantage. Where the service required calls for pumping from the mine bottom to the mine pump or to the station pump the flexibility of the electrical control, the compact arrangement of the motor-driven pump and the exposure to which the apparatus can be subjected have made these devices of exceptional utility.



FRONT VIEW, GOULDS ELECTRIC MINE-SINKING PUMP.



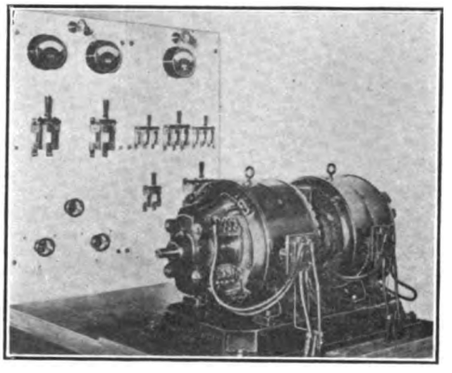
REAR VIEW, GOULDS ELECTRIC MINE-SINKING PUMP.

The accompanying illustrations show a front and a rear view of an electric mine-sinking pump made by the Goulds Manufacturing Company, Seneca Falls, N. Y. This is an electric double-acting sinking pump, outside packed. The motor gearing and all working parts are protected by a strong casing, so that the motor can not be injured by abrasion or falling rocks. All parts of the pump and motor are easily accessible through ample hand-hole plates. The working pressure is 130 pounds or 300 feet elevation. The capacity is 5,640 gallons to 10,320 gallons per hour. With plungers of four and one-half inches diameter and six inches stroke, at sixty revolutions, the capacity is generally ninety-four gallons per minute. This pump, with a four-inch suction and three-inch discharge, requires a fifteen-horse-power motor for a 300-foot elevation. With plungers of six inches diameter and six inches stroke, at a speed of sixty revolutions per minute, the capacity is generally 172 gallons per minute. With a suction of five inches and a discharge of four inches the motor required for a 300-foot elevation is rated at twenty-five horse-power.

The Multiple-Voltage System of Motor Control in New England Cloth-Printing Establishments.

The accompanying illustration shows the multiple-voltage balancing set as installed by the Allis-Chalmers Company, Milwaukee, Wis., in several New England cloth-printing establishments. The successful operation of these installations has developed a wide field for the application of electric motors in this industry, installations having been made in the United States Finishing Company, Norwich, Ct.; the Algonquin Printing Company, Fall River, Mass.; Glenlyon Dye Works, Phillipsdale, R. I., and the Arnold Print Works, North Adams, Mass.

The business of cloth-printing is an extensive one, and in most cases is done



MULTI-VOLTAGE BALANCER SET AND SWITCHBOARD.

under contract, the mill supplying the cloth as it comes from the looms to the finishing company, which does the printing and puts it in proper condition for the market. The cloth-printing machine consists of a large revolving cylinder, around which the cloth passes; and, bearing against the cylinder, with the cloth between, are one or more—sometimes as many as ten—copper rolls, called printing rolls, upon which the design has been engraved, the number of rolls being dependent upon the number of colors used. These rolls, in revolving, take up from a trough certain colors which are impressed in design upon the cloth. From the printing machine the cloth passes through drying rooms heated by steam to a high

Digitized by Google

temperature, emerging with the ink entirely dry.

Previous to the adoption of the electric motor the printing machines were usually driven by twin-cylinder engines direct-coupled to a main driving shaft. The variation in speed was obtained by hand-throttling the engine. The printing room was encumbered with line shafting and belting, with its accompaniment of dust and dirt-carrying possibilities. With the old system of operation the exhaust steam from the engines was used for heating water for the dye works and for other purposes, but it is said that the gain has been so great that live steam may now be used economically for these purposes.

The usual method of equipping a printing machine is to install the motor on the floor below the printing room and belt it up to a driving pulley on the main shaft of the machine.

On account of the very slow speeds required at different times the four-wire multiple-voltage system is selected in preference to the three-wire system. To obtain the slowest speeds a few steps of armature resistance are used, and this has necessitated the development of a special type of controller. This controller will give eighteen speeds, the very slow speeds being obtained through the use of armature resistance.

The power necessary to drive the printing machine depends upon the number of colors for which it is built, and, in addition, the pressure necessary to force the ink into the cloth being printed. Experience has demonstrated that for a machine built for three colors or less a seventeen and one-half-horse-power motor is well adapted, and for any greater number of colors a thirty-horse-power motor is recommended.

A New Capstan Cable Jack.

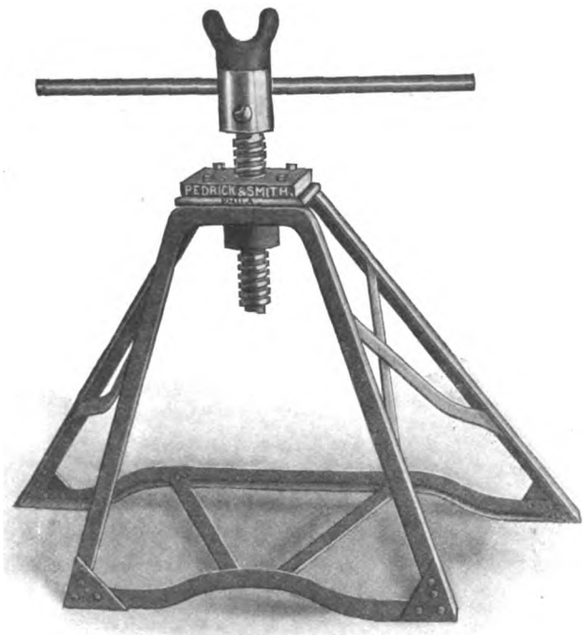
The accompanying illustration shows a new form of structural steel screw capstan cable jack which has recently been placed upon the market. Much trouble has been experienced in utilizing cable jacks for handling heavy drums, because of the cumbersome nature of the apparatus and the great weight generally attached to these machines. The device illustrated herewith is claimed by the makers to serve every purpose for which it is designed, and while strong and capable of handling the heaviest drums, it is readily portable, weighing but sixty pounds. When the drum is revolving no vibration is noticed.

The stand is formed from strongly braced steel angles. The jacks are used in pairs, one on each side of the drum, which revolves on an axle. The illustration shows a jack ready for the drum. The side that faces in the direct foreground is the side that stands next to the drum. This is referred to as the inner support, the opposite side being referred to as the outer support. The inner support is constructed to take up as little room as possible. There is but little slope —about one and one-half inches from the perpendicular. This feature adds strength, as it allows the drum to revolve very close to the supporting jacks. The spread of the jacks covers fourteen inches, which does not interfere with the man operating the drum. This enables the placing of the drum nearly over the manhole or aperture into which the cable is being laid.

The supporting feature is vested in the outer support. The slope of the outer support from the drum is five and one-half inches from the perpendicular. Its spread is thirty-six inches, assuring a condition of stability and equilibrium.

The screw is of heavy pitch and will elevate the drum rapidly with little effort.

The apparatus is manufactured by Pedrick & Smith, Church Lane and Philadelphia & Reading Railway, Germantown, Philadelphia, Pa.

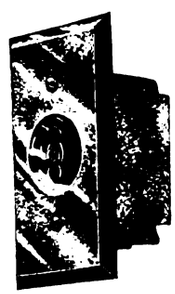


A New Capstan Cable Jack.

A 250-Volt, Double-Pole Rotary Flush Switch.

In response to a demand from a number of prominent engineers and architects, the Marshall Electric Manufacturing Company, Boston, Mass., has designed, and for some time has had on the market, a rotary flush switch which, it claims, is meeting the latest requirements.

The first peculiarity of this design is the fastening of the face-plate solidly to the back of the switch by screws, doing away with the arrangement of having the plate fastened by the handle, which, it is said, strains the mechanism and allows the plate to become lopsided after a short period of use. These face-plates are made from cast metal somewhat thicker than the usual custom.



Ten-Ampere, 250-Volt, Double-Pole Rotary Flush Switch.

The switches are furnished with handles, the ends of which are exactly even with the face-plate, so that nothing can be hung or fastened to the handles when the switch is in position. When an ordinary type of extending handle is desired, this can be furnished for this switch.

Another feature is the use of a fibre false plate, which is attached to the switch when it is sent out, and which securely seals the mechanism from plaster and dirt between the time of installation and the attachment of the finishing plate. These switches are now carried in stock at the New York office, 227 Fulton street; the Chicago office, 169 Adams street, as well as at the Boston works.

Digitized by Google

The Manufacture of Storage-Battery Plates.

The accompanying illustrations are interesting as showing the mechanical construction of the plate used in the well-known Gould storage battery.

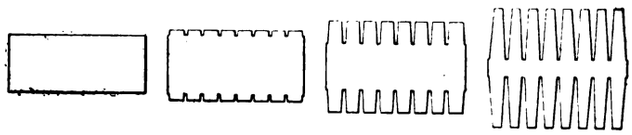


FIG 1.—FRAGMENT OF PLATE SHOWING MANNER IN WHICH CONTACT SURFACE IS FORMED.

The Gould plate is of the Planté type, in which the active material is formed electrochemically out of the lead composing the contact surface between the ribs, filling the spaces

FIG. 2 —LONGITUDINAL SECTION OF PLATE, SHOWING WEB OF METAL LEFT AFTER SPINNING.

ing the supporting plate of contact surface. Fig. 1 is a fragment of a Gould plate, illustrating the manner in which the large contact surface for the active material is developed out of a sheet of rolled lead cut to the size and shape of the

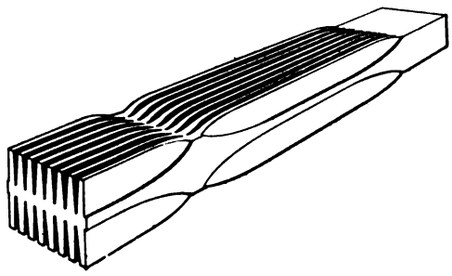


FIG. 3.—PERSPECTIVE OF FRAGMENT OF FINISHED PLATE.

plate. This blank is placed between two shafts, on which are mounted sets of rapidly revolving steel discs with spacing washers. These washers are pressed

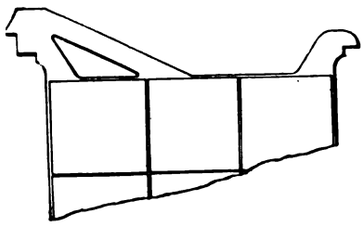


FIG. 4.—OUTLINE OF PLATE SHOWING DOUBLE CONDUCTING LUG.

against the plate and moved to and fro, working into the lead further and further, and spinning the metal up between the discs into thin parallel ribs.

Fig. 2 is a longitudinal section of a fragment of a plate and shows the web of metal left as a central conductor, and also the diamond-shaped cross-conductors and current-distributing bars.

Fig. 3 is a perspective drawing of a small fragment of finished plate, and clearly indicates the character of the construction. The active material is formed out of the lead composing the contact surface between the ribs, filling the spaces with closely compacted but highly porous active material.

Fig. 4 shows the double conducting lug, by means of which a large distributing surface is secured.

A San Francisco "Branch Office."

The accompanying illustration shows the establishment of the John R. Cole Company, 766-770 Folsom street, San Francisco, Cal., which was constructed and occupied in six weeks after the earthquake and general disaster. The company is one of the progressive manufacturers' agencies on the Pacific coast and represents the following interests: American Circular Loom Company; Harvey Hubbell, Inc.; George F. Brunt Porcelain Company; New York Insulated Wire Company; Bossert Electric Construction Company; Cutter Electrical and Manufacturing Company, and the Chase-Shawmut Company. A special consignment of building material was obtained, and the galvanized sheet iron which was used enabled the construction to be rapidly accomplished. The absence of show-windows and other superfluous paraphernalia as generally observed by commercial establishments is a conspicuous feature. This company is practically a branch of the several manufacturers which it represents, consequently it carries large stocks of each of their products, and as soon as the building was constructed new consignments were on hand, so that the actual interruption of the company's business was something less than six weeks.

A SAN FRANCISCO "BRANCH OFFICE."

A Large Installation of Gas-Engine-Driven Generators for Traction Purposes.

The Allis-Chalmers Company, Milwaukee, Wis., has secured a contract for gas-engine-driven electric power equipment for the Milwaukee Northern Railway, the southern terminal of which will be located at Milwaukee, Wis. The engineer and contractor for this new interurban line is the Comstock-Haigh-Walker Company, Detroit, Mich. The equipment ordered from the Allis-Chalmers Company comprises three twin-tandem gas engines, 1,500 horse-power, direct-connected to three 1,000-kilowatt, three-phase, twenty-five-cycle alternators, together with gas-

Digitized by Google

driven exciter sets and complete equipments for eight substations.

The present northern terminal of the system will be at Port Washington, Wis. It is expected that cars will be in operation by June, 1907. The main powerhouse is at Port Washington, and sites for substations have been provided at Burleigh, Cedarburg, Georgia avenue, Marblehead, Brown Deer, Cedar Grove, West Bend and Campbellsport. As soon as grading and construction work between Milwaukee and Port Washington is completed, work will be begun from Cedarburg to Fond du Lac. The route from Port Washington to Milwaukee is over a private right of way for almost the entire distance.

Gasolene-Electric Apparatus for Moving a Drawbridge.

A year ago, when the lake traffic was resumed, the cities of Houghton and Hancock, Mich., experienced an unlooked-for accident by being suddenly deprived of their bridge connection. This not only inconvenienced the public in general, but blocked one of Uncle Sam's highways of commerce, prevented street car companies from making through connections, and compelled a steam railroad company to change its schedule and transfer its passengers and freight by ferry for a whole year. The cause of this unlooked-for and costly event in the history of a busy centre was "lack of steam pressure" when the bridge operator wished to open the draw. The usual whistle was given him by a large freighter, but the operator, who was busy with his "getting-up-steam proposition," failed to give his danger signal, and the result was that the freighter struck the draw, and the bridge was thrown across the channel, a wreck.

The county commissioners and representative engineers of the steam and electric railroad companies, having placed the contracts for the removal of the wreckage and reconstruction of the bridge, were not desirous of another such experience with a steam outfit, and after deliberation over a number of bids and schemes the contract for motive power was awarded to Fairbanks, Morse & Company, of Chicago, for gasolene engines, electrical equipment and scheme of operation.

The new bridge structure is a double-deck draw, having the steam railroad tracks on the lower deck and the street car track and foot passenger walk on the upper deck. It measures 290 feet over all and weighs 800 tons. The operating house is placed at the top of the centre tower above the highway. A Fairbanks-Morse motor operates the end-lifts on each end of the draw, and two larger motors connected by gearing to the rack constitute the power for turning purposes. The power for operating these motors is obtained from one of several sources which have been arranged for in the operating house. The motors on the lower deck are operated by a series-parallel controller, placed centrally in the operating house.

Two twenty-five-horse-power gasolene engines direct-connected to dynamos are installed in this operating house, and a storage battery has been placed on the balcony of the room.

A white Italian marble switchboard has been furnished, and by a specially designed switch it is possible to obtain power from any one of six sources, as follows:

Battery only (which is capable of turning the bridge thirty times on one charge).

No. 1 generator and battery together.

No. 1 generator.

No. 2 generator and battery together.

No. 2 generator.

Both generators in parallel.

As a seventh and last resource, provision has been made to charge the battery from the trolley circuit, which is directly under the operating room.

The special switch is so arranged that only one combination can possibly be made at a time, and therefore no fear of disaster need be entertained through inexperienced handling.

The contract called for the bridge to be opened in one minute, whereas it is possible to open it in one-half minute if the emergency should arise. The engines can be started up from rest, dynamos brought up to voltage, and motors operating in less than three minutes, which is more than ample time required for general operation.

Electrical Developments in Japan.

We have from time to time noticed the prominent place which the electrical and cognate industries occupy in the rapid development of Japan, and a report on the trade of the consular district of Yokohama, issued by the foreign office, truly reflects the activities indicated in our previous notices. A feature of the report is the increased imports of tools and machinery, which is suggestive of several items in Japan's industrial expansion. Particularly noticeable, however, are the increases in electric motors (from $475,995 to $838,995) and electric light apparatus, gas engines, etc. Among the principal items of import at the port of Yokohama during the year 1905 were 7,368 tons of telegraph wire, valuing $374,345. The value of the electric light apparatus imported was $195,910, as against $147,645, an increase of $48,265. This increase eclipses even the steady average—$36,285—maintained between the years 1900-4. As we have already pointed out, the imports of electric motors show a noticeable increase of $363,000; gas engines were imported to the value of $43,435, an increase of no less than $22,035 within one year: while steam engines and boilers maintain a steady advance, without, however, attaining the high average increase registered between the years 1900-4. $334,850 worth of electric light wire was imported at Yokohama during 1905, comparing with $325,385 for the previous year; submarine and underground telegraph cables, however, show a decrease in the value of import to the amount of $249,925. One of the disquieting features about the figures contained in the report is that, with the exception of submarine cables, nearly all the imports of electrical machinery and apparatus came from the United States or Germany. Of course, it may seem in the nature of a truism to observe that such a state of affairs must be dependent upon many factors. Yet we can not repress the thought which suggests that one of the most important factors—that of enterprise and "go," as our American friends would term it—is not sufficiently applied by our manufacturers. With our home market cut up by competition, fostered by the absence of a tariff wall, our home lies abroad, and what Sir William Mather last week told the shareholders of Mather & Platt about his firm's entry into the highly protected markets of terror-stricken Russia, can surely be copied in an enlightened and sympathetic country as Japan. We also learn from a French source that hydroelectric works are well under way in that empire. At the present moment a station is being constructed with a power of 19,500 kilowatts to serve the town of Tokio. Five Pelton turbines are being installed of 3,000 kilowatts each, driving direct 6,000-volt, twenty-five-cycle alternators. Current at 40,000 volts will be transmitted from the falls to Tokio, a distance of forty kilometres, and later it is intended to increase the voltage to 60,000. Japanese capitalists have approached the minister of agriculture for the concession to utilize two waterfalls in Korea for the generation of electricity. A thirty-year concession is sought for, after which the works will revert to the Korean government.—*Electrical Engineer (London)*.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

NORTH GEORGIA ELECTRIC COMPANY TO INCREASE STOCK—The capital stock of the North Georgia Electric Company will be increased from $5,000,000 to $7,500,000. The company has obtained a franchise to distribute current in Atlanta.

ELECTRIC CONSTRUCTION CONCERN FORMED—The Electric Operating Construction Company of New York City has been incorporated with a capital of $1,000,000. The directors are: A. D. Bowen, San Francisco; Maurice A. Viele, George C. Hutchinson, of New York; R. S. Masson, Los Angeles, and W. D. Beardsley, of Nyack.

RIO DE JANEIRO TRAMWAY LIGHT AND POWER COMPANY—The Rio de Janeiro Tramway, Light and Power Company is ready to deliver 3,500 horse-power from a temporary plant, and the big plant under construction from which 48,000 horse-power will be secured will be in operation within fifteen months. Conditions favor an immediate market for all the power the company will have available.

MUNICIPAL OWNERSHIP IN ATLANTA—The agitation for municipal ownership of gas and electric plants in Atlanta, Ga., continues, led by Alderman Kay and other citizens. A municipal ownership league is forming. The proposition is for the city to issue bonds and begin by building a municipal lighting plant for its own use, to be extended to include a general lighting and gas system. There is also a sentiment in favor of taking over the street railway, but no definite campaign is made in this direction.

MANHATTAN RAILWAY COMPANY TO ISSUE NEW STOCK—The state railroad commission has granted permission to the Manhattan Railway Company of New York, to issue $4,800,000 new stock for construction and equipment. A good part of the money to be received from the sale of stock has already been expended on the elevated lines. The commission has granted permission to the New York & Queens County Railway Company to issue a mortgage for $10,000,000. Under the order of the commission only $8,000,000 can be issued by the road at this time. All but $2,000,000, which is for the refunding of existing mortgages, is for new power-houses and equipment and the reconstruction of a portion of the road.

SOUTHERN PACIFIC TO INSTALL AN ELECTRIC SYSTEM—The Southern Pacific has begun the work of installing an electric system on its line over the Sierra Nevada Mountains for the purpose of helping the heavy freight trains up the steep mountain grades by means of electric motors. Details have not yet been given out, but it is said that the engineers will settle upon the third-rail system. The installation of this system is a radical change in railroad operation in the West. At present freight trains are divided into several sections, and then require two and three engines, with corresponding large crews to haul them up the steep mountain grades. Powerful electric motors will take the place of the engines under the electric system.

STREET RAILWAY CONSOLIDATION—John G. Webb, president and owner of the Columbus, Delaware & Marion Street Railway, which operates street car lines to Marion, Ohio, and which is building an extension from Marion to Bucyrus, Ohio, has been in conference with E. W. Moore, of the Everett-Moore syndicate, with the object of arranging a consolidation in order to establish a through line with Columbus and lake points. The new link contemplated will also connect the Everett-Moore system and the Schoepf system of street railways in Ohio. The street railroads directly involved are the Lake Shore Electric, with $7,500,000 of stock and $7,500,000 bonds; Sandusky, Fremont & Southern, with $2,000,000 of stock and $2,000,000 of bonds; and the Columbus, Delaware & Marion, with $3,000,000 of stock and $3,000,000 of bonds, representing a total of $25,000,000 of securities.

RAILWAY CONCESSION GRANTED IN BOGOTA TO AMERICAN CAPITALISTS—The government of the capital district of Bogota has granted an important and valuable concession, extending over a period of sixty years, for an electric tramway or street car franchise, with exclusive rights, to the streets of Bogota and the roads of the district. This company, incorporated under the laws of New Jersey, and known as the Bogota Street Railway Company, has held a franchise for some years in Bogota which would expire in the comparatively near future. The service is now with mules, but the new franchise calls for electric or other means of more rapid transit. In view of the large amount of money that must be invested to make the necessary changes and improvements, the company sought a new franchise covering a long period, which has been granted.

MERGER OF MEXICAN PROPERTIES DOUBTFUL—According to Alfonso O'Kelard, manager of the Compañia Industrial de Guadalajara, the French Light and Power company of Guadalajara, Mexico, interests identified with La Electra, S. A., the Spanish company, have raised their offer for the French light and power business in that city nearly $1,000,000 since the offer of $1,600,000 was made. It is understood that the exact amount of the last offer made by the Spaniards was $2,500,000. This offer has been likewise refused. Mr. O'Kelard said: "An offer more than fifty per cent in excess of $1,600,000 has been made by interests identified with La Electra, S. A., for the plants and business of the Compañia Industrial de Guadalajara. This offer we have refused." It is said that the Spanish interests are unwilling at this time to pay more for the French holdings, and a consolidation of the light and power interests of Guadalajara now seems doubtful.

PHILADELPHIA COMPANY STOCK ISSUE—The proceeds of the sale of the $3,240,000 of the common stock of the Philadelphia Company made recently at par to the stockholders, are to be used in part to pay $800,000 of notes given for the purchase of the capital stock of the Beaver Valley Traction Company, and also to pay for the capital stock of the Washington & Canonsburg Railway, to the amount of $475,000. The remainder of the proceeds of the issue is to be applied in payment of extensions to gas lines and in advances to other companies controlled by the Philadelphia Company for extensions and improvements as needed, and for corporate purposes. The Beaver Valley Traction Company is a Pennsylvania corporation having a capital stock authorized of $1,500,000 and issued of $1,075,000. Its authorized funded debt is $4,250,000, while the amount outstanding is $1,500,000. The Beaver Valley Traction Company owns and operates thirty-two miles of track connecting various towns and boroughs in the Beaver valley, Beaver county, Pa. The Washington & Canonsburg Railway Company is a Pennsylvania corporation with a capital stock of $1,000,000, of which all is issued. Its funded debt amounts to $650,000. It is a consolidation of the Washington Electric Street Railway Company, and the Canonsburg Street Railway Company, and owns and operates thirteen miles of track.

EXTENSIVE PITTSBURG TRACTION SCHEME—The same men who are backing the Carnegie, Oakdale & McDonald Street Railway Company, which intends to enter Pittsburg in the near future, crossing the Monongahela river, are back of a gigantic scheme to give the people of Pittsburg a new system of street railways, with elevated line and tunnel connections, in opposition to the Pittsburg Railways Company. The lines will cover most of the unoccupied streets of Pittsburg and Wilkinsburg, crossing some streets for which the Pittsburg Railways Company now hold right, considerable private property, and territory now covered by the plans of the Pittsburg Elevated Company. Some of the routes selected are in line with the old Mellon franchises, which were sold to the Pittsburg Railways Company several years ago. Most of the companies follow the names of the main streets or location, which it is proposed to traverse, such as Forbes and Halkett, Harriett, Glenwood, Glenwood avenue, Squirrel Hill, Hale street, Frankstown avenue, Portland street, Coral street. These will be applied for at Harrisburg on October 11. The following are the names of the elevated lines to be applied for on October 24: Water street, Wilkinsburg loop, Glenwood, Forbes connecting, City, Oakland, Lawrenceville, Pittsburg, and Wilkinsburg and Beatty street elevated railway companies.

Digitized by Google

NEW PUBLICATIONS.

SPECIAL REPORTS OF THE CENSUS OFFICE—ELECTRICAL INDUSTRIES, 1902—The Bureau of the Census, Department of Commerce and Labor, has issued, in one volume, the special reports showing the conditions of the electrical industries up to the completion of the census for 1902. This includes reports on the central electric-light and power-stations, street and electric railways, and telephones and telegraphs. Much of this information has already appeared in pamphlet form, the present volume being illuminated by numerous half-tone illustrations of power-stations, station interiors and physical applications of electrical apparatus. The volume is a very valuable compendium upon the present state of electrical development.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES—The prospectus for 1906-1907 of the Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., is ready for distribution. This prospectus contains the preliminary announcement of the anniversary meetings, addresses, lectures, exhibitions, department meetings, concerts, dramatic readings, courses of instruction, schools and other educational work which will be conducted by the institute and its departments during the year 1906-1907. The season of active work begins on Thursday, September 27, 1906, and closes on Saturday, June 1, 1907. The number of anniversary addresses, lectures and department meetings open to every member is 475, or about fourteen for each of the thirty-six weeks of the season. In the department of electricity there will be ten lectures on electrical subjects, a course of illustrated lectures on physical chemistry, six illustrated lectures on "The Use of the Electric Current in Chemical Analysis and in the Preparation of Organic and Inorganic Substances," six illustrated lectures on "Supersensible Radiations or Forms of Motion That Do Not Affect the Senses," and fourteen illustrated lectures on electricity. In the department of engineering there will be a series of illustrated lectures at the regular monthly meetings of the department, held on the third Thursday of each month.

DATES AHEAD.

American Electrochemical Society. New York city, October 8 and 9.

American Society of Mechanical Engineers. New York, N. Y., December 4-7.

American Street and Interurban Railway Engineering Association; American Street and Interurban Railway Association. Columbus, Ohio, October 15-19.

Empire State Gas and Electrical Association. New York city, October 12.

Illuminating Engineering Society. 44 West Twenty-seventh street, New York city, October 12.

Kansas Gas, Water and Electric Light Association. Lawrence, Kan., October 16-17.

Michigan State Electric Association. Grand Rapids, Mich., October 10-12.

National Machine Tool Builders' Association. New York city, October 23-24.

Old Time Telegraphers' and Historical Society. Washington, D. C., October 9, 10 and 11.

Railway Signal Association. Annual meeting, Washington, D. C., New Willard, October 16, 17 and 18.

NEW INCORPORATIONS.

HARRISBURG, PA.—Stoever Electric Light Company, Mount Joy. $5,000.

WAUSAU, WIS.—Wausau Electric Company. Capital increased from $75,000 to $150,000.

ALICE, TEX.—Alice & Rio Grande Telephone Company. $10,000. Incorporators: Felix Hobbs, J. S. Turner and Phil Hobbs.

DOVER, DEL.—People's Car and Electric Company, Mason City, Iowa. To own and direct electrical work of all kinds. $800,000.

CLEO, TEX.—Cleo Telephone Company. $5,000. Incorporators: C. R. Wiliams, Philip Herald, Charles E. Walker, E. E. Christie and others.

HARRISBURG, PA.—Brady's Bend & Butler Street Railway Company. To build a line from East Brady to Chicora, and from Chicora to Butler. President, John Daly.

OLYMPIA, WASH.—Missoula Light and Water Power Company, of Spokane. $400,000. Incorporators: A. H. Wethey, W. M. Bickford, J. K. Heslet, of Butte, and C. E. McBroom, of Spokane.

BELLEVILLE, ILL.—East St. Louis, Granite City, Alton & Suburban Railway Company. $2,500. Incorporators: L. C. Haynes, George V. Pierce, T. W. Gregory, F. H. Thomas and F. E. Allen.

MOUNTAIN VIEW, CAL.—Mountain View Gas and Electric Company. $50,000. Directors: William Neuroth, George Jagels, Fred Dreischmeyer, Jr., and Charles Buschinch, of Mountain View, and Angus McLeod, of San Francisco, Cal.

OKLAHOMA, OKLA.—The Lawton Interurban & Street Railway Company, of Lawton. $100,000. To build an interurban road between Lawton and Fort Sill, and to other points in Comanche county. Incorporators: Frank Broadwell, Frank McMasters, Phil McGrory, B. F. Bowman and George Short.

SPRINGFIELD, ILL.—Moline, Rock Island & Eastern Traction Company, of Rock Island. To construct an electric interurban road from Carbon Cliff to Rock Island, and from Rock Island to Galesburg. $5,000. Incorporators and the first board of directors: James F. Lardner, Frank G. Young, Joseph F. Porter, Herbert E. Casteel and Burton F. Peek.

PERSONAL MENTION.

MR. RALPH BACHE, superintendent at Bound Brook, N. J., for the Public Service Corporation will resign to take charge as manager of the Colorado Springs Electric Company, at Colorado Springs, Colo.

MR. JOHN SMITH, for the past two and one-half years manager of the Jacksonville, Mich., exchange of the Citizen's Telephone Company will retire and his place will be taken by Mr. C. R. Kehoe, formerly wire chief.

MR. E. T. PENROSE has resigned as superintendent and commercial agent of the West Penn Electric Company, and will leave Connellsville, Pa. Under his direction the company has recently been very successful.

MR. JAMES H. FOSTER, secretary-treasurer of the Evansville (Ind.) Gas and Electric Light Company, died at Evansville, on September, 19, aged sixty-two years. He was a graduate of Indiana University, class of '68.

MR. P. W. GREEN, who has been since December last cashier in the Augusta, Ga., exchange of the Southern Bell Telephone and Telegraph Company has been promoted to the post of cashier at the company's Jacksonville, Fla., office.

MR. R. S. LEBEAUX has been appointed manager of the New York office of the Marshall Electric Manufacturing Company, Boston, Mass., taking the place of A. F. Wilson, who has resigned to become associated with the Manhattan Electrical Supply Company.

MR. L. P. ANDREWS, president of the Sedalia (Mo.) Water and Light Company, the Sedalia Waterworks Company and the United Water, Gas and Electric Company, has been appointed receiver of the three companies by Judge John F. Phillips, of the United States Circuit Court.

MR. GEORGE W. WOOD, of Syracuse, N. Y., has been appointed construction engineer of the Central New York and Empire State Telephone and Telegraph companies. The position of superintendent of construction has been abolished and all employés of the construction department have been placed under the direction of Mr. Wood.

MR. R. D. HOLABIRD, of the Holabird-Reynolds Electric Company, Los Angeles, Cal., and the Holabird, Reynolds & Sayles Com-

Digitized by Google

pany, San Francisco, Cal., has been making a trip through the eastern states, visiting last week the Franklin Electric Manufacturing Company, of Hartford, Ct., for which company Mr. Holland acts as San Francisco representative.

MR. ALFRED S. BROWN, for many years an electrical engineer for the Western Union Telegraph Company, died at his home in New York city, on September 26. He began as an operator and worked his way through various positions until he became superintendent of the Eastern District. He held this position for ten years, until he was made chief electrician for the company. He is survived by a widow and two daughters.

MR. CYRUS O. BAKER and MR. JOHN J. CARTY and their families have returned to New York from a six weeks' sojourn at the country place of Miss Annie Russell, sister of Mrs. Carty, on the Maine coast. Both Mr. Baker, who is known as the "Platinum King" of the United States, and Mr. Carty, who is one of the leading telephone engineers of the world, greatly enjoyed their rest from the strenuous life of the metropolis.

MR. A. A. MILLER, the representative of the Westinghouse Electric and Manufacturing Company at Seattle, Wash., was a visitor to New York city last week. Mr. Miller was for a short time connected with the sales office of the Westinghouse company in New York city, and found much pleasure in renewing old acquaintances. He reports a very brisk demand for supplies of all kinds on the Pacific coast, and speaks enthusiastically of the outlook for business in his territory.

MR. HORATIO A. FOSTER, the well-known consulting electrical and mechanical engineer, has become associated with Mr. Lewis B. Stillwell, consulting electrical engineer, of New York city, and will remove his office from the Bullitt Building, Philadelphia, to Baltimore, where he will become resident engineer in charge of the office which Mr. Stillwell has recently opened in the Continental Building. Mr. Foster is the well-known author of Foster's "Electrical Engineer's Pocketbook," and he has also published a useful book relative to central-station accounting, of which subject he has made a special study. Mr. Stillwell has effected a contract with the United Railways and Electric Company, of Baltimore, under which he has assumed the responsibility for electrical and mechanical work in reconstruction and new construction, and will also take entire charge of training a competent force for the proper operation of the plant. Mr. Stillwell regards the organization and training of the force as a very essential feature in connection with the construction of power-plants. The Baltimore work Mr. Stillwell expects to complete within one year.

PROFESSOR DUGALD CALEB JACKSON, of the University of Wisconsin, has been called to the Massachusetts Institute of Technology to become head of the course in physics and electrical engineering left vacant by the resignation of Professor Louis Duncan two years ago. This post has since been occupied temporarily by Professor Clifford. The arrangement will continue until the beginning of the second term, when Professor Jackson will take up active work. Professor Jackson was born in Kennett Square, Pa., in 1865. In 1885 he graduated from the Pennsylvania State College and went to Cornell University for a two-year graduate course in electrical engineering. For two years he was vice-president of the Western Engineering Company, of Lincoln, Neb., and then became affiliated with the Edison interests as assistant chief engineer of the Sprague Electric Railway and Motor Company. Later he became chief engineer of the central district of the Edison General Electric Company. During this period he designed, built and operated many of the largest electric railway and lighting plants, and is now advising engineer for several large corporations. He was a member of the International Jury of the World's Columbian Exposition in 1893, and of the Association of Scientists at the Pan-American Exposition in 1901. He is a member of the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers, and of the Société Internationale des Electriciens.

ELECTRICAL SECURITIES.

For the past week the tendency of the stock market has been steadily downward. While the movement has been irregular, with periods of good recovery, the sentiment has been unsettled, with a growing bearishness, resulting in considerable short selling. As compared with a week ago, prices show general declines. The monetary outlook as a stock market factor was practically a secondary consideration in the concern which was evident concerning the nominations for governor in New York state. The high level for call rates was only 7 per cent last week, against 10 per cent the previous week and 12 per cent and 40 per cent in other weeks of the month. There has been no change in news reflecting widespread industrial activity. The iron and steel demand is almost as unprecedented as is the demand for copper. Railroad earnings are on a record level, and the officials predict a general shortage in equipment, despite recent large additions.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 29.

New York:	*Closing.*
Allis-Chalmers common	17½
Allis-Chalmers preferred	41¾
Brooklyn Rapid Transit	76½
Consolidated Gas	138
General Electric	164½
Interborough-Metropolitan common	36⅛
Interborough-Metropolitan preferred	76¼
Kings County Electric	155
Mackay Companies (Postal Telegraph and Cables) common	71½
Mackay Companies (Postal Telegraph and Cables) preferred	71¼
Manhattan Elevated	145
Metropolitan Street Railway	105½
New York & New Jersey Telephone	127
Western Union	86
Westinghouse Manufacturing Company	155

Directors of the New York & New Jersey Telephone Company have declared the regular quarterly dividend of 1½ per cent, payable October 15 to stockholders of record on October 5.

Boston:	*Closing.*
American Telephone and Telegraph	139¼
Edison Electric Illuminating	234
Massachusetts Electric	70½
New England Telephone	129
Western Telephone and Telegraph preferred	85

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	68¾
Electric Storage Battery preferred	68¾
Philadelphia Electric	8 5/16
Philadelphia Rapid Transit	28¾
United Gas Improvement	85½

An official of the Philadelphia Rapid Transit Company estimates the increase in gross earnings in September at $50,000.

Chicago:	*Closing.*
Chicago Telephone	116
Chicago Edison Light	146
Metropolitan Elevated preferred	66½
National Carbon common	85
National Carbon preferred	116
Union Traction common	—
Union Traction preferred	—

ENGINEERING SOCIETY.

WESTERN SOCIETY OF ENGINEERS—The Western Society of Engineers has announced the following tentative programme: Wednesday, October 17, "Smoke Prevention and Suppression," A. Bement; Wednesday, November 7, "Notes on Road Resistance," C. H. Hudson; Wednesday, November 21, "Waterproofing, Particularly as Applicable to Masonry and Concrete Structures," Edward W. De Knight; Wednesday, December 5, "Concrete Pipe Culverts," O. P. Chamberlain; Wednesday, December 19, "Gravity Switching Yards for Freight Traffic," M. H. North; Tuesday, January 8, 1907, annual meeting and annual dinner.

Digitized by Google

ELECTRIC RAILWAYS.

JAMESTOWN, N. Y.—The Chautauqua Traction line has been opened through to Westfield from Mayville.

NIAGARA FALLS, ONTARIO—An electric railway is to be built between St. Catherines and Niagara-on-the-Lake.

LOCKPORT, N. Y.—The grading work of the Buffalo, Lockport & Rochester trolley line has been completed from Medina to Middleport, and also in sections from Middleport to this city.

BUZZARD'S BAY, MASS.—It is stated that the proposed electric road between this place, Bournesdale, Sagamore and Sandwich will be constructed during the coming winter, and that the line will be in full operation early next summer.

COLUMBIA, S. C.—Work on the new electric line from Columbia college through the property of the North Columbia Land Company has been commenced. The line will extend two miles from the terminus of the Columbia college line.

DALLAS, TEX.—J. F. Strickland, president of the Texas Traction Company, which is to build the Sherman-Dallas interurban line, states that work will begin on the road within thirty days, all papers for the construction having been signed.

PITTSBURG, PA.—It is reported in Homestead that the Pittsburg Railways Company is back of a proposition to build a trolley line to Whittaker, on the hilltops near Homestead, by way of Duquesne Junction, Bellwood and Munhall.

SAN JOSE, CAL.—The Peninsular Electric Railroad Company has been active in Redwood City securing needed rights of way. As soon as a few remaining property holders sign the agreement the company will begin the work of construction.

CONNELLSVILLE, PA.—The West Penn Railways Company has opened its new line from Mount Pleasant to Greensburg, via Hecla, a distance of fourteen miles. A regular schedule has been placed in operation and passenger cars will be run every half hour.

ST. LOUIS, MO.—The preliminary survey on the proposed electric line from Mexico, Mo., to Perry, Ralls county, has been started. The line will run due north through a section from which much stock is shipped every week. The line may later be extended to Hannibal.

INDEPENDENCE, KAN.—Work has been begun on the Independence-Coffeyville interurban line. It is the intention to build to Cherryvale without delay and to have the entire line in operation in eight or nine months. The power-house will be located at Independence.

BIRMINGHAM, ALA.—The Tidewater Development Company, which proposes the construction of an electric railway from Gadsden to Tuscaloosa, has been granted a franchise through the city of Bessemer. It already holds franchises in most of the other municipalities of Jefferson county.

DAVENPORT, IOWA—A new interurban company headed by J. F. Porter, president of the merger company, and J. F. Lardner, general manager of the Tri-City Railway Company, has been formed which has for its purpose the building of an interurban line which will extend from the tri-cities to Galesburg, Ill.

WINCHESTER, KY.—The council has granted to the Central Kentucky Traction Company right of way through Winchester for its electric line to Lexington, and sold the city street-car franchise for twenty years to the company. The traction company has bought the present street-car system and will reorganize and improve the service.

ST. LOUIS, MO.—The Hillsboro, Kimmswick & Northern Railroad Company has filed its acceptance of the terms of the franchise as granted by the St. Louis county court from the southern city limits to Jefferson county, and deposited its bond for $5,000 required to hold the county harmless from damages in the construction of the road.

MONTGOMERY, ALA.—A meeting of the stockholders of the Alabama City, Gadsden & Attalla Street Railway has been called for October 15, in Birmingham, at which time a proposition will be entertained to issue $300,000 of first mortgage five per cent bonds to make addition to the road and equipment. A line is contemplated to Noccalula Falls, several miles from Gadsden.

MIDDLEPORT, PA.—At a meeting of the Middleport borough council the right of way was given the Eastern Pennsylvania Railway Company to construct a trolley line through the town. This line is to connect with the present line which has its terminus at Pottsville. The new branch will be six miles in length and will give a through trolley connection from Mauch Chunk to Orwigsburg.

LOUISVILLE, KY.—At the meeting of the board of commissioners of Floyd county at New Albany, rights of way were granted over roads of that county to the Louisville, New Albany, French Lick & West Baden Traction Company and to the Louisville & Northern Railway and Lighting Company, the intention of those companies being to build electric lines to Paoli, French Lick Springs and West Baden.

COLUMBUS, OHIO—Two petitions with 146 signers have been presented the county commissioners by citizens of Worthington and Clintonville, asking that the franchise of the Columbus, Delaware & Marion Traction Company be revoked unless it establishes a half-hour schedule between the former city and Columbus. The petitioners assert that under the terms of the franchise cars must be operated every half hour.

ST. LOUIS, MO.—R. D. Smith, president of the McKinley system of interurban railroads, says arrangements have been completed whereby the McKinley system, which operates in ten counties of Illinois and has 400 miles of trackage, will enter St. Louis within sixty days. The cars will enter the city by ferryboats from Illinois. Terminal facilities will be constructed on property of the McKinley system on the river front.

BOONVILLE, IND.—The Evansville & Cannelton Electric Railway Company has been organized to build a traction line connecting Evansville and Cannelton, both on the Ohio river. The officers of the new company are as follows: president, F. W. Cook; vice-president, W. H. McCurdy; secretary and treasurer, Marcus Sontag; directors, F. W. Cook, W. H. McCurdy, George A. Cunningham, Marcus Sontag, Gus Muhlhausen, C. C. Tennis and C. H. Battin.

BLOOMSBURG, PA.—Arrangements are being completed for the sale by the Delaware, Lackawanna & Western Railroad of the towpath recently acquired from the Pennsylvania Canal Company between Catawissa and Northumberland. It is understood that the purchaser is to be the Danville & Sunbury Electric Railway, which has acquired the privilege of extending its tracks between Northumberland and Danville. It is expected that the towpath will be used for the further extension from Northumberland to Catawissa.

VALDOSTA, GA.—Charles J. Peeler, president of the Georgia Land and Industrial Company, of Milltown, Ga., announces that his company has purchased the water power of the famous Banks mills at Milltown, and will begin soon the exploitation of the same. The company will develop the power for electrical purposes, furnishing lights for the town and power for manufacturers. By far the most important feature of the enterprise will be the building of an interurban trolley line from Milltown to Valdosta, which it is announced will be commenced in a short while.

WILMINGTON, DEL.—A trolley line from Wilmington to Chesapeake Haven, a resort in Cecil county, Maryland, on the Chesapeake bay, is proposed. The resort will be established midway between the Elk and Sassafras rivers, the trip by trolley from this city occupying one hour and twenty minutes. The Delaware Interurban Railway Company has a charter to build a road from Wilmington to Elkton and Chesapeake City, which is expected to be soon in operation. It is probable this line will be extended to Chesapeake Haven. The Chesapeake Land Improvement Company will establish the resort.

AUGUSTA, ME.—The board of railroad commissioners has approved the articles of the Rumford Falls & Bethel Street Railway Company, which is to be formed for the purpose of constructing and operating a street railroad in and through Mexico, Rumford, Hanover, Newry and Bethel, the same to be operated by electricity or compressed air. The length of the line will be thirty miles. The amount of capital stock is $120,000 and the subscribers to the capital stock are: Elliott W. Howe, Everett K. Day, Orville J. Gonya, William H. Raye and Dennis J. McCoy, of Rumford. The commissioners also approved the articles of association of the Augusta, Oakland & Waterville Street Railway Company. The proposed road will begin at Oakland, skirt each side of Messalonskee Pond to the

Digitized by Google

highway of West Sidney. Then it practically will follow the highway to the Bond Brook road in this city, except that it will make one small detour. The distance will be eighteen miles. The directors of the proposed road are Amos F. Gerald and Edwin J. Lawrence, of Fairfield; A. B. Page, of Shawmut, and Cyrus W. Davis, of Waterville.

PROVIDENCE, R. I.—The Norwich-Westerly road has been opened, the first car coming to Westerly from Norwich with Railroad Commissioner Seymour; President E. E. Kernon, of the Construction Company; Electrical Engineer J. N. Long, of the Westinghouse Electric and Manufacturing Company; Treasurer R. W. Perkins; President H. H. Gallup and Secretary C. D. Noyes. The trip was made in an hour and a half, which is twice the time arranged for the regular schedule. The cars will come to Westerly only as far as the West street bridge, which yet remains to be built. The orders for the iron work for the bridge have been in some time, but on account of the big demand for bridge structures some delay is being met with.

SPRINGFIELD, OHIO.—At a meeting of the Springfield Street Railway Company stockholders, W. H. Stackhouse was elected a director to succeed I. Ward Frey, who has moved to Joplin, Mo. Outside of this change the same board was elected that was in control of the company last year. Those elected are as follows: Oscar T. Martin, W. F. Foos, Charles L. Bauer, John H. Miller, H. J. Crowley and C. L. S. Tingley, the last two being from Philadelphia. The officers elected are: president, Oscar T. Martin; vice-president, H. J. Crowley; secretary and treasurer, C. L. S. Tingeley; general manager, John H. Miller. The report submitted by Mr. Miller was most pleasing, showing that the business of the company had increased greatly the past year.

TELEPHONE AND TELEGRAPH.

UTICA, N. Y.—The Bell Telephone Company has erected a new line from Lee Center to Rome.

FLORENCE, S. C.—The Southern Bell Telephone Company has begun the work of rebuilding the local telephone system.

ANAHEIM, CAL.—The Home Telephone Company has received five carloads of poles for its local system, and work will soon be commenced.

SAN FRANCISCO, CAL.—It is reported that a complete reorganization of the Pacific States Telephone and Telegraph Company will take place in the near future.

MOSHEIM, TENN.—The Mosheim & Little Chucky Telephone Company has been incorporated by L. B. Harrison, J. M. Hendry, C. F. Hartman, J. M. Cobble and A. J. Johnson.

COHOCTON, N. Y.—E. W. Sutfin, for many years lessee and manager of the local office of the Bell Telephone Company, has given up his lease and the business has reverted to the Bell system.

DAVENPORT, WASH.—At the meeting of the city council the matter of a franchise for a new telephone system in town was up for consideration, and it was decided not to grant another franchise.

BRIDGEPORT, W. VA.—The Belmont and National Telephone companies are laying a cable across the river at Bellaire that will improve the Belmont service from Bridgeport to Wheeling and from Martins Ferry to Wheeling.

DOLGEVILLE, N. Y.—The work of the Bell telephone in establishing its system in this village has been started. The exchange is already in such condition that the only work necessary there will be the installation of the mechanical appliances.

BURLINGTON, VT.—The board of aldermen of the city of Rutland has granted to the Home Telephone Company, of Albany, a franchise to locate and operate a plant in Rutland. It is the concern's first franchise in Vermont, but it proposes to try to get franchises in other cities at once. An office building will be erected in Rutland.

GAINESVILLE, GA.—The Southern Bell Telephone Company is preparing to extend its line from this point to Athens. The line will be a double circuit, one circuit being used by the public and the other exclusively by the Gainesville Midland Road. The circuit to be used by the railroad will give a combination telephone and telegraph service with telegraph offices at Gainesville, Belmont, Jefferson and Athens. The right of way of the Gainesville Midland road will be used on which to construct the line.

WEBSTER, N. Y.—The Bell Telephone Company has completed twenty-five miles of new construction and is adding seventy-five new subscribers to its list. A new switchboard has also been installed, and many other improvements made. A year ago Webster had only a little over two hundred subscribers, to-day there are over five hundred.

LAUREL, MISS.—The Cumberland Telephone and Telegraph Company has announced its intention to extend the line south to Richton, a distance of twenty-five miles, and north to Bay Springs, about the same distance. At Bay Springs, the line will connect with a local line, which will give the people of Laurel direct communication with Lake Como, Newton, and points north.

TRENTON, N. J.—Plans are being prepared for a handsome new building for the headquarters of the Trenton district of the Bell Telephone Company. The details of the building are not known at this time, but the plans will be completed in time to permit starting the work early next spring. The new building will occupy the site of the present office on East State street, together with the lot adjoining.

NEW HAVEN, CT.—It is expected that within a short time the directors of the Southern New England Telephone Company will announce a new issue of stock to the extent of $500,000. This will bring the capitalization of the company up to $5,000,000, an increase of $1,000,000 within a year. The money, it is stated, will be used for improving the service and making further extensions of the lines in the state.

GUEYDAN, LA.—A meeting of farmers and business men was held at Fisher's Hall recently, the object being to form an independent telephone company. The following officers were elected: H. L. Gueydan, chairman; W. M. Cowan, secretary. It was decided to organize a $5,000 stock company, to be called the Farmers' Mutual Telephone Company, Limited, for the purpose of building a line to Lake Arthur, Shell Beach and Klondike; another to Relief, about seven miles east of Gueydan; also a third line to a point five miles south of Gueydan. A large share of stock was subscribed.

HORNELL, N. Y.—At a special session of the common council a franchise was granted the Bell Telephone Company, which permits it to construct a system of conduits for its wires throughout the city. The franchise, as originally presented has been so amended as to allow the Hornellsville company to occupy the same trenches as the Bell, and it is provided that in such case they shall jointly defray the cost of excavation, refilling and replacing the streets. It is also provided that either company shall give the other sixty days' notice in case of a decision to build conduits, and that the company so notified shall, before the expiration of thirty days, give notification of its intention to occupy the conduits jointly. The franchise is for fifty years from January 1, 1907.

PHILADELPHIA, PA.—On property recently purchased at the southeast corner of Broad and Spruce streets the Bell Telephone Company will erect a ten or twelve-story office building and exchange, the estimated cost of which, including equipment, will be $1,500,000. The lot has frontages of ninety-five feet on Broad street and ninety feet on Spruce, and was purchased to relieve the strain on the exchanges at Seventeenth and Filbert streets and Eleventh and Filbert streets, and to provide for the expected heavy growth in telephone business. A new exchange at No. 1705 South Broad street, to be known as Dickinson office, will be completed early in the year and will take care of the business down-down. It can take care of 18,000 telephones. The Eleventh street office can handle 25,000, the Seventeenth street office 20,000, and the proposed new exchange at Broad and Spruce streets will have a capacity of 36,000. This will give the company practically 100,000 telephones between Eighth street and the Schuylkill south of Spring Garden street. A handsome two-story central office building has been completed this month at Chestnut Hill, at which 12,000 telephones can be operated. Besides these buildings the company has built in the suburbs of Philadelphia within the last two years a number of buildings to provide for future growth of the suburban telephone business on a most liberal scale and designed to give the best service.

Digitized by Google

ELECTRIC LIGHTING.

ALBANY, N. Y.—The town board of Whitesboro has granted a franchise to the Hudson River Electric Power Company to distribute light, heat and power in the town.

GRAND FORKS, N. D.—A permit has been issued for the construction of the Grand Forks Gas and Electric Company's power-building. It places the value of the structure at $28,000.

GREENFIELD, MASS.—The Massachusetts gas commissioners have authorized the Greenfield Electric Light and Power Company to issue $65,000 additional capital stock at par, the proceeds being to take up floating debt incurred by additions.

ELKTON, MD.—The county commissioners of Cecil county have granted a franchise to the Rising Sun Electric Light and Power Company to erect poles along the county roads. The new company which was recently formed proposes to light the town of Rising Sun by electricity.

ORILLA, CANADA—The municipal electric plant of Orilla, is reported to be a success. The power is developed twenty miles distant at Ragged Rapids, and is sold to the factories at $16 per horse-power per annum, and two cents per week per 16-candle-power lamp for incandescent lights.

NORFOLK, VA.—The Retail Merchants' Association, of Portsmouth, has agreed that in the event that its complaint of the inefficient service of the present lighting plant is not attended to promptly it will immediately take measures to establish a new lighting and power enterprise there.

VICTORIA, B. C.—The Dawson Electric Light and Power Company, recently sold under foreclosure of mortgage, has been taken over by N. A. Fuller, a Tanana and Dawson capitalist, and Dr. A. S. Grant, who are preparing to furnish power by a fifty-mile of transmission line from the Coal creek coal mines.

MANHATTAN, KAN.—A committee from the Manhattan Commercial Club has been appointed to investigate the possibilities of damming the Blue river at Rocky Ford, four miles north of Manhattan for the purpose of creating power to be utilized in operating an electric plant to furnish electric power in the city.

COVINGTON, IND.—The Covington Electric Light and Waterworks power-house was entirely destroyed by fire September 13. The loss is estimated at $20,000, with $5,000 insurance. A majority of the stock of the company was owned by ex-United States Treasurer E. H. Nebeker and H. C. Yount, of this city. They will rebuild at once.

SCRANTON, PA.—The Dunmore Electric Light Company has entered into a contract with the borough of Dunmore to furnish light to the borough for the next six years beginning October 1, at a cost of $72.50 a light. This is a reduction of $10 in the cost of each light annually, and will save the borough about $700 this year or about $7,000 during the life of the contract.

HART, MICH.—A trust deed in the sum of $200,000 has been filed with the register of deeds to enable the Pere Marquette Light and Power Company to procure cash to complete its dam and power plant now in the course of construction on the Pere Marquette river in Mason county. The mortgage is filed to the American Trust and Savings bank and Frank H. Jones, of Chicago.

EAST McKEESPORT, PA.—The United Electric Light Company, of Wilmerding, an independent company of the Turtle Creek valley, has closed a contract with the borough of East McKeesport for furnishing arc lights for the town at $60 per light per year. The contract is for five years. The price is the lowest in the county, with the exception of that granted Turtle Creek and East Pittsburg by the Rose Hill Electric Light Company, of Turtle Creek.

SALT LAKE CITY, UTAH—An application has been filed by A. M. Hill, A. P. Hanson and L. H. Gray, all of Salt Lake, for a flow of 110 cubic feet per second, to be diverted from the Blacksmith fork of Bear river, in Cache county. The diverting work will consist of a dam, headgate, and a pipe line. The diverting channel will be 8,000 feet long and one and one-half feet in diameter, and the flow will run two water-wheels, size yet to be determined, and will give power to operate machinery for an electrical plant on Blacksmith fork.

SALT LAKE CITY, UTAH—Benjamin E. Rich, of Centerville, has plans to furnish light and power in Davis county, and has filed in the office of the state engineer an application for a water right that will enable him to carry out his plans. Mr. Rich wishes to divert four second-feet of water from Farmington creek, and convey it by means of a channel, 600 feet long to the point where the power plant will be erected. One twenty-four-inch wheel is to be used, operating under a head of 480 feet and producing a total of 180 horse-power.

MANCHESTER, N. H.—At the annual meeting of the stockholders of the Manchester Traction Heat and Power Company, the following directors were elected: William A. Tucker, S. Reed Anthony, W. M. Parker, P. L. Saltonstall, J. Brodie Smith, George H. Hood, R. G. Sullivan, Charles M. Floyd, Stillman F. Kelley, B. P. Larned, R. H. Hallowell and W. Parker Straw. W. Parker Straw succeeded to the vacancy caused by the death of Harry E. Parker. The directors elected Mr. Tucker president, Mr. Smith vice-president, and Mr. Anthony treasurer.

SOUTHBRIDGE, MASS.—In connection with a plan of buying in heat and power plants in this section of the state the Boston Heat and Power Company has announced the purchase of the Southbridge Gas and Electric Light Company, of this town. The former company has already taken over several other companies. The plan is to increase and extend the lighting service in Southbridge, and to have all-night service. The small stockholders have been notified by the purchaser of the controlling interest, that they can dispose of their stock at $62.50 per share. The par value of the stock is $50.

ONEIDA, N. Y.—The board of public works has entered into a contract with the Empire State Power Company for lighting the streets and public places of the city for a term of five years, the contract bearing date of January 1, 1907. The company is to give a bond of $10,000. Under the new contract the Empire State Power Company will light the city for $3,650 a year, furnishing about ninety lights to burn until 1 o'clock and forty lights to burn all night. Aside from the street lights about seventy-five free incandescent lights are to be furnished for lighting the city offices, police and fire stations, etc.

GOUVERNEUR, N. Y.—Under the terms of the contract made by the village in September, 1904, with the Oswegatchie Light and Power Company to furnish light for the streets of Gouverneur, an all-night service was to be provided after October, 1906. The company now announces that it will be unable to do more than continue the present midnight service, claiming inability at this time to secure the equipment necessary to increase the efficiency of the plant at Hailesboro to the point where all-night service can be given. The request of the Oswegatchie people that the date for furnishing all-night service be extended one year has been granted by the board of village trustees.

DILLSBORO, N. C.—H. S. Harkins has sold to G. W. Reagan and associates a valuable water power on the Tuckaseegee river, near Dillsboro. The purchasers of the water power are Gastonia cotton mill men and it is said to be their intention to develop the water power for the manufacture and distribution of electricity, and also to establish a large cotton mill to be operated by electricity. The water power that has been transferred by Mr. Harkins to Mr. Reagan and others is said to be one of the finest in this section of the state and easily developed. The site of the proposed power plant is scarcely fifteen miles from Bryson City and, if the development plans are carried out, Bryson City will be enabled to obtain electricity for light and power purposes.

TRENTON, N. J.—There has been incorporated at the State House the Portland (Pa.) Power Company with a capital of $500,000. the object of which is believed to be to tap the Delaware river a short distance above Belvidere and divert the water for electrical purposes, carrying it through a canal about four miles to Foul Rift, at which point a power-house will be erected for trolley and electric light and power purposes. The charter of the new company gives the following facts: Registered office, Belvidere; agent in charge, William H. Morrow; capital stock, $500,000; incorporators, Henry D. McDonald, Lewis H. Nickolos, Jennie Killian, Jacob V. Carter and Dayton Brugler. The charter gives the corporation the right to erect dams, build power-houses, generate electricity for light and power, deal in electric power and ice.

Digitized by Google

INDUSTRIAL ITEMS.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a catalogue and price list of specialties covering every conceivable item necessary for general wiring.

THE NORTHERN ELECTRIC AND MACHINE COMPANY, 22 Brooklyn avenue, Brooklyn, N. Y., has opened an office in Buffalo, N. Y., with William R. Gibson in charge.

THE REED ELECTRICAL CORDAGE COMPANY, Syracuse, N. Y., advises that it is about to increase its manufacturing facilities and to greatly enlarge its quantity of production of insulated wires.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., has produced a very attractive September bulletin describing and illustrating "P.-K." rosettes, baby knife switches, taplets and waterproof socket plugs.

KENDRICK & DAVIS, Lebanon, N. H., manufacturers of high-grade battery motors and electrical novelties, have completed and moved into a large addition to their factory, nearly doubling their capacity.

THE MARSHALL ELECTRIC MANUFACTURING COMPANY, Boston, Mass., reports a very brisk demand for its new rotary flush switch, which is carried in stock in Boston, New York and Chicago for immediate delivery.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., is distributing a new hanger bearing calendars for October, November and December, and the 300 words which have been recommended by the simplified spelling board.

THE MOORE ELECTRICAL COMPANY, 52 Lawrence street, Newark, N. J., has ready for distribution a new pamphlet describing several features of the Moore electric tube light. This pamphlet will be sent to any one interested upon request.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., is distributing a very attractive folder entitled "Have You Struck the Keynote?" This folder calls attention to a special line of porcelain sign receptacles which this company is producing.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, is distributing some new literature describing the "J-M" electric car heaters. The company will be pleased to send full information concerning various classes of car heaters upon application.

THE AJAX LINE MATERIAL COMPANY, 12 and 14 South Jefferson street, Chicago, Ill., will be pleased to send its October bulletin, showing some new outdoor lighting specialties, including pole tops, rainproof rope, galvanized chain, insulators, swivel pulleys, break arms, cleats and mast arms.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has prepared a neat pamphlet illustrating and making brief references to its complete line of products. This is intended merely as a ready reference to the company's material, and suggests in each case where additional information may be secured concerning the product described.

KEOUGH BROTHERS & COMPANY, Boston, Mass., announce that on September 14 the firm was dissolved by mutual consent. All outstanding accounts and contracts have been assumed by Augustus Keough and James E. Keough, who will carry on the business of electrical contractors at 41 North street, Boston, under the firm name of Keough Electric Company.

THE LOWELL INSULATED WIRE COMPANY, Lowell, Mass., is about ready to enlarge its present facilities and is searching for a site upon which to build a much larger works. The plant is under the management of R. Dunsford, and he estimates that a plant with a floor area of from 40,000 to 50,000 square feet will be necessary to meet the demands for the company's product.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is sending to the trade a catalogue descriptive of condulets, and calling attention to the fact that it is carrying a complete stock of all styles and sizes up to and including one inch. These condulets have been on the market for a comparatively short time, but have already made a place for themselves and are becoming popular among contractors and wiremen.

THE STANDARD ELECTRIC LAMP COMPANY, of Newark, N. J., is now established at Van Buren and Ferry streets. The company has recently been reorganized, F. B. Flinn being elected president. The other officers have not been fully chosen, but the names will be announced later. The company has a capacity for refilling 5,000 lamps weekly at the present time. It is announced that this capacity will be enlarged, and that in the near future the company will enter into the manufacture of standard types of lamps.

THE LOMBARD-REPLOGLE ENGINEERING COMPANY, Akron, Ohio, has ready for distribution a new bulletin describing and illustrating Lombard-Replogle water-wheel governors. Nathaniel Lombard and Mark A. Replogle have joined forces, and in addition to their experience, the services of other practical engineers have been secured. The company is getting ready to occupy its new quarters in a commodious building in the centre of Akron, where it will have seven stories with over 100,000 square feet of floor space.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., announces the contract for a new twenty-two-inch by forty-two-inch Reynolds Reliance Corliss engine for direct-connection with a 300-kilowatt, direct-current generator for the Eastman Kodak Company, Rochester, N. Y. A contract has also been made with the Mauch Chunk Heat, Power and Electric Light Company, Mauch Chunk, Pa., for a twenty-inch by thirty-six-inch Reynolds Reliance Corliss engine of the belted type. This engine is to be installed for driving an electrical generating apparatus.

Record of Electrical Patents.

Week of September 25.

831,530. TROLLEY-POLE CONTROLLER. James F. Boggs, Needles, Cal. Filed September 21, 1905. A pneumatic trolley-catcher.

831,548. JOINT FOR ELECTRIC CONDUCTORS AND OTHER WIRES. Austin Fleeger, Chicora, Pa. Filed August 18, 1905. A sleeve with tapering ends containing angular gripping bodies.

831,599. INDUCTIVE SYSTEM. Ralph C. Browne, Salem, Mass. Filed August 19, 1904. A therapeutic device making use of an intermittently charged and discharged condenser.

831,609. ELECTRICAL MEASURING INSTRUMENT. Carl Hering, Philadelphia, Pa. Filed August 3, 1905. The current through two coils in unstable equilibrium reacts so as to limit its variations.

831,624. ELECTRIC RAILROAD. Jeremiah Murphy, Chicago, Ill. Filed February 9, 1906. An inverted grooved third rail and supports.

831,625. VENTILATED ARMATURE. James F. McElroy, Albany, N. Y., assignor to Consolidated Car Heating Company, Albany, N. Y. Filed April 18, 1905. Ventilating ducts are secured by means of punched spacing discs.

831,628. SHADE-HOLDER COUPLING. Edwin F. Pierce, Milwaukee, Wis. Filed October 18, 1905. Renewed June 11, 1906. A holder for incandescent lamp shades.

831,634. ALARM-SYSTEM APPARATUS. Richard F. Spamer, Chicago, Ill., assignor to Consolidated Fire Alarm Company, New York, N. Y. Filed September 23, 1905. An electro-magnetic device for setting off a distant alarm.

Digitized by Google

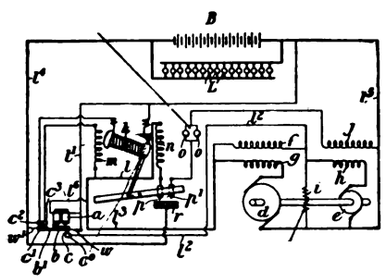
831,685. VARIABLE-SPEED DEVICE. Grant B. Rossman, New York, N. Y. Filed September 29, 1903. A frictional device, the parts being held together magnetically.

831,687. SELECTING AND SIGNALING SYSTEM. Robert J. Sheehy, New York, N. Y. Filed October 9, 1902. An electromagnetic step-by-step mechanism enabling any one of a number of local circuits to be connected into the main circuit.

831,724. METHOD OF FIXING INCANDESCENT LAMPS. Josef Levin, Munich, Germany. Filed November 16, 1905. A method of attaching a socket to the conduit.

831,740. ARMATURE-WINDING MACHINE. Paul E. Oswald, Los Angeles, Cal. Filed October 23, 1905. The armature is rotated about an axis perpendicularly to the shaft, enabling the wire to be laid easily in the slots.

831,776. RAIL BOND. Fred H. Daniels, Worcester, Mass. Filed June 8, 1903. A flat stranded conductor is looped through slots in the bond head.



831,059. AUTOMATIC ELECTRIC SWITCH.

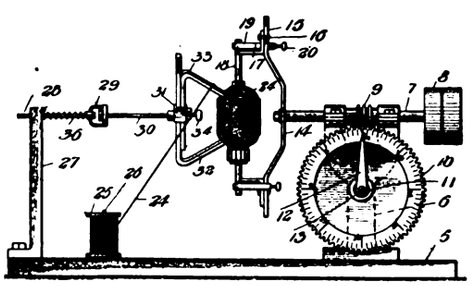
831,779. MAGNETIC SOUND RECORD. Victor H. Emerson, Newark, N. J., assignor to American Graphophone Company, Washington, D. C. Filed January 14, 1904. Renewed March 2, 1906. The crumbling of a magnetic needle leaves a magnetic record on a non-magnetic surface.

831,792. TROLLEY WHEEL. William Livingstone, New York, N. Y., assignor of three-eighths to himself and five-eighths to Empire State Engineering Company, New York, N. Y. Filed March 27, 1905. A wheel formed of sheet metal with a seamless rim.

831,815. CONNECTOR FOR ELECTRICAL CONDUCTORS. Paul F. Williams, Chicago, Ill. Filed May 23, 1905. A pair of insulating members protecting the electrical coupling.

831,819. TELEPHONE SYSTEM. Francis G. Bell, London, England, assignor of one-half to Isidore Bernard Birnbaum, London, England. Filed October 9, 1905. A modified form of common battery system.

831,821. ILLUMINATING DEVICE. Alfred W. Beuttell, London, England. Filed October 17, 1902. A reflector for double-ended incandescent lamps.



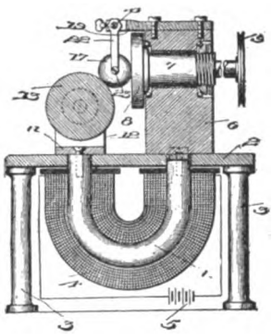
831,740. ARMATURE-WINDING MACHINE.

831,830. RAIL BOND. John P. Clark, Ypsilanti, Mich. Filed May 27, 1905. The terminal is wrapped with wire cloth.

831,843. PROCESS FOR THE ELECTROLYTIC PRODUCTION OF ZINC. Victor Engelhardt, Vienna, Austria-Hungry, assignor to Siemens & Halske Aktiengesellschaft, Berlin, Germany. Filed September 14, 1904. The current density in a sulphate solution is from twenty to fifty times as great at the anode as at the cathode.

831,846. AUTOMATIC TELEPHONE SYSTEM. John Erickson, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed December 30, 1904. Makes use of a selector switch controlled by a differential relay.

831,847. ELECTROTHERMAL SWITCH. John Erickson, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed December 31, 1904. Contact is made or broken by the expansion or contraction of a hard rubber rod.



831,685. VARIABLE-SPEED DEVICE.

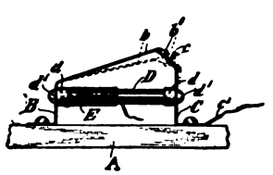
831,848. ADJUSTABLE HARMONIC RINGER FOR SELECTIVE SIGNALING SYSTEMS. John Erickson, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed September 18, 1905. Means are provided for adjusting the fulcrum of the clapper.

831,855. TELEPHONE TRANSMITTER ARM. Harry J. Guttman, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed November 25, 1905. A method of construction.

831,875. INTERRUPTER FOR AUTOMATIC TELEPHONE OR OTHER SWITCHES. Alexander E. Keith, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed February 17, 1905. A device for automatically selecting an idle trunk.

831,876. SWITCHING OR TELEPHONE SYSTEM. Alexander E. Keith, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed March 9, 1905. A method of arranging the plurality of trunk lines and groups of terminals.

831,889. TELEPHONE ATTACHMENT. William A. Patterson, Pittsburg, Pa. Filed October 20, 1905. The transmitter mouthpiece is closed with a perforated cover on which is a shutter.



831,847. ELECTROTHERMAL SWITCH.

831,916. ELECTROSTATIC APPARATUS. Millard Woodsome, Boston, Mass., assignor by mesne assignments, to Huff Electrostatic Separator Company. Filed August 2, 1904. Electrostatic ore separator.

831,959. AUTOMATIC ELECTRIC SWITCH, PARTICULARLY FOR USE IN CHARGING ELECTRIC ACCUMULATORS. Henry Leitner, Woking; Richard N. Lucas, Byfleet, and Harry Hill, Woking, England; said Hill assignor to said Leitner and Lucas. Filed February 10, 1905. The switch is controlled by a compound-wound magnet.

831,996. LAMP SUPPORT. Adolph Rydquist, Rochester, N. Y. Filed September 14, 1905. A three-armed frame holding an adjustable support.

832,024. PROCESS FOR THE ELECTRODEPOSITION OF METALS. Josef A. Nussbaum, Charlottenburg, Germany, assignor to Siemens & Halske Aktiengesellschaft, Berlin, Germany. Filed November 28, 1905. A colloidal diaphragm is formed over the surface to be coated.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 15. NEW YORK, SATURDAY, OCTOBER 13, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW
CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING
BOSTON
NEW ENGLAND OFFICE, M. W. BARBER, Mgr., DELTA BLDG., 10 Post Office Sq.
LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE
TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS.

EDITORIAL:
American Electrochemical Society . . . 573
Phase Displacement in Alternating-Current Electrolysis . . . 573
A Successful Use of Electric Rock Drills . . . 575
The American Street and Interurban Railway Association . . . 575
Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw. 576
Subway System for Chicago . . . 578
Decision in Storage-Battery Litigation . . . 578
Manhattan Transit Company Sold . . . 578
San Francisco's Progress Toward Recovery . . . 578
Electric Railway Engineering Preliminaries—Part II, by Sydney W. Ashe . . . 579
American Electrochemical Society . . . 583
How Electricity Was Served to Consumers and Street Car Lines by the San Francisco Gas and Electric Company After the Fire, by L. E. Reynolds . . . 584
Two Cities Left in Darkness by Breaking of a Canal Bank . . . 586
General Electric Company to Issue New Stock . . . 586
The Street Railway Convention . . . 587
Tramway Lines on the Continent, by C. L. Durand . . . 589
Frequency Meters, by F. Conrad . . . 594
The Effect of Iron in Distorting Alternating-Current Wave-Form (Concluded), by Frederick Bedell and Elbert B. Tuttle . . . 595
Dedication of the New Building for the Engineering Departments of the University of Pennsylvania . . . 597
Traction Managers' and Auditors' Association . . . 597
The Testing of Coal, by A. Bement . . . 597
Double Trolley System Not a Sure Cure for Electrolysis . . . 600
The Maximum Development of the Steam Engine . . . 600
Electrical Notes from Great Britain . . . 601
Instructing Telephone Operators . . . 602
Single-Phase Equipment for the Washington, Baltimore & Annapolis Railway . . . 602
The New Plant of the Home Telephone Company, Detroit, Mich . . . 603
Evening Courses in Direct-Current Testing at the Polytechnic Institute, Brooklyn . . . 603
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 604
METHODS OF GETTING NEW BUSINESS . . . 606
INDUSTRIAL SECTION:
A Metallic Support for Cross-Arms . . . 607
The Marshall Electric Manufacturing Company's Standard Dial Switch . . . 608
A Fifty-Ampere Dry Cell . . . 608
The Franklin Electric Manufacturing Company's Street Railway Incandescent Lamp . . . 608
Small Generators Arranged for Direct Connection . . . 608
National Motor-Generators in the Substations of the Columbus, Ohio, Railway and Light Company . . . 609
Electric Power in the Plant of the Springfield Metallic Casket Company, of Springfield, Ohio . . . 609
Diesel Oil Engine Test . . . 610
The New Plant of the H. T. Paiste Company . . . 610
Portable Car Telephones . . . 611
Linemen's Portable Telephone-Testing Sets . . . 611
A New Lamp Guard . . . 612
Cook's Automatic Electrical Testing and Resetting Plug . . . 612
CURRENT ELECTRICAL NEWS . . . 613
DIRECTORY OF ELECTRICAL AND ALLIED ENGINEERING AND SCIENTIFIC SOCIETIES . . . 618
RECORD OF ELECTRICAL PATENTS . . . 619

Copyright, 1906, by Electrical Review Publishing Co.

THE AMERICAN ELECTROCHEMICAL SOCIETY.

The American Electrochemical Society held, during the present week, a short meeting in New York city. Heretofore semi-annual meetings have been held, but a large number of the members have been in favor of but one meeting, and the present plan has been adopted as a sort of compromise. As an experiment this can hardly be called a success, for the attendance was slight and the interest shown in the papers small. For some reason or other the interest in this society seems to be on the wane. The attendance at the meetings grows smaller, and except for the work of a few members, the papers presented have become less interesting to the greater number. Whatever may be the reason for this, the trouble should be found and remedied.

The society started out a few years ago with a broad field before it, and apparently with unbounded enthusiasm; to-day it can not draw twoscore people to one of its meetings, even when held in New York city, and to those who intend attending it can not give definite information regarding the plans of the meeting and the papers to be read a week in advance. Conditions can not go on as they are at present. If the society wishes to carry out the purpose for which it was organized it would seem about time to bring about a general stirring-up. Nobody can be expected to attend meetings unless papers of general interest can be looked for; and no one with the material for a good paper will care to read it before the society if he can not at least be sure of an interested audience.

PHASE DISPLACEMENT IN ALTERNATING-CURRENT ELECTROLYSIS.

When an alternating current is passed through an electrolytic cell, several phenomena appear. The actual result accomplished will depend upon several factors. If the construction of the cell be such that a direct current may cause electrolysis, a similar reaction will undoubtedly take place, due to the alternating current; but since this is periodically reversed, the action occurring at the two electrodes will also be reversed, and, neglecting other influences, there will be no resultant decomposition, for whatever of one electrode is dissolved during one half wave will be redeposited upon the electrode during the next half. This is undoubtedly mainly what takes place under the conditions generally met, but if an exceedingly low frequency were employed there might be sufficient time for the compound formed by the current to diffuse throughout the solution, and not all the metal dissolved at one instant would immediately be replated. The result would be that the electrolyte would itself suffer decomposition to make good the deficiency due to the diffusion, and the electrodes would become corroded.

Digitized by Google

A similar result might be accomplished if a sufficiently violent circulation of the electrolyte were caused to take place at the surface of the electrodes. Under normal conditions, however, but little or no corrosion takes place, provided, of course, there be no purely chemical action. But, under some conditions, disintegration may be brought about, which appears to be partly a mechanical action. This is noticeable principally in using carbon electrodes, and is due either to the effect of gases set free within the pores of the electrode or to a dissolving away of the binding material. Probably both actions occur.

But although no resultant dissolving away of the electrodes may take place in an electrolytic cell, the electrolytic action does occur during every half wave, and this, of course, gives rise to those phenomena noticed in direct-current electrolysis. These, for convenience, may be grouped together under the term "polarization," a term which has been so useful and so much discussed in the study of electrolysis. For the present purpose it is sufficient to consider this polarization as setting up a counter-electromotive force opposing the flow of current which gives rise to it. In addition, there are the electromotive forces due to each electrode, but these under normal conditions are equal and opposite.

Another action, or, better, a rather different action, in alternating-current electrolysis is noticed when the products of the reaction are not soluble in the electrolyte. A notable instance of this kind is that met with when using aluminum as an electrode. The current may pass freely from the solution into the aluminum, but a passage in the opposite direction causes an oxidation of the electrode which acts as an insulating coating and in this way opposes the flow of current. This effect is entirely different from the one mentioned above, although the results of the two are, in a way, similar. It is this insulating effect that has been made use of in the so-called electrolytic rectifiers and electrolytic condensers. In the latter case both electrodes are made of aluminum and both become coated with the insulating layer. No new phenomena are involved in this device, and it may be considered as a leaky or somewhat defective condenser of large capacity—defective because the insulating coating is liable to break down, necessitating reforming, though imperfections of this kind do not destroy the condenser, as would be the case with an ordinary electrostatic condenser. They have large capacity because of the extremely thin dielectric. They have the disadvantage that a loss of energy takes place, heating the device. The arrangement is nevertheless a true condenser and causes a displacement of current in advance of the applied electromotive force.

But a similar displacement of current may be caused by a true electrolytic cell—that is to say, a cell in which electrolytic action takes place normally, due to direct current. The polarization which takes place during one half cycle opposes the flow of current, and it will reverse this current as soon as the voltage of the applied electromotive force is less than that of polarization. If, then, the applied electromotive force be but slightly greater than that of polarization, the current will be reversed almost immediately after the electromotive force has reached its maximum value, and, as a consequence, there will be a phase displacement of current nearly ninety degrees in advance of the applied electromotive force. This is the result obtained with a true condenser, though in one case the opposing electromotive force is due to a chemical change, and in the other case to an electrical charge. Practically, the former has no value for constructing a condenser, since the capacity would be relatively small and the efficiency would be low. Heating will take place due to the passage of the current through the electrolyte, and in some cases due also to chemical action which would be set up as a secondary result of the electrolytic decomposition caused by the current.

But although this effect is not of value for constructing condensers it may become a disadvantage. Probably the most usual method of constructing a non-inductive resistance of large current-carrying capacity is to make use of an electrolytic cell, it being assumed that there is no inductance or capacity in such a device. But, as has been shown, there is a capacity action in such arrangements which, under certain conditions, would vitiate the test. The importance of this factor depends upon the relative values of the electromotive force of polarization and the fall of potential through the cell due to ohmic resistance. Usually the latter is by far the greater; in fact, when testing electrical machinery the condenser effect is not only negligible, but probably could not be detected, so that the assumption that the resistance is non-inductive is justified. This has been demonstrated by recent experiments conducted by Herr Karl Wallin, of the Stockholm Technical High School, who took oscillograph records of the current and electromotive force at the terminals of an electrolytic resistance. These show that the current and pressure were in phase. It should be noted, however, that in these experiments, when the voltage was low, the current was also small, so that polarization was necessarily slight; and that when large currents were employed the voltages were also high, so that the fall of potential due to ohmic resistance made up practically the whole difference of potential between the electrodes. If, however, a high resistance had been obtained by connecting a number of such cells in series, so as to build up a high counter-electromotive force, phase displacement would undoubtedly have been found; in fact, when such effects are sought there is no difficulty in observing them. Oscillograph curves have been published from time to time, showing large phase differences between the currents and applied voltages of electrolytic cells.

Although, in engineering work, the effect of this counter-electromotive force may be neglected, it is possible that in other fields it may cause trouble. It is customary to measure the resistance of solutions by means of alternating currents, and in such cases, unless precautions be taken, Ohm's law can not be applied directly to the readings of current and voltage. If the ohmic resistance be small, or the polarization great, such an assumption might give rise to considerable error.

Digitized by Google

A SUCCESSFUL USE OF ELECTRIC ROCK DRILLS.

In the issue of the ELECTRICAL REVIEW for September 1 attention was called to an article which discussed rather briefly the relative merits of the electric and compressed-air rock drill, the conclusion being reached that the former type has not been at all successful, due to a lack of ruggedness, which is the saving virtue of the compressed-air drill, as the latter type of drill has little else to be said in its favor. As these conclusions were reached after what seemed to be a rather limited experience with the electric drills, the opinion was expressed that it was hardly fair to the latter to condemn them altogether. Situations, no doubt, exist in which the advantages of the less rugged electric drill are greater than its disadvantages. It was pointed out that there are several types of electric drill, one type being mentioned in which the efficiency of the electric system is combined with the ruggedness of the compressed-air mechanism.

The issue of the *Engineering and Mining Journal* for September 22 contains a reply to the previous article appearing in that journal. In this reply Mr. Charles A. Chase gives, somewhat in detail, his experiences with several electric drills of the combination type. The results obtained with these as compared with those of air drills at the same point were decidedly in favor of the former.

The company with which Mr. Chase is associated had had some unfavorable experience with the simple electric drills, and had discarded them, replacing them with compressed-air drills supplied from a motor-driven air-compressor. In 1904 several compressed-air-electric drills were installed, and, after very thorough tests, were adopted. It was found that, working in competition with the simple compressed-air drills, the former worked considerably faster, and after two years of service they are still in excellent condition. The electric machine drilled from fifty to sixty feet of hole in eight to nine hours, leaving time for the holes to be loaded and shot; while the air drills were merely capable of drilling the same length of hole in the same time. But the advantage of the electric drill which is most marked is its great power economy as compared with the other. This is the strong feature of this type of machine, and in the case here under consideration, the difference is very marked. It was found that the power consumption for one electric drill was only five horse-power, while the motor input at the compressor of the air drill was fifty horse-power; and, as the company purchases its power, the saving effected by the use of the electric drill is a very considerable item. Mr. Chase states that he is not an advocate either of electric power or air power, since each has its advantages; but, to his mind, there is a place for electric drills in many mines, and his company has certainly found one drill that fits this place.

These conclusions are entirely in accord with the opinions expressed in the ELECTRICAL REVIEW. There can be no doubt that, in some places, the ruggedness of the air drill is a feature of the greatest value; but the low efficiency of this device makes it incumbent upon mining engineers to investigate the merits of more efficient machines and to adopt the latter when this gain more than offsets a greater liability to breakdowns.

THE AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.

The American Street and Interurban Railway Association, which meets in Columbus, Ohio, during the week beginning October 15, has a good deal of important work to do. In addition to the reading and discussion of papers, the work of the association's committees is not less valuable. Certain of the committees which are to report at this meeting have been engaged on matters of interest not only to the members of the association, but to the public and to other industries. This applies particularly to the standardization committees, which are endeavoring to bring about certain standard practices in construction work, such as car-building and track work. These committees have been gathering a large amount of data dealing with the present practice, a considerable part of which, no doubt, will be in shape for consideration. It will remain, however, for the association to take such steps as may seem advisable in completing the work of these committees, and in this it should not lose sight of both sides of the question. Standardization is very desirable, so long as it does not bring about cures which are worse than the ills. It is possible to go too far in these matters. It is very well to have a set of general specifications which will guide builders and engineers and thus prevent what would frequently result in freak construction. On the other hand, it is not wise to attempt to bind down the experienced engineer and to force him to use a method when he knows it will not, in the end, be the best. There seems to be a tendency for a standardization committee to recommend rather rigid rules, as recent experience has shown. After having made an elaborate study of current practice it decides upon what, to it, seems to be best, and wishes this to be adopted; yet, in nearly all cases, the work of such a committee should be suggestive, rather than compulsory, particularly when engineering principles are involved. It should point out what seems to be the plan best suited for average conditions. Upon the other hand, there are certain features in practice involving no elements of particular importance, such as the height of car steps and other minor details, but which, to the public, are frequently of much concern. In such matters definite action can very properly be taken and a standard strongly insisted upon. As part of the work of the association's standardization committees deals with such details, it is to be hoped that the work of these committees will be given careful consideration, and, if possible, some definite action taken.

This convention, which follows a year of working under the new system of organization, will undoubtedly be one of the most successful which the affiliated associations have ever held. Present indications are that the attendance will be large. Reservations on the special trains leaving New York are numerous and the representation of eastern interests will be strong.

The exhibit, this year, promises to be full of interest. Ample space is available for complete demonstrations of apparatus, both large and small. The list of exhibitors is extensive, and as each has a pride of membership in the organization the high standard set at Philadelphia last year well be maintained if not excelled.

Digitized by Google

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW, F. I. C.

V—The Sources of Natural Water Supply and the Physical and Chemical Characteristics of the Same.

The water supply is only second in importance to that of fuel for the efficient working of steam boilers, and an adequate supply of pure water is an essential condition of cheap steam-generation.

The dissolved impurities, present in varying amounts in all natural waters, separate as sludge or as a scale inside the boiler, and the greater the amount of these impurities, the more often will cleaning and scaling of the boiler be necessary.

The water intended for use in boilers for steam-raising purposes can not, therefore, be too free from impurity, and the generally held opinion that rain-water or condenser water is too pure is fallacious. The corrosive action observed with rain-water is due, not to its purity, but to the impurities present in the form of dissolved gases. On heating the water these dissolved gases (oxygen and carbon dioxide) escape, and the pitting and corrosion found round the feed-water supply-pipe of boilers fed with rain-water is due to the chemical activity of these gases at the moment of their liberation. The best method of expelling these gases before the water enters the boiler will be dealt with in Article VII.

In addition to the gaseous impurities found in natural water, there are present varying amounts of dissolved salts, and in some cases suspended impurities. The carbonates and sulphates of lime and magnesia are the most common dissolved salts, but chlorides and nitrates are also found in some waters. The waters that are free from suspended impurities and appear the most clear and sparkling to the eye are not as a rule the most suitable for use in steam boilers. Chemical examination is always necessary before we can be certain that it will be safe or advisable to use a particular water for steam-raising purposes, without some preliminary treatment for removal of its impurities.

The source from which the water is drawn has much influence upon the character and amount of its impurity. Below, the general characteristics and composition of rain, river and well waters are given so far as these have any bearing upon the use of such waters for steam-raising purposes.

Rain-Water—This is the purest natural water, for it contains only the impurities taken up by the water during its passage from the clouds to the earth, namely oxygen, carbon dioxide, sulphur dioxide, soot and dust. In country districts rain-water is often entirely free from the three last-named impurities, and contains only comparatively small amounts of oxygen and carbonic acid gas. To obtain an adequate supply of such water for boiler-feed purposes, however, involves the creation of large reservoirs fed by large catchment areas, and in most cases this is not possible for the ordinary works or factory, owing to the capital expenditure involved. Rain-water collected in towns or upon the outskirts of industrial districts is, on the other hand, so contaminated with sulphurous acid, soot, dust and other impurities that filtration and chemical treatment are necessary before such water can be safely used in steam boilers. For this reason rain-water is not often employed for feed-water supply except in those special cases where these two objections lose much of their force and weight. It is quite possible, however, that rain-water might be used much more extensively than at present is the case for steam-raising purposes, and that some thought and ingenuity expended by engineers in arranging catchment areas and storage reservoirs would be well repaid in the greater freedom of the boilers from scale and corrosion due to the purity of the feed-water used. An average rain-water will contain less than two parts of dissolved or suspended matter per 100,000 of water.

Surface and River Waters—Rain-water, after it has traveled any distance over the surface of the ground, either in country or town districts, becomes further contaminated with suspended and dissolved matter, and therefore less suitable for use in boilers without some purification treatment. Here again the appearance of the water may be wholly deceptive, and chemical examination will alone reveal the nature and amount of the impurities present. In mountainous districts the amount of impurity taken up from the soil is small, and the surface water collected in the catchment area of Lake Vyrnwy, in North Wales, or in the catchment area of Thirlmere, in the lake district, for supply of the cities of Liverpool and Manchester, respectively, is remarkably pure and free from dissolved salts. As one comes down to lower levels and approaches the neighborhood of towns, the amount of dissolved and suspended matter in the surface water increases considerably. The following tests of the Liverpool water supply are interesting in this respect:

	Parts per 100,000 of Water.		
Vyrnwy—Total solids in solution	4.46	Hardness..	1.70
Rivington—Total solids in solution	10.36	Hardness..	3.90

Vyrnwy is a mountainous district in North Wales, while Rivington is the old catchment area near Bolton. The influence of the neighborhood of towns upon the purity of the supply is shown by the increase of dissolved matter from 4.46 to 10.36 parts per 100,000.

When the catchment area is formed by peaty land a large amount of organic matter finds its way into the water, due to the gradual decay of the plant life which forms the peat. In such cases the surface water will be colored brown, and may contain large amounts of organic acids. Surface waters coming from peat or moor-lands, even when colorless, should therefore always be examined by a competent chemist before use in steam boilers, for these organic acids are not detected by the ordinary reagent, litmus.

Surface waters collected in chalky districts may contain large amounts of lime in solution, either as carbonate or sulphate. In some cases the dissolved impurities present in such surface waters may exceed in amount those found in well waters. The impurities present in surface waters, in fact, vary greatly in different districts, and the geological formation of the surrounding country has much influence upon the nature and amount of the impurities. As a general rule, surface waters collected in country districts are purer than river or well waters; and such waters may often be used in boilers without any preliminary purification.

River water, on the other hand, is usually contaminated with the drainage and refuse of the villages and towns situated along its banks, and the water, except when taken from near the river's source, is more impure than the surface drainage water which flows into it. The dissolved salts may in some exceptional cases be less, but the suspended impurities and organic matter are nearly always greater in amount.

As the river grows in width and volume, the impurities as a rule increase in even greater ratio, and attain a maximum at the point where the river meets the tidal waters of the sea. Here sodium and magnesium chloride are added to the list of dissolved salts present in the water. It is, therefore, dangerous to use water from tidal rivers within five miles of their mouth for steam-raising purposes, without daily sampling and testing for detection

[1] All rights of reproduction and translation are reserved. Copyright, 1906, by John B. C. Kershaw.

Digitized by Google

of these impurities. Chlorides are, in fact, most dangerous salts to have present inside a steam boiler.

Spring and Well Waters—The water that has passed through any considerable thickness of the earth's crust is as a general rule highly charged with dissolved gases and salts. The greater the depth from which the water flows, or is pumped, the larger will be the amount of these impurities. Carbonate of lime with the corresponding salt of magnesia is insoluble in pure water, but the presence of carbonic acid in the water renders these salts soluble. This acid is formed in the water by the carbon dioxide dissolved in its percolation through the upper soil and subsoil of the earth's crust. Sulphate of lime, on the other hand, is slightly soluble in pure water; and 1,000 grammes of water can dissolve 2.72 grammes of calcium-sulphate. Carbonates and sulphates of lime and magnesia exist in large masses in the earth's crust. The nature and amount of the dissolved impurities present in well and spring waters therefore varies in different districts, and water drawn from 300 feet below the surface in some districts will be much purer than water from a similar depth in other districts. Since the percolation through the soil removes all suspended impurities and charges the water with dissolved gases, well and spring waters are generally clear and sparkling. Owing to the amount of gaseous and solid impurities they contain these waters are, however, most unsuitable for boiler-feed purposes and they should never be employed if an alternative supply is available. When the local conditions are such that well or spring water must be used, a treatment by chemicals for removal of the greater portion of the impurities is essential to the economical working of the boiler plant.

All waters, from whatever source, containing over fifteen parts of solid matter per 100,000 should, in fact, be submitted to chemical and mechanical purification treatment; and as far as possible the boiler should be fed with the purest water which can be obtained in this way. The formation of scale inside boilers leads to so many evils and so diminishes the efficiency and life of the boiler that in most cases the capital outlay upon and cost of working a softening plant is a wise expenditure of money, and is repaid by the savings in fuel and repairs.

The salts found in solution in natural waters may, in fact, be divided into two classes—scale-forming and non-scale-forming. To the first-named class belong calcium carbonate, magnesium carbonate, calcium sulphate and magnesium hydrate. To the second class belong the following salts: calcium nitrate; magnesium sulphate, nitrate and chloride; sodium sulphate, nitrate and chloride. The carbonates of lime and magnesia produce what is known as "temporary hardness," since it can be removed by boiling; while the sulphates and hydrates of lime and magnesia produce what is known as "permanent hardness." It is important to note that the accumulation of the non-scale-forming salts in a boiler produces evils nearly as great as those caused by scale. Chlorides decompose at temperatures which may be attained in the boiler and produce free chlorine, a most corrosive gas. The sulphates and nitrates, on the other hand, when present as concentrated

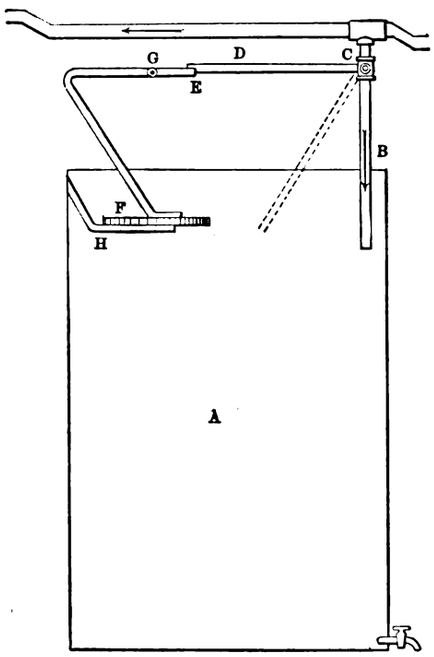


FIG. 22.—ELEVATION OF WATER SAMPLING APPARATUS.

solutions, attack the brass and gun-metal fittings of the boiler, and cause much trouble from leakage. When using feed-water containing considerable amounts of these non-scale-forming salts, it is therefore necessary to blow off the boiler at frequent intervals. This, of course, means loss of heat and diminution of its working efficiency. For these reasons, in nearly every large works, it will be found that economy is promoted by the use of a purer water, or by the erection of a water-softening plant.

SAMPLING BOILER FEED-WATER.

The sampling of water does not present such difficulties as the sampling of fuel, but some thought and care must be expended upon the matter if fair and representative samples are to be obtained.

The water in large tanks or reservoirs can be adequately sampled by stopping the flow of water from the inlet pipe, using a wooden plunger to mix the water, and after waiting ten minutes, withdrawing one or more samples of the water in Winchester quart glass bottles provided with well-fitting glass stoppers. These bottles are rinsed out twice with the water to be sampled, and are then held until filled in a vertical position, with the mouth one inch below the surface of the water in the reservoir or tank. In large reservoirs it is advisable to take samples from more than one position, filling an aliquot portion of the bottle from each selected point, and a boat is requisite in these cases for the work of sampling.

If the supply of natural water is known to be quite constant in character and composition, the sample may be taken either at the inlet or exit pipe of the tank or reservoir; but in most cases it is advisable at the same time to sample the whole body of water as described above, and to compare the test results.

The sampling of water as it flows from the reservoir or tanks to the boilers can also be carried out by automatic apparatus, and below a description is given of an apparatus which is in use at Joseph Crosfield & Sons' Soap Works, Warrington, for this purpose.

Fig. 22 is a sectional elevation of a portion of this sampling apparatus. A is an iron tank, twenty-four inches in diameter by thirty-six inches in height, provided with a runoff tap at the bottom. Above this tank a three-quarter-inch wrought-iron pipe branches from the main supply pipe to the boilers, and delivers the water into the tank A, by the one-half-inch diameter down flow-pipe marked B, and cock C. This cock is opened and closed by the lever D, formed of solid iron rod, and sufficiently heavy to fall into the position shown by the dotted line, when the support at the point E is withdrawn. F is a wooden float, eight inches in diameter and one and one-half inches in thickness, which ordinarily rests on the support H, and by means of an elbow lever and pivoted joint at G, provides a support for the cock lever at E. When the tank is quite filled with water, the float F rises off its support, the lever D is released at E and drops into the position of the dotted lines, thus automatically closing the cock C, and cutting off the supply of water to the tank A.

By arranging that the pressure of water in the three-quarter-inch pipe is not too great, and by providing a series of these

Digitized by Google

tanks, each with its float and cock, it is possible to collect any number of samples of water, each representing the flow from the softening apparatus, or to the boilers for an equal period of time.

The supply-pipe must be bent as shown in Fig. 22 between each successive tank, in order to make these fill in rotation, and by aid of a cock on the three-quarter-inch pipe where it joins the main to the boilers, the flow of water can be regulated so that each of the tanks requires any predetermined period of time for filling. A series of twelve tanks may thus be made to contain samples of twelve or twenty-four hours' work, and from these twelve tanks either a general sample may be prepared by putting twelve equal portions into a Winchester quart bottle and vigorously shaking; or any particular one may be sampled and tested as desired.

This apparatus is of especial use in checking the work of softening apparatus of the automatic and continuous type, since, for the reasons given in the next article, one can never be certain that the amount of softening chemicals is correct unless regular and systematic sampling and testing are carried out.

The sampling of water from springs and artesian wells demands a different method of sampling, for here it is important that the water should lose none of its dissolved gases before testing. In this case, therefore, the Winchester quart glass bottle is filled directly from the spring or well, with as little delay as possible. Care must be taken also to select a bottle with a particularly close-fitting stopper, which should be tied down after the sample is taken. Samples of well and spring water should not be exposed to sunlight and should not be violently shaken before testing, since either of these influences may influence considerably the amount of gaseous matter retained in solution in the water.

Subway System for Chicago.

It has been announced that the Chicago Union Traction and the Chicago City Railway companies have agreed to do away with down-town surface lines. The initial cost to be paid by the companies is approximately $5,000,000, the Union Traction Company paying $3,000,000, and the City Railway Company $2,000,000. The route of the tunnel has not been fixed, but will be decided by the engineers and representatives of the city.

Decision in Storage-Battery Litigation.

On October 1, 1906, Judge Hazel, sitting in the United States Circuit Court for the Southern District of New York, issued a decision in the suit brought by the Electric Storage Battery Company, Philadelphia, Pa:, against the Gould Storage Battery Company, New York city, alleging infringement of the patent to Mailloux, No. 430,868, June 24, 1890, in favor of the Gould company. The alleged infringement was the system regularly employed by the Gould Storage Battery Company, in which a battery booster has its field automatically regulated by a counter machine whose electromotive force is, in turn, regulated by the current fluctuations of the main generator or generators. A Gould installation in the power plant of the Lexington & Boston Street Railway Company, Lexington, Mass., was the particular plant upon which testimony was taken.

The complainant claimed infringement on claims two and six. The Mailloux patent described the regulation of the booster by the fluctuations of the working circuit, and showed the field winding of the booster in the working circuit, so that it would be subjected to all the fluctuations on the trolley line. Judge Hazel held that a prior system described by Lane Fox in an early patent contained the elements of the system, except only the particular location of the regulating coil.

The court held that the regulation of the defendant's counter machine by a field winding in the circuit of the generator involves a different principle, and produces a different kind of regulation and distinct results.

The court sums up as follows: "My conclusion is that the claims can not be given a scope to embrace a booster automatically regulated by a coil in the generator circuit, when such regulation occurs by the conditions of such a circuit. It follows that the defendant's system can not be included in the scope of the claims in suit, and its means of regulation do not correspond to those of the complainant, nor do they produce the same result."

Manhattan Transit Company Sold.

The Manhattan Transit Company has been sold by Joseph H. Hoadley to John C. Sheehan, of New York city. The Manhattan Transit Company has a state franchise under which it has claimed a monopoly of the passenger traffic, other than on street railway cars and the Fifth avenue omnibus line, on the streets of the city of New York. It claims equal rights with the Fifth avenue 'bus line on Fifth avenue, and exclusive rights other than on street railway cars, on all the streets of all the cities of New York state. In addition, the company owns fifty-one per cent of the stock of the New York & Brooklyn Railway Company, which claims a franchise to construct a subway from the Post-office in Manhattan to any point in the borough of Brooklyn.

It is also announced that Mr. Sheehan has secured control of the Long Acre Light and Power Company. This company was organized about a year ago by a number of theatrical men for the purpose of furnishing themselves with electric light. Following the transfer of the company to Mr. Sheehan, William H. Lambrecht, a Cleveland banker, was made chairman of the board.

The Long Acre Light and Power Company claims a franchise permitting it to distribute electricity for lighting purposes. It is announced that the company proposes to enter the electric lighting field at once and to exercise all its rights under its charter.

San Francisco's Progress Toward Recovery.

A bulletin recently issued by the California Promotion Committee gives some remarkable figures indicating the progress of San Francisco, Cal., toward recovery from the effects of the recent fire and earthquake. Reports from all railroads entering California show that traffic has increased enormously, both on colonist and tourist tickets. All parts of California are feeling this infusion of new settlers. Labor supply is still inadequate to meet the demand, both in city and country districts. There is great need of ordinary laborers in San Francisco, and the demand for skilled artisans in building trades is constantly increasing.

Estimates based on computations of military authorities place the present population of San Francisco at 370,000. The enrollment in the school buildings is placed at 29,803. It is estimated that with proper facilities there would be at least 15,000 more school children ready to take up instruction.

Of $208,000,000 insurance on property in San Francisco destroyed by fire, $150,000,000 has been paid policy-holders.

During September there were 1,050 building permits issued, with a value of $5,902,000. There were 316 building contracts recorded, having a value of $3,252,090. The bank clearings were $198,712,503.47. The bank clearings for September, 1905, were $168,329,716.22.

Digitized by Google

Electric Railway Engineering Preliminaries—Part II.[1]

By Sydney W. Ashe.

HIGH-SPEED Interurban Electric Railways — The primary factor which usually governs the engineering preliminaries of an interurban, intercity electric railway is its ability to compete with steam roads already covering the same territory. The success of such a proposition therefore depends upon offering a frequent, high-speed service.

Using the curves for city traffic, Fig. 5, Part I, to determine the most suitable service for an interurban proposition, would lead to erroneous results. There are two population values to be considered in an interurban proposition, the population of the towns through which the railway passes and the population of the rural districts surrounding the railway under projection. Considering the former population, only about one-third are passengers; whereas with the latter, rural districts, the amount of traffic is very small. As an illustration, statistics secured by the Muncie, Hartford & Fort Wayne Railway Company show that 82.7 per cent of its passenger traffic comes from towns in intercity traffic, whereas but 17.3 per cent of the traffic is supplied by rural districts.

Assuming a high-speed service a necessity, other limiting factors enter into consideration, such as large energy consumption at high speeds for cars of few units. This tends to eliminate single-car operation. In the experiments performed upon the Buffalo and Lockport line of the International Railway Company in March, 1900, the fact was discovered that with trains of one or two units operating at maximum speeds of seventy-five miles per hour, the watt-hour consumption per ton-mile was 137, compared with seventy-five watt-hours per ton-mile for a train of several units.

Another factor must be considered, namely, that the maintenance of high speeds calls for very low grades, a maximum of about three per cent, and for the elimination of sharp curves and in fact all curves where possible. Long curves are not desirable, as a motorman can not see sufficiently far ahead to prevent accidents. If the road is equipped with block signals this difficulty disappears.

DETERMINATION OF MOTOR CAPACITY.

Four methods are in common use for determining the motor capacity required for a given service. These may be designated as

1—The rule-of-thumb method;
2—Armstrong's method;
3—Storer's method;
4—Hutchinson's method.

The Rule-of-Thumb Method — This method consists in having at hand data in tabulated form upon all of the principal railway installations throughout the country. The problem under consideration is compared with this table and from the table is selected an installation of somewhat similar nature. The motor capacity of this installation is then noted and considered with reference to the problem at hand. Care is taken in such cases to select a system in which the profile and contour of the road are somewhat similar to the problem at hand, and also to note that the total weight of the equipment, including passenger load, and the schedule speed compare favorably.

The rule-of-thumb method is based upon the assumption that a motor capacity which has proved adequate in one service will serve equally well in another service which is almost similar. This assumption is justifiable and in fact is followed almost unconsciously by many engineers. The data for such a table may be readily obtained by reference to the technical journals for past years in which descriptions may be found, giving data, upon almost every installation of note. In addition may be found descriptions of new rolling stock, representing improved methods, installed on old systems. Data of this kind may be arranged both alphabetically and according to total horse-power of motor per car installed. Table 1 illustrates in brief form the latter method. Referring to this table, it may be noted that the motor capacity per unit ranges from one single forty-horse-power motor to four 550-horse-power motors, or a total of 2,200 horse-power. The maximum speeds range from about sixteen miles per hour to seventy miles per hour. As case 14 in Table 1 includes locomotive service a truer comparison of horse-power would be with case 13. The number of motor units varies from one to four, depending upon the amount of traction desired. Where the traffic conditions are severe a four-motor equipment is often preferable.

Referring to Table 1 and to the original problem worked out in Part I, in which a car has a length of sixteen feet, a total weight including passengers of 14,860 pounds, and operating at a schedule speed of 8.5 miles per hour, it is obvious that two twenty-five-horse-power motors would be ample. The service, in other words, would correspond to that of Austin, Tex., providing the contour and profile were about the same.

Owing to the lack of available data the foregoing method does not meet with success, when applied to an original problem of widely different nature, such as a trunk-line problem. Applying this method to such a problem would be expensive and would probably result in improper design, as the heating of a motor under these conditions is entirely different from an inter-

TABLE I.

CAR MOTOR EQUIPMENTS USED BY VARIOUS RAILWAY COMPANIES.

Case	Company.	No. of Motors.	H.-P. Rating of Motors.	Total H.-P.	Length of Car.	Width of Car.	(Estimated.) Maximum Speeds, M. P. H.	(Estimated.) Maximum in City Limits.
1	Atlantic City	1	40	40	.....	.....	16	8
2	Austin, Texas	2	25	50	30 ft. 7 in.	7 ft. 9 in.	16	10
3	Atlantic City	2	40	80	.....	.....	16	8
4	Chicago & Indianapolis	2	55	110	41 ft.	8 ft. 4 in.	20	12
5	Conneaut & Erie	4	35	140	41 ft.	.....	20	10
6	Easton, Pa	4	40	160	40 ft. 1 in.	8 ft. 4 in.	20	..
7	Warren & Jamestown	4	50	200	52 ft. 14 in.	9 ft.	50	..
8	North Shore R. R., Cal	2	125	250	56 ft. 4 in.	.....	60	..
9	Chicago & Milwaukee	4	65	260	46 ft. 9 in.	.....	40	20
10	Indianapolis & Northwestern	4	75	300	60 ft.	8 ft. 8 in.	42	..
11	Los Angeles-Pacific R. R.	4	80	320	55 ft.	.....	60	..
12	Interborough Rapid Transit, N. Y.	2	200	400	.....	.....	High-speed	Interurban
13	Schenectady Railroad, N. Y.	4	125	500	51 ft.	8 ft. 9 in.	70	..
14	N. Y. C. & H. R. R. R.	4	550	2,200	Locomotives		60	..

[1] For Part I see ELECTRICAL REVIEW, June 2, 1906.

Digitized by Google

urban problem. One fortunate factor which the practical engineer has at his disposal in solving such problems is the immense engineering resources of the larger manufacturing companies which are always placed willingly at his disposal.

Armstrong's Method—In a paper presented by A. H. Armstrong at the twentieth annual conventon of the American Institute of Electrical Engineers at Niagara Falls, N. Y., June 30, 1903,[1] was given a set of curves, Figs. 1, 2 and 3, from which could be determined the required motor capacity for a given service. These curves were plotted for

A. Trains of twenty cars or more;
B. Trains of two cars;
C. Single cars.

These curves are based upon a service rating which shows the relation between the commercial rated horse-power of a motor and the weight of car in tons it can propel at any speed without heating more than sixty-five degrees above the temperature of the air. The curves are plotted for a level track, gross acceleration of 120 pounds per ton; braking, 120 pounds per ton; duration of stops, fifteen seconds; coasting, ten seconds. To use the curves apply the following example:

Example—Given a forty-ton single car moving at thirty miles an hour, to determine the required motor capacity for a four-motor equipment. Refer to curve sheet C, Fig. 3, for single cars. The tons per motor would be ten. Referring to the curve sheet, note the intersection of the thirty-mile-per-hour curve with the ordinate ten tons per motor. Referring this point vertically to the lower scale on the abscissa may be found the required rated commercial horse-power per motor, in this case fifty-two. If there is considerable layover at the ends of the lines, the motor of the next smaller size manufactured by standard companies may be employed.

Armstrong's curves were based upon the friction curves plotted from the Davis formulæ. A more recent set of friction curves obtained by Armstrong is given in Figs. 4 and 5. They are based upon the formula,

$$R = 4 + 0.07\ V + \frac{0.0025}{T} A V^2 \left(1 + .1\ (n-1) \right)$$

Where R = train resistance in pounds per ton,
T = weight of train in tons,
A = cross-section of car in square feet,
V = speed in miles per hour,
n = number of cars in train.

Referring to Figs. 4 and 5, the curves have been plotted in terms of speed in miles per hour, and train resistance in pounds per ton, for a car weight of forty-five tons, and a cross-section of 110 square feet. The curves indicate values for trains of various numbers of cars. Fig. 5 represents locomotive service.

Storer's Method of Determining Motor Capacity—This method serves in cases where a motor has been selected for a given service, and it is desirable to determine whether or not it has the proper capacity. Average speed time and power curves are drawn for this motor, and the effective current values determined. The average motor voltage over a whole cycle is also determined. The effective current value and this voltage value are referred to the characteristic curves of the motor. As the average potential will be in the vicinity of 400 or even 300 volts, the continuous capacity in amperes at these two potentials must be known. Usually a motor selected in this manner will have about twenty-five per cent excess capacity due to the fact that the ventilation is much better when mounted under a car than when the motor is mounted on a stand. This excess is on the safe side, and is particularly advantageous to the motor when operated by an incompetent motorman. Where greater accuracy is desired with this method, the original I^2R losses of the motor and its core loss at a particular voltage are found, and the total loss calculated. This value is compared with the heating value of the motor under similar conditions and its adaptibility for the service determined.[1]

Hutchinson's Method for the Determination of Motor Capacity—This method affords a means of determining the energy, the power, and the losses for any schedule speed, over a course of any length, with any initial acceleration, tractive resistance or braking effort, and with any desired use of the "motor curve." The paper[2] describing this method was presented before the American Institute of Electrical Engineers in January, 1902. It will be found in the transactions, vol. xix, page 129, and is one of the greatest classics on this subject.

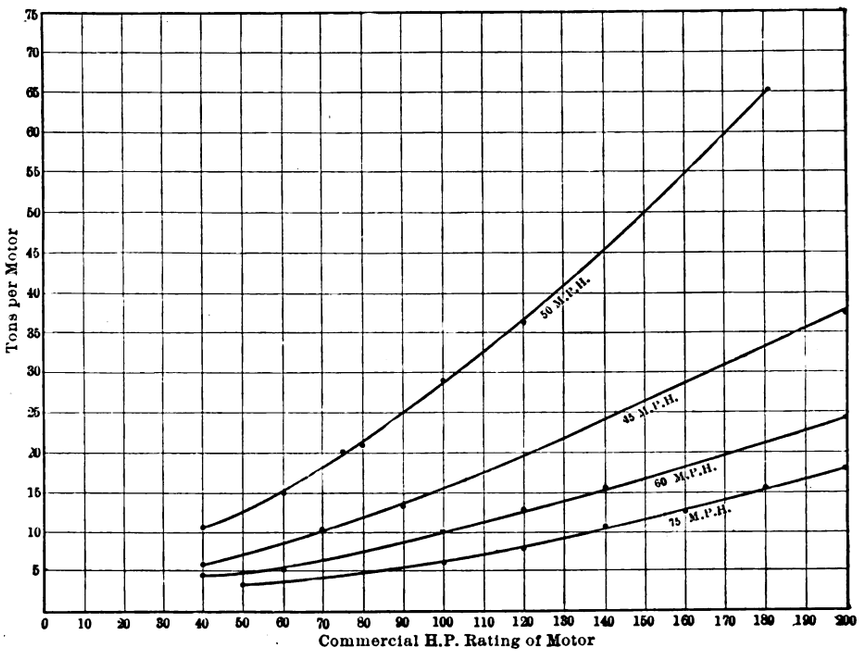


FIG. 1.—SERVICE CAPACITY CURVES—TRAINS OF TWENTY CARS OR MORE.

Discussion of Schedules—The initial rate of acceleration deserves great attention when selecting a motor equipment for a local service. There has been a tendency of late to use high initial rates of acceleration with a view to lowering the watt-hour consumption per ton-mile for a given schedule. The results have not been altogether satisfactory except where the motors were designed with low core losses, as was the case with some of the recent installations like that of the Interborough Rapid Transit Company's of New York. A rate of acceleration of 1.5 miles per hour per second seems to be the most satisfactory. This rate of acceleration is the standard for many railways throughout the country. Referring to Fig. 6, which is reproduced from Hutchinson's paper, this point is at

[1] See ELECTRICAL REVIEW, vol. xliii, page 7, July 4, 1903.

[1] *Street Railway Journal*, January 5, 1901.

[2] See ELECTRICAL REVIEW, vol. xl, pages 137 and 165, February 1 and 8, 1902.

Digitized by Google

once obvious. For instance, with a through acceleration of 0.3 (through acceleration = average speed between stations divided by the running time between stations) the watt-hours per ton-mile are approximately 115 for an initial rate of acceleration of one. Where the initial rate of acceleration is 1.5 the watt-hours per ton-mile become ninety-eight and, where it is two, the watt-hours are approximately ninety-two. When it is considered that the motor equipment is directly proportional to the rate of acceleration, or in other words the current used while accelerating, taking the one-hour rating as a basis, it is obvious that it would be advisable to consider a difference in watt-hour consumption of 115 compared with ninety-eight. On the other hand it would be hardly justifiable to consider a difference between ninety-two and ninety-eight. The increased motor capacity in the latter case at two miles per hour per second would hardly be economic.

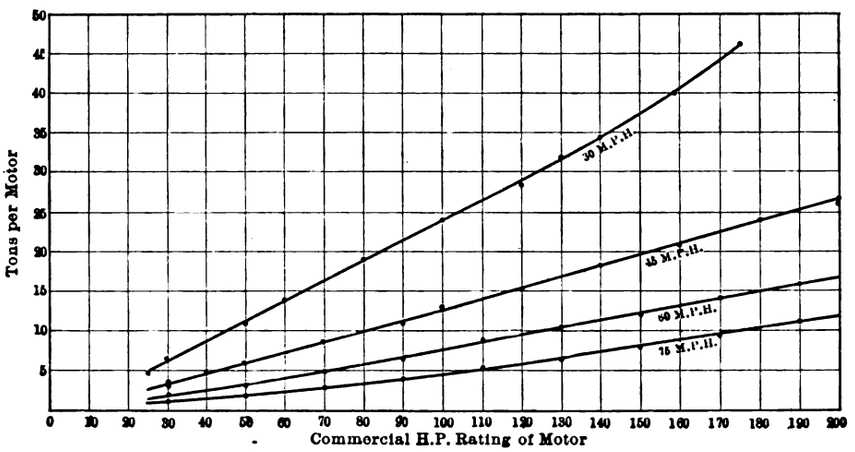


FIG. 2.—SERVICE CAPACITY CURVES—TRAINS OF TWO CARS.

Another point. Throughout the consideration of an entire problem the fact must be borne in mind that the heating of a railway motor determines its capacity. If the motor is overloaded, the armature coils will burn out, causing delay and expense. Consequently, there should be a reasonable proportion of coasting. Unfortunately delays are caused at stations by loading and unloading of passengers, with the result that the motorman eliminates the coasting, obtains a higher through acceleration, consumes more energy than ordinarily, and overheats the motors. As brought out by Mr. Hutchinson, a motor can dissipate about one-quarter of its rated losses continuously, on the assumption that the losses are about twelve per cent. Consequently, in order to produce an equilibrium of temperature, a motor should not develop twelve per cent of its rating in heat for more than twenty-five per cent of the time. On long grades there is a tendency for a motor to overheat.

Graphic Time-Table—Having determined, as indicated in Part I, the number of miles of track, the frequency of traffic and the size, type and seating capacity of cars for a given service, the motor capacity may be determined as indicated, by one of the methods outlined above. The question of distribution of cars should next be considered in order to calculate power-house capacity, size and distribution of substations. A proposed time-table is prepared such as will accommodate the possible traffic most economically. A clear conception of the distribution of trains during a day may be formed by means of what is termed a graphic time-table. This table or chart is plotted in terms of station stops or distance and the time values representing the various hours of a day. The location of each train during the day at the various time intervals is indicated on this chart. From such charts, many features are obvious, such as the passing of trains, location of turnouts on single-track roads, variation of speed of trains, changes in roadbed due to curves or grades, and many other features.

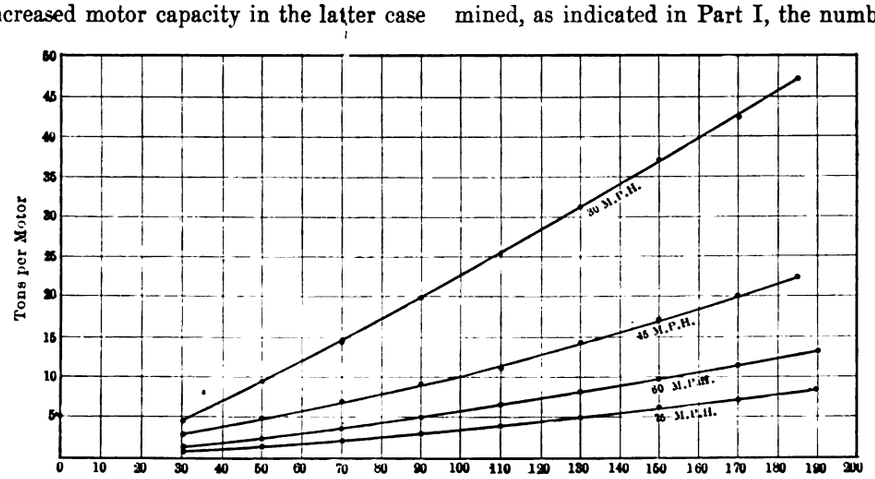


FIG. 3.—SERVICE CAPACITY CURVES—SINGLE CARS.

Energy Curves, Load Diagrams—Granting that all preliminary problems relating to schedule, size of cars, control and motor capacity have been considered, the next feature of importance is to calculate the amount of electrical energy required by the cars, and furthermore, to decide upon the most economical method of generating and distributing this energy.

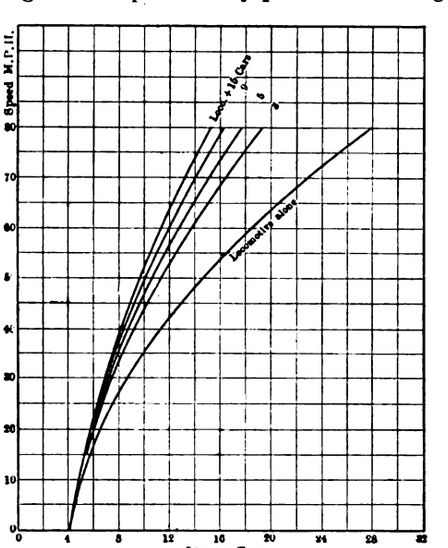


FIG. 4.—TRAIN FRICTION CURVES - LOCOMOTIVE TRAIN.

Starting with a single car or train unit, speed-time and energy curves should be plotted, for an entire day, representing complete service. From sets of these curves corresponding to various cars may be determined their average watt-hour consumption per ton-mile. This may be determined mathematically, as outlined in Hutchinson's method of determining motor capacity for a level tangent track, but in actual practice the conditions are so varied that the former method is preferred.

Having determined the average watt-

Digitized by Google

hour consumption, some idea of the total required energy consumption per day may be gained. Knowing the car-mileage facilitates this determination. Then the load-factor of the proposed service is determined and the desired installed capacity becomes apparent.

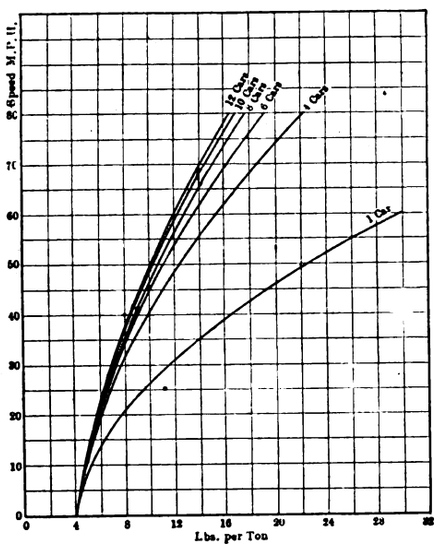


FIG. 5.—TRAIN FRICTION CURVES—MOTOR-CAR TRAINS.

In order to determine the load-factor, it is necessary to plot graphically on a chart the energy consumption of each train or single car for a single typical day, the abscissæ for this chart being time and the ordinate kilowatts. The kilowatt values are obtained from the energy curves plotted in connection with the speed-time

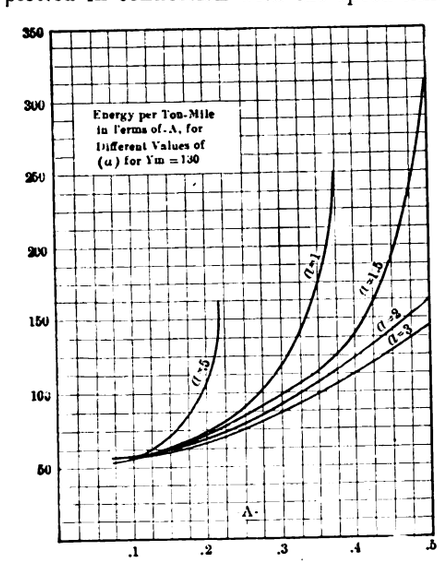


FIG. 6.—THROUGH ACCELERATION CURVES.

curves previously mentioned. The energy values may be taken at as frequent intervals as the character of the service necessitates. For instance, with trunk-line service the power is on for a much longer period of time than with interurban service and consequently the time intervals may be reasonably long. With trolley service the period in which the power is on is quite short. When the train energy values for an entire day's service have been plotted on this chart the values should be summed up and a curve termed the load diagram will be the result. Sometimes it is interesting to pass curves through the points representing the energy consumption of the individual trains.

From the load diagram the average load value may be quickly determined by means of a planimeter, and with the average and the maximum values, the load factor is at once determined. This method was used on a large scale by Bion J. Arnold when making a preliminary report upon the proposed electrification of the New York Central & Hudson River Railroad. In the problem treated by Arnold the purpose was to substitute electricity for steam. Dynamometer tests were made upon steam locomotives in use and the results compared with proposed electric service. This problem was discussed by Mr. Arnold in a paper[1] presented before the American Institute of Electrical Engineers on June 19, 1902, in which may be found load diagrams of the New York Central & Hudson River Railroad problem.

Location of Power-House—It is impossible to give any general solution for the location of a power-house of a railway proposition, except that it should be located as near the load centre of the system as possible. When treating such problems it is customary to consider several sites near the load centre with reference to elements such as cost of real estate, use of river water for cooling condensers, transportation of coal, ashes, etc., insurance, and proximity of resident sections. The method of generation and distribution to be used depends upon the distance over which the system extends.

Location of Substations—The location of substations for a railway proposition is usually determined by certain fixed centres of load which develop with almost every proposition. As an example, assume that there is under consideration an elevated railway consisting of several branches. If the traffic is heavy it often becomes desirable in such cases to locate substations near the junctions of the two structures, and to use the elevated structure for the return circuit. This results in great economy of copper, for, if a twelve per cent loss in the feeders is allowable, nine per cent of this can be in the positive feeders, and three per cent in the negative feeders. It is found in practice that the carrying capacity of an elevated structure, when well bonded, is very great. Where tunnels sheathed in metal are used, it is usual to employ the sheathing of the tunnel for the negative circuit.

Where the traffic on a road is light and the system is not complicated, Kelvin's law may be used to advantage in the location of substations, as shown by C. W. Ricker in a paper[1] presented before the American Institute of Electrical Engineers, December 15, 1905.

Conclusion—From the foregoing discussion of the engineering preliminaries of an electric railway, it is obvious that considerable engineering ability is required to engineer a new proposition. With railway work the conditions are so varied in different localities that the only thing which can be systematized is the method of treatment. This has been the purpose of the writer. In doing this in a limited space it has been necessary to omit many small working details, and simply to refer to prominent engineering papers bearing on the subject rather than to abstract them.

[1] See ELECTRICAL REVIEW, vol. xli, page 104, July 26, 1902.

[1] See ELECTRICAL REVIEW, vol. xlviii, page 13, January 6 1906.

September Telephone Gain in New York Breaks all Records.

During the month of September, the New York Telephone Company and the New York & New Jersey Telephone Company secured a net gain in New York city of 7,584 new telephones, which is over 1,000 more telephones than were ever gained in this territory in any previous month. New residence telephones to the number of 3,500 were secured, which indicates the extent to which the telephone is being used in the home life of the city.

Ten years ago, in 1896, the gain for the entire year was less than half the number of telephones gained during this one month of 1906. The total gain in New York city for 1905, which was about 50,000 telephones, will be exceeded this year about at least 10,000.

The latest statistics and estimates obtainable show that in all probability the gain in telephones in New York city during the current year will exceed the telephone gain for all Great Britain.

New York is already the best telephoned city in the world, not only as regards the number of telephones, but also in the matter of efficient service. As the telephone companies point out, the fact that every telephone added to the system increases the value of the service to each user has become an important factor in this growth.

Realizing that by subscribing to telephone service they can reach not only all points in the city or suburbs, but practically every city and town of importance in the United States, business men have come to regard the telephone as a necessity. They find that the use of it saves them time, travel and money. It would be difficult indeed to estimate the value to New York city of the efficient telephone service with which it is now supplied.

Digitized by Google

American Electrochemical Society.

The tenth general meeting of the American Electrochemical Society was held in New York city, October 8 and 9.

The first meeting for the discussion of papers was held at Havemeyer Hall, Columbia University, at 10 A. M., October 8. The society was welcomed to Columbia University by Professor C. F. Chandler, who expressed the pleasure of the university in having one of the youngest scientific associations accept its hospitality. He pointed out the great field open to the society, and showed what revolutionary changes have already been made in chemical processes by making use of electrolytic reactions. He thought that the aid which chemistry would derive from electrical methods would be far greater in the future than it has been in the past. On behalf of the society, President Hering thanked Professor Chandler, and through him the university, for its courtesy and good wishes.

A paper entitled "Formula for the Helmholtz Concentration Cell," submitted by Professor Henry S. Carhart, was read by Dr. W. D. Bancroft. The paper starts with the well-known Helmholtz equation, and shows that when applied to a concentration cell the expression for the electromotive force reduces to $E = T\ d\ T$, which shows the relation between the Helmholtz and the Nernst equations, and indicates that the latter may be derived entirely from thermoelectric data. The values obtained by calculation, using this formula, give results of the same order as those observed.

The paper was discussed by Carl Hering and Dr. Bancroft, the former asking whether the equation, as proposed, was in agreement with the second law of thermodynamics, and the latter calling attention to the fact that the relation deduced had been pointed out in 1899.

A paper entitled "Visible Migration of Particles between Electrodes," was read by Carl Hering. This described the behavior of minute particles of matter when in a fluid placed between two electrodes, when observed by means of a microscope. It was found that these particles responded to the action of the current and traveled in one direction or the other. Occasionally particles of two kinds were found in one mixture, these moving in opposite directions. They seemed to exert a mutual repulsion, as they deviated from their paths in passing one another. No attempt to explain this was made, but it was thought that the phenomenon might account for irregularities occurring in electrolytic processes, particularly when oxidation occurs at the cathode or particles of foreign matter are found to be contained in the deposited material. The speed of these particles was about one foot in four hours.

Dr. Bancroft thought that the phenomenon was merely a reversal of ordinary endosmose. In this case the diaphragm, being disintegrated, could move, as well as the liquid. As there are two kinds of diaphragms the particles of one would move in one direction and those of the other in the opposite direction. He did not think it explained oxidation at the cathode, but was the more inclined to attribute this to local chemical action.

Mr. Hering did not agree with these comments, but thought that the disintegrated diaphragm would always move with the liquid, and that no other explanation had been offered for finding inactive material, such as carbon, in a deposit of iron.

C. A. Acker, of Niagara Falls, called attention to a recent patent issued in this country which claimed an electrolytic process in which foreign particles were introduced into the solution, which particles all moved in one direction. This process, it was explained, contemplates the use of gelatine or some gum, and that the transferred particles collect upon the high points of the plated surface, and in this way, by introducing a resistance, assist in building up the lower parts.

E. A. Sperry called attention to the process employed by Betts in refining lead, in which gelatine is used, and wished to know what difference there might be between the two.

Dr. Bancroft explained that Betts made use of gelatine because he found it effective, while the patentee of the new process had found that gelatine, under the action of the current, would move toward the cathode, and would therefore be effective.

A paper by J. W. Turrentine, entitled "Copper Cathodes in Nitric Acid," was read by Dr. Bancroft. This described an investigation of the action taking place when copper cathodes are used in nitric acid. The action at the anode is the formation of copper nitrate; that at the cathode the reduction of nitric acid, nitric acid or ammonia being set free, according as copper is in the solution or not.

A paper entitled "An Aluminum and Magnesium Cell," presented by G. H. Cole and H. T. Barnes, was read by Dr. Bancroft. The cell consists of a solution into which a magnesium and an aluminum plate are introduced. There is a momentary flow of current from the aluminum to the magnesium, and then the cell reverses and current flows in the opposite direction through the solution. When hydrogen peroxide is introduced as an oxidizer, an electromotive force of 2.14 volts is obtained.

Dr. M. Loeb thought the action of the cell might be explained by the effect of magnesium upon water, which it decomposes. The hydrogen set free might then react with the hydrogen peroxide. No explanation, however, was given why this cell, if it were a hydrogen-oxygen cell, should develop such a high electromotive force.

A paper by Francis R. Pyne, entitled "Melting Points of Some Cryolite-Alumina Mixtures," was read in abstract by S. S. Sadtler. Mr. Sadtler also read a paper presented by P. B. Sadtler and W. H. Walker, entitled "Double Decomposition of Zinc Sulphate and Sodium Chloride," and a paper by H. E. Patten, entitled "Some Factors Affecting the Distribution Law," this being a study of the absorption of liquids by polarized solids.

The reading and discussion of papers was resumed on Tuesday morning at 10.30 o'clock. It was opened by Dr. E. F. Roeber, who discussed the subject of temperature measurements, showing that temperature is merely a relative term and all methods of measuring are based upon the changes taking place in the substance as it is heated or cooled. Attention was called to the great progress made recently in the construction and use of pyrometers, and the necessity for international agreement in the use of fixed points for calibration was dwelt upon.

A paper entitled "A Thermoelectric Pyrometer for General Industrial Applications" was read by F. F. Schuetz. This described the newest forms of Bristol pyrometer as developed for industrial use. The requisites for a practical pyrometer are that it must be accurate and capable of being handled by ordinary workmen. The Bristol pyrometer was described in the issue of the ELECTRICAL REVIEW for May 12, 1906. It depends upon thermoelectric effects, and the couples are mounted in different ways for different purposes. The fire tips for these pyrometers intended for very high temperatures may be replaced, while the extension piece is permanent. The latter may be twenty feet in length or more. For indicating instruments Weston millivoltmeters are used, and for recording instruments the record is made on a smoked dial, the recording needle standing normally free

Digitized by Google

from the paper, but being brought in contact with it by vibrations set up in the paper itself. In this way friction is eliminated and a continuous record secured. The pyrometer has been developed in various styles, for various purposes, and by making use of relays is adapted for automatically controlling oven temperatures. The resistance of the units varies from two to ten ohms, so that a fairly large actuating torque is secured. The indicating instruments may be provided with two scales, one reading to 750 and the other to 2,000 degrees. With the combination pyrometers—that is, those suited for high temperatures—platinum-rhodium couples are employed, and these are so attached to the leading-in extension piece as to neutralize the effect of heating at that point.

F. H. Whipple, of the Cambridge Scientific Instrument Company, described English practice in the development and use of pyrometers, referring particularly to those of the resistance type. He showed the construction of these by means of a number of lantern slides. Other types of pyrometer were described by those who took part in the discussion.

Professor F. B. Crocker read a paper entitled "The Decker Primary Battery." He reviewed the history of primary batteries, showing that no improvement in the type of cell has been made since 1842, with the exception of the Lalande cell, which is not a power cell, and the Bunsen. No advance in structural features has been made since 1850. He had discussed this matter before a meeting of the American Institute of Electrical Engineers in 1888. He believed the cell to be described to be the first real advance in the mechanical design of a primary battery that has been made since 1842. This cell is of the zinc-carbon-sodium bichromate type. The principal feature is the method of construction. Porous cups are formed by burning together two halves of porcelain of considerable thickness, ribbed on the inside for strength, and then grinding down the outside so as to leave a thickness of shell comparable to paper. These cups are mounted permanently in hard-rubber vessels, and graphite plates are placed on the sides, also mounted permanently, great precautions being taken to prevent any corrosion of the electrodes. The zinc plates are introduced into the porcelain cups, the connection being such as to avoid corrosion here. All connections, excepting those of the zinc, are made permanently, and are brought through the sides of the rubber jar. Three or more of these jars are united together and vulcanized so as to form one solid piece. The lower part of each cup is provided with an opening into which a hard-rubber tube leads, the joint being made acid-tight. This tube leads down into a conduit which is provided in the base of the cell, and which connects with a similar conduit to the next cell. This provides for circulation of the electrolyte, and although it allows slight local action to take place, this is not serious. The cells are charged by replacing the old zincs by new, drawing off the old solution through openings provided at the bottom and introducing fresh. A battery made up of three cells, each weighing when filled seventeen pounds, the total battery, therefore, weighing fifty-one pounds, gives an output of 160 ampere-hours at a discharge rate of thirty amperes, the average voltage being 1.7. This corresponds to about one horse-power. The zincs will last for three charges of electrolyte. As the solution makes up about half the weight of the entire cell, by providing two reservoirs, each containing two charges of solution, the output of the cell is increased three by simply doubling the total weight. It has been figured out that power may be obtained from this cell for thirty-five cents per horse-power-hour. While, on its face, this could not be compared with electrical energy supplied from a dynamo, or even from a storage battery, all things considered, such as convenience, the quickness with which the cells may be recharged and the value of the waste product which may possibly be regenerated, there would seem to be a field for such sources of electrical energy. This applies particularly to vehicles, for train lighting and for launches. As an indication that the cost of power would not be fatal, it was pointed out that the cost of energy from a Lalande battery is about $5.30 per horse-power-hour, a figure which is not prohibitive for certain purposes. The internal resistance of the battery is 0.013 ohm per cell. The leakage current is about one-twentieth ampere for a thirty-volt battery. These batteries have been undergoing tests for the past two years, particularly on an electric vehicle, and have withstood successfully very severe work. The voltage remains nearly constant until the end of the discharge is approached. The leakage current corresponds to a "zinc efficiency" of eighty-five per cent, and this does not seem to be affected by lower rates of discharge.

The social features of the meeting were rather informal. On Monday afternoon a lecture by Dr. Charles Baskerville, on "The Use of Ultra-Violet Light in the Laboratory and in Practice," was given at the College of the City of New York. In the evening an informal dinner was held at Liederkranz Hall, and during the afternoons various points of interest were visited. The hotel headquarters was at the Prince George Hotel, while the Chemists' Club and Liederkranz Hall were thrown open to all the members.

HOW ELECTRICITY WAS SERVED TO CONSUMERS AND STREET CAR LINES BY THE SAN FRANCISCO GAS AND ELECTRIC COMPANY AFTER THE FIRE.[1]

BY L. E. REYNOLDS.

In order to get a clear idea of how San Francisco was supplied with light and power to consumers and street car lines after the fire of April 18, 19 and 20, it will first be necessary to go over the normal condition of its distributing system as it existed previous to this time. It is as follows:

The down-town section was furnished by a complete Edison system of three-wire, 220-volt, direct-current tube for lights and power. This was composed of about 130,000 feet of main on standard Edison tube and 95,000 feet of Edison tube feeders. The mains were placed on either side of the street so that services were tapped off direct to the building. These mains terminated in fused junction boxes at street intersection. The feeders extended fan-like from the station to various junction boxes, and did not directly supply any consumers. There was also a complete system of alternating-current mains of 220-volt, two-phase, four-wire, supplied by subway transformers, which in turn were connected to 2,200-volt feeders. The alternating-current mains were installed by the Independent Electric Light and Power Company, and are usually parallel with the Edison system. This system contains approximately 160,000 feet of conduit, ranging from four to sixteen ducts. There are also 1,050 manholes, which contain junction boxes, fuse boxes, and subway transformers. Within this conduit system there are installed 102,500 feet of 11,000-volt, three-conductor, three-phase cable, and 10,000 feet of 4,500-volt, three-conductor, three-phase cable; 75,000 feet of 2,200-volt, four-conductor, two-phase cable; 130,000 feet of 220-volt, two-phase, four-conductor cable; 240,000 feet of miscellaneous cable, supplying service, special installation, direct-current cables in conduit system, etc. Outside the fire limits the distribution is carried on poles in the usual manner, having installed approximately 10,000 poles and 1,500 miles of wire.

The steam plant known as Station A is located at Twenty-third and Georgia streets, and contains about 30,000 horse-power of steam plant capacity. This plant is also connected by two lines to the Martin power-house, which is a gas-engine

[1] Paper read at the fourteenth annual convention of the Pacific Coast Gas Association, San Francisco, September.

Digitized by Google

generating station, having approximately 16,000 horse-power capacity. Two lines extend south from the Martin power-house and connect with the water-power system of the California Gas and Electric Corporation. The capacity of the lines between the Martin power-house and Station A is 12,000 horse-power. The larger portion of this energy was transmitted directly to the central substation on Jessie street between Third and Fourth streets, having a capacity of 3,800 kilowatts in motor-generator sets, 2,000 horse-power in steam engines, and 1,500 kilowatts in storage batteries, 3,000 horse-power in steam-generating apparatus having been destroyed February 22, by fire.

Substation No. 1 was at Fern avenue, between Polk and Larkin streets. It contained 500 kilowatts in motor-generators and 250 kilowatts of storage batteries feeding directly into the Edison system.

Substation No. 2 was on Minna street, between Eleventh and Twelfth streets, containing 500 kilowatts in motor-generators and 250 kilowatts of storage batteries.

Substation No. 3 was on Pacific street, between Dupont and Stockton streets, containing 500 kilowatts in motor-generators and 250 kilowatts of storage batteries, also one fifty-light arc transformer.

Substation No. 4 was an alternating-current station, on Eighth street, between Mission and Howard streets. This station was used as a switching station between Station A and the other alternating-current substation. It contained 2,000 kilowatts capacity of 11,000-volt to 2,200-volt step-down transformers, also an arc transformer for taking care of 800 city arcs, one 400-kilowatt rotary converter, 550 volts, direct current, for delivering energy to the street railway. Also one 250-kilowatt rotary converter, 220 volts, delivering energy into the Edison system. This substation received its energy from four underground 11,000-volt, three-conductor cables from Station A. Also one overhead line of three-conductor, as far as Seventh and Folsom streets, thence underground for three blocks, and after passing through switches goes directly to central substation. There is also an overhead line from Station A as far as Seventh and Folsom streets, thence underground directly to central station. From substation No. 4 there were two lines to each of the other alternating-current stations, which were located as follows:

Substation No. 5, Mission street between New Montgomery and Third streets, containing 2,000 kilowatts capacity of 11,000-volt to 2,200-volt step-down transformers and 250 kilowatts in motor-generator sets delivering direct-current energy into the Edison system. One 400-kilowatt, 500-volt rotary converter capable of supplying energy to the United Railroads. This station was supplied from two 11,000-volt cables from substation No. 4.

Substation No. 6 was located on Sacramento street, between Sansome and Montgomery streets, containing 1,500 kilowatts capacity of 11,000-volt to 2,200-volt step-down transformers, and one 250-kilowatt rotary converter, delivering 220-volt energy into the Edison system. This station was supplied by two 11,000-volt cables from substation No. 4.

Substation No. 7, on Hyde street, between Golden Gate avenue and McAllister street, contained 2,500 kilowatts capacity of 11,000-volt to 2,200-volt step-down transformers, receiving its energy from two 11,000-volt cables from substation No. 4.

Substation No. 8 is at Townsend street, between Second and Third streets, and contains 850 kilowatts capacity in motor-generator sets, delivering energy into the Edison system.

There is also a Kansas street station, on Kansas street near Division street, which was used as a switching station, receiving water-power energy and also steam energy, and delivering same to substations 1, 2, 3 and 8, as these were all fed by overhead lines.

The earthquake and fire did not even crack the walls or do any damage at Station A, except one transformer burnout. The machine foundations for this station were made by blasting out the solid rock, and then building up on large masses of concrete. The walls were of brick laid in cement mortar, and same is as good as before the earthquake.

Central station had its steam plant destroyed, also all the wiring and switchboards, on February 22 of this year, so that the subway with its wires, also switchboard, were only temporary, being installed as quickly as possible after the other fire. The substation portion of this building was fireproof, and except for the fact that a six-story brick wall fell on the roof, caving it in the running motor generator room, the station would not have suffered much damage. The high tension switching apparatus, containing large quantities of oil, did not burn. Office furniture and records of superintendent stations, also locker room and store room for supplies, remained intact and did not burn, although in this vicinity fire was as hot as anywhere in the burned district. This substation was composed of brick exterior with wire-glass windows and slate roof. The motor generator sets were damaged after the roof had been broken down with large masses of brick and steel from the adjoining building, and a crane which was used for the installation of motor generators was brought down on top of them.

Substations 2, 3, 4, 5, 6 and 7 were completely destroyed, so that we had no further use for them.

Substation No. 8 was saved by the exceptionally good work done by its operator, Mr. Fay. A steam boiler was used in the rear of substation No. 8 to pump oil from the bay to the central station, also for circulating water. A fire pump was installed in the basement of B station, which was just across the street from substation No. 8. Mr. Fay kept this fire-pump going, pumping salt water on the surrounding buildings until B station was ready to fall. He then left the pump going and worked the hose, keeping his own station and several warehouses near-by from being destroyed. The station was not damaged at all.

The four underground cables from Station A to substation No. 4 were so badly wrecked by the earthquake and gas explosion that they were out of commission some ten or twelve days. The overhead lines were burned down for four blocks. The underground extension of these lines was so badly damaged that the conduit and manholes had to be reconstructed in many places. Along Seventh street, from Mission to Howard street, the earth was displaced from five to eight feet in a direction lengthwise to conduit. This caused some of the manholes to crush like eggshells, although they were twelve-inch concrete walls. The conduit was pulled apart at other places, and cables were wrenched and torn from their boxes, and in some cases pulled apart between manholes, so that these breaks were not discovered until after we had tested with full voltage. Five different attempts were made before we succeeded in establishing connections between Station A and the central station. The overhead line was replaced on Seventh street for four blocks. A temporary overhead line was built from the Kansas street station to substation No. 8.

The underground Edison system had services tapped off into the basements, which had been ruined, so that every joint had to be dug up and cleared before service could be reestablished on the main itself. Fortunately for the public, it was not necessary to wait to clear all of these mains, as it will probably be several

Digitized by Google

months before we can open the street because of piles of débris over them. Since all of our alternating substations with their apparatus have been destroyed, and also since we could not reestablish connection with our Edison mains completely for some months, it was decided to abandon the alternating-current system of distribution for the underground section and use the cables for direct current. We therefore had service where same was needed before the building stopped smoking, and light was established in the banks and those buildings which were not burned, as soon as it was needed. Each block of main had to be gone over, however, removing all services therefrom and tested out carefully before the main could be used.

In addition to the substation mentioned above, during heavy load last winter we found it necessary to build an overhead cross-town line from Station A over Mariposa and Seventeenth streets, tapping Folsom and Mission streets, running west as far as Stanyan street, and thence north to Fulton street, thence west to First avenue, thence north to Washington street. The function of this line was to boost up the outer end of feeders so as to keep a uniform potential at long distances from substations. Pole transformers were installed on this line, transforming directly from 11,000 volts to 2,200 volts as load required. Two 750-kilowatt step-down transformers were installed at Seventeenth street, near Folsom street, which take care of all of the unburned section of the Mission for power and light. One transformer for 200 city arcs was also installed in the temporary station, and a fifty-kilowatt light transformer which was formerly at substation No. 3 was repaired and installed here. Thus all except about 100 of the street lights in the unburned section of the Mission were provided for. These had to remain out until we could get apparatus for their control.

The Western Addition was supplied by two 750-kilowatt transformers placed on the sidewalk at First avenue near Point Lobos. Here, also, was placed a transformer for 200 city arcs. This provided for all the city arcs in the Western Addition with the exception of 100 which were purposely scattered.

On the morning of the eighteenth, as the fire was approaching the storeroom where all distribution supplies were maintained, we succeeded in removing one buggy-full and one automobile-full of linemen's tools, tape, solder and such small supplies as we could get hold of, quickly to a place of safety. As soon as the men had taken care of their families temporarily, the company established a commissary department, setting aside one wagon and two soldiers to collect food to provide for the men and their families. It was necessary in order to keep the men to care for them in this way. A mess house was established and they were boarded until better accommodations could be obtained. We thus kept a large force of men busy when we needed them most. Regular work was organized on Saturday, the third day after the earthquake, and 100 city arcs were ready to burn on Saturday night and 200 more were ready Sunday night, and so on the work progressed. On Monday many of the houses were lighted in the Western Addition. From then the work was carried on very rapidly with constantly increasing speed. We were also very busy as soon as we could get teams, picking up our copper which had fallen down from burned lines. We regained about $60,000 worth of this metal from the streets. Every house in the unburned portion of the city which had previously been lighted by electricity had to be disconnected from the main before current could be turned on at all. Then service was established one block at a time on the company's mains after the same was inspected very carefully. Before each house was connected it was inspected by the department of electricity and also by one of the company's experts, and a careful test was made for broken wire and grounds. Service was then restored.

In order to get service for the street railway the energy from the water-power plant and also the steam plant from Station A, which has a frequency of sixty cycles, must pass through frequency changers at the Martin power house, where it is changed to 13,000 volts at twenty-five cycles, three-phase. Two lines of 13,000 volts, three-phase connect the Martin power house with the Geneva avenue station, which in turn connected with the Turk and Fillmore streets station and steam plant at North Beach belonging to the United Railroads. There are also two other 13,000-volt, twenty-five-cycle lines from the Martin power house to the Bryant street station, which is also connected by two lines to meet lines between the Geneva avenue and Turk and Fillmore streets substation. It was possible to run the frequency changers as soon as the United Railroads had cleared their trolley so as to be ready to receive energy. Connection was reestablished in the usual manner and cars were immediately allowed to run.

It may be interesting to note that in the substations where lead-covered cables extend from the main floor through tubing to the subway, that the lead was not melted off the cable more than six inches below the floor line. This was true in substations where the second floor contained oil transformers, which allowed their contents to run down the walls and burn on the floor. The fire was so hot in these stations that one could peel off with their fingers from one to one and one-half inches of the solid brick wall which had been laid in cement. In one case the wood trap door into the subway burned away, but directly underneath and about two feet away was a pile of old rags containing oil and grease, which did not ignite. In another station five gallons of gasolene remained in the tunnel with the trap door burned away, while the building burned down and was also dynamited.

Two Cities Left in Darkness Because of the Breaking of a Canal Bank.

An accident to the plant of the New Milford Power Company, New Milford, Ct., on Sunday morning, October 7, left the cities of New Britain and Waterbury in darkness for several days. In addition to this the trolley service in the New England towns between Waterbury and New Britain was demoralized.

The accident was caused by the breaking away of the bank of the canal which leads from the company's dam at Merwinsville to the turbines at Bull's Bridge, where the power-house is located. The raceway is built of earth, without masonry, and a leak in a section of it which runs through marshy ground had been disregarded. On Sunday morning 100 feet of this embankment gave way and the water flowed into the Housatonic river. No damage was done except to the embankment.

General Electric Company to Issue New Stock.

It is anounced that the directors of the General Electric Company will shortly issue the $5,000,000 of stock in the company's treasury and make provision for an additional stock issue. The matter has been under discussion for some time, and in all probability the amount of stock to be issued, including that now in the treasury, will be close to $11,000,000, or twenty per cent of the outstanding capitalization of $54,000,000.

Digitized by Google

The Street Railway Convention.

Programme of the American Street and Interurban Railway Association and the Engineering Association; the Special Trains; the Exhibits of the Manufacturers' Association.

THE annual meeting of the American Street and Interurban Railway Association, together with that of the Engineering Association, the Accountants' Association and the Claim Agents' Association, will be held at Columbus, Ohio, October 15, 16, 17, 18 and 19.

A fine programme of papers has been prepared, the entertainment features have been in capable hands and it is expected that the Manufacturers' exhibit will be far ahead of previous years.

The convention sessions will be held at the Ohio State Fair grounds, where the Manufacturers' exhibit will also be held.

The following programmes have been announced:

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.

WEDNESDAY, OCTOBER 17, 10 A. M. to 12.30 P. M.—Convention called to order; address of welcome; president's address; report of executive committee; report of secretary and treasurer; addresses by presidents of affiliated and allied associations; announcements; new business.

WEDNESDAY, OCTOBER 17, 2 P. M to 4.30 P. M—Reports of committees: (a) membership; (b) compensation for carrying mail; (c) subjects; (d) car wiring; (e) standardization of equipment; (f) insurance; (g) promotion of traffic.

THURSDAY, OCTOBER 18, 10 A. M. to 12.30 P. M. (Interurban Meeting).—Report of committee on heavy electric railroads. Paper—"Elevated Railways and Their Bearing on Heavy Electric Traction," by H. M. Brinckerhoff, consulting engineer, New York city. Paper—"Electric Railways in Sparsely Settled Communities," by E. P. Roberts, of the Roberts & Abbott Company, Cleveland, Ohio. Paper—"Interurban Limited Trains," by Harrie P. Clegg, president Dayton & Troy Electric Railway Company, Dayton, Ohio. Paper—"Interurban Freight and Express," by E. C. Spring, general manager Dayton, Covington & Piqua Traction Company, West Milton, Ohio. Paper—"Tickets and Rates," by F. W. Coen, secretary and treasurer Lake Shore Electric Railway Company, Cleveland, Ohio. Paper—"Some Distinctions Between City, Suburban, Interurban and Railroad Traffic," by Theo. Stebbins, expert, National Civic Federation, Cohasset, Mass. Appointment of nominating committee.

THURSDAY, OCTOBER 18, 2 P. M. to 4.30 P. M. (Employés' Meeting).—Report of committee on rules. Paper—"Y. M. C. A. Branches," by E. M. Willis, railroad secretary international committee of Y. M. C. A., New York city. Paper—"Selection of Trainmen," by C. E. Learned, superintendent of inspection Boston Elevated Railway Company, Boston, Mass. Paper—"Discipline of Trainmen," by F. W. Brooks, assistant general manager Detroit United Railway, Detroit, Mich. Paper—"Uniforms and Badges," by John R. McGivney, purchasing agent New Orleans Railway and Light Company, New Orleans, La.

FRIDAY, OCTOBER 19, 10 A. M. to 12.30 P. M. (Executive Session).—Report of committee on municipal ownership; report of committee on public relations. Paper—"Handling Public Complaints," by John A. Beeler, vice-president and general manager Denver City Tramway Company, Denver, Col. Paper—"Leaks Between Passenger and Treasurer," by A. H. Stanley, general superintendent Public Service Corporation of New Jersey, Newark N. J.

FRIDAY, OCTOBER 19, 2 P. M. to 4.30 P. M.—Report of nominating committee; election of officers; resolutions; unfinished business; adjournment.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION.

MONDAY, OCTOBER 15, 10 A. M. to 12.30 P. M.—Registration; convention called to order; address of welcome; address—Hon. W. Caryl Ely, president American Street and Interurban Railway Association; address—Prof. Bernard V. Swenson, secretary and treasurer American Street and Interurban Railway Association; reading of the minutes of the last meeting; address of the president; annual report of the executive committee; annual report of the secretary and treasurer; appointment of convention committees.

MONDAY, OCTOBER 15, 2 P. M. to 5 P. M. —Report of special committees; report of committee on control apparatus; report of committee on maintenance and inspection of electrical equipments; paper—"Ballast," by Charles H. Clark, engineer maintenance of way Cleveland Electric Railway Company, Cleveland, Ohio; report of committee on way matters; paper—"Ties, Poles and Posts," by C. A. Alderman, chief engineer, Cincinnati Traction Company, Cincinnati, Ohio.

TUESDAY, OCTOBER 16, 10 A. M. to 12.30 P. M.—Report of the committee on standardization. Paper—"Gas Engines," by Paul Winsor, chief engineer motive power and rolling stock, Boston Elevated Railway Company, Boston, Mass. Paper—"Underground Cables," by H. G. Stott, superintendent motive power Interborough Rapid Transit Company, New York, N. Y.

TUESDAY, OCTOBER 16, 2 P. M. to 5 P. M. —Paper—"Economy of Car Equipment, Weights and Schedules," by E. H. Anderson, Schenectady, N. Y.; discussion of the question box.

TUESDAY, OCTOBER 16, 8 P. M.—Informal reunion and dinner.

WEDNESDAY, OCTOBER 17, 10 A. M. to 12.30 P. M.—Joint meeting with "American" Association.

WEDNESDAY, OCTOBER 17, 2 P. M. to 5 P. M.—General business; election of officers.

The railroads have granted the rate of a fare and a third on the certificate plan. The Manufacturers' Association has selected the New York Central line as its official route from New York city. The New York Central has made up a special train, with the following schedule: leave Boston, *via* Boston & Albany Railroad, 10.45 A. M., Sunday, October 14; Worcester, 11.45 A. M.; Springfield, 1.11 P. M.; Pittsfield, 2.59 P. M.; New York, *via* New York Central & Hudson River Railroad, 2.04 P. M.; Albany, 5.08 P. M.; Schenectady, 5.36 P. M.; Utica, 7.09 P. M.; Syracuse, 8.24 P. M.; Rochester, 10 P. M.; Buffalo, 10.52 P. M.; arrive Columbus, 6.58 A. M., Monday, October 15.

The Pennsylvania Railroad has announced a special train from New York to Columbus, leaving New York 8.25 P. M., Saturday, October 13, arriving at Columbus, 1.40 P. M., Sunday, October 14.

The following companies have made application for space at the Manufacturers' exhibit:

Allis-Chalmers Company, Milwaukee, Wis.

American Brake-Shoe and Foundry Company, Mahwah, N. J.

American Instrument Company, Philadelphia, Pa.

American Railway Supply Company, New York, N. Y.

A. & J. M. Anderson Manufacturing Company, Boston, Mass.

Digitized by Google

Armstrong Oiler Company, Philadelphia, Pa.
Atlas Railway Supply Company, Chicago, Ill.
American Mason Safety Tread Company, Boston, Mass.
American Steel and Wire Company, Chicago, Ill.
Atha Steel Castings Company, Newark, N. J.
Adams & Westlake Company, Chicago, Ill.
Acme Automatic Street Indicator Company.
Bayonet Trolley Harp Company, Springfield, Ohio.
Blake Signal and Manufacturing Company, Boston, Mass.
J. G. Brill Company, Philadelphia, Pa.
Harold P. Brown, New York, N. Y.
Buckeye Engine Company, Salem, Ohio.
Burnham, Williams & Company, Philadelphia, Pa.
Brady Brass Company, New York, N. Y.
S. F. Bowser & Company, South Bend, Ind.
L. M. Booth Company.
Cleveland Frog and Crossing Company, Cleveland, Ohio.
Consolidated Car Fender Company, Providence, R. I.
Consolidated Car Heating Company, New York, N. Y.
Cook's Railway Appliance Company, Kalamazoo, Mich.
Curtain Supply Company, Chicago, Ill.
Creaghead Engineering Company, Cincinnati, Ohio.
Cambria Steel Company, Philadelphia, Pa.
Carnegie Steel Company, Pittsburg, Pa.
Dearborn Drug and Chemical Works, Chicago, Ill.
D. & W. Fuse Company, Providence, R. I.
Duff Manufacturing Company, Pittsburg, Pa.
Dayton Manufacturing Company, Dayton, Ohio.
Joseph Dixon Crucible Company, Jersey City, N. J.
Duplicate Transfer and Rebate Company, Philadelphia, Pa.
DuQuesne Steel Foundry Company, Pittsburg, Pa.
Dossert & Company, New York, N. Y.
Dressel Railway Lamp Works, New York, N. Y.
O. M. Edwards Company, Syracuse, N. Y.
Electric Railway Equipment Company, Cincinnati, Ohio.
Electric Storage Battery Company, Philadelphia, Pa.
Charles I. Earll, New York, N. Y.
Electrical Review, New York, N. Y.
Electric Service Supplies Company, Chicago, Ill.
Eclipse Railway Supply Company, Cleveland, Ohio.
Franklin Car Heating Company, Syracuse, N. Y.
Franklin Electric Manufacturing Company, Hartford, Ct.
Felt & Tarrant Manufacturing Company, Chicago, Ill.
Galena Signal Oil Company, Franklin, Pa.
W. R. Garton Company, Chicago, Ill.
General Electric Company, Schenectady, N. Y.
Gold Car Heating and Lighting Company, New York, N. Y.
Goldschmidt Thermit Company, New York, N. Y.
Globe Ticket Company, Philadelphia, Pa.
Griffin Wheel Company, Chicago, Ill.
General Systems Company, Dayton, Ohio.
Hale & Kilburn Manufacturing Company, Philadelphia, Pa.
F. P. Harrison Electric and Manufacturing Company, Incorporated, New York.
Albert B. Herrick, Ridgewood, N. J.
Heywood Bros. & Wakefield Company, Wakefield, Mass.
George S. Hastings & Company, Cleveland, Ohio.
Helios Manufacturing Company, New York, N. Y.
Indianapolis Switch and Frog Company, Indianapolis, Ind.
Ingersoll Company, Pittsburg, Pa.
International Register Company, Chicago, Ill.
International Sprinkler Company, Philadelphia, Pa.
H. W. Johns-Manville Company, New York, N. Y.
Kalamazoo Railway Supply Company, Kalamazoo, Mich.
Kinnear Manufacturing Company, Columbus, Ohio.
Keystone Brake-Shoe Company, New York, N. Y.
Lagonda Manufacturing Company, Springfield, Ohio.
Lorain Steel Company, Philadelphia, Pa.
Lord Electric Company, Boston, Mass.
George W. Lord Company, Philadelphia, Pa.
Lumen Bearing Company, Buffalo, N. Y.
Massachusetts Chemical Company, Walpole, Mass.
John W. Masury & Son, Brooklyn, N. Y.
Maryland Steel Company, Sparrow's Point, Md.
Miller Anchor Company, Norwalk, Ohio.
McGuire-Cummings Manufacturing Company, Chicago, Ill.
National Brake Company, Buffalo, N. Y.
National Brake and Electric Company, Milwaukee, Wis.
National Lock Washer Company, Newark, N. J.
Niles Car and Manufacturing Company, Niles, Ohio.
R. D. Nuttall Company, Pittsburg, Pa.
National Car Wheel Company, Pittsburg, Pa.
Ohio Brass Company, Mansfield, Ohio.
Ohmer Fare Register Company, Dayton, Ohio.
Pantasote Company, New York, N. Y.
Pressed Steel Car Company, Pittsburg, Pa.
Pennsylvania Steel Company, Philadelphia, Pa.
Pittsburg Insulating Company, Pittsburg, Pa.
Quincy, Manchester, Sargent Company, Chicago, Ill.
Rail Joint Company, New York, N. Y.
Recording Fare Register Company, New Haven, Ct.
Joseph T. Ryerson & Son, Chicago, Ill.
Frank Ridlon Company, Boston, Mass.
Sherwin-Williams Company, Cleveland, Ohio.
Southern Exchange Company, New York, N. Y.
Speer Carbon Company, St. Marys, Pa.
Standard Paint Company, New York, N. Y.
Standard Steel Works, Philadelphia, Pa.
Peter Smith Heater Company, Detroit, Mich.
Security Register and Manufacturing Company, New York, N. Y.
Standard Varnish Works, New York, N. Y.
Star Brass Works, Kalamazoo, Mich.
St. Louis Car Company, St. Louis, Mo.
Sterling Varnish Company, Pittsburg, Pa.
The T. H. Symington Company, Baltimore, Md.
Schoen Steel Wheel Company, Philadelphia, Pa.
St. Louis Car Wheel Company, St. Louis Mo.
Sterling-Meaker Company, Newark, N. J.
Taylor Electric Truck Company, Troy, N. Y.
Trolley Supply Company, Canton, Ohio.
United States Metal and Manufacturing Company, New York, N. Y.
United States Engineering Company.
W. T. Van Dorn Company, Chicago, Ill.
Van Dorn & Dutton Company, Cleveland, Ohio.
Wallace Supply Company, Chicago, Ill.
Western Electric Company, Chicago, Ill.
Westinghouse Companies, Pittsburg, Pa.
William Wharton, Jr., & Company, Philadelphia, Pa.
Wheel Truing Brake-Shoe Company, Detroit, Mich.
Wilson Company, Chicago, Ill.
Yale & Towne Manufacturing Company, New York, N. Y.

Digitized by Google

Tramway Lines on the Continent.

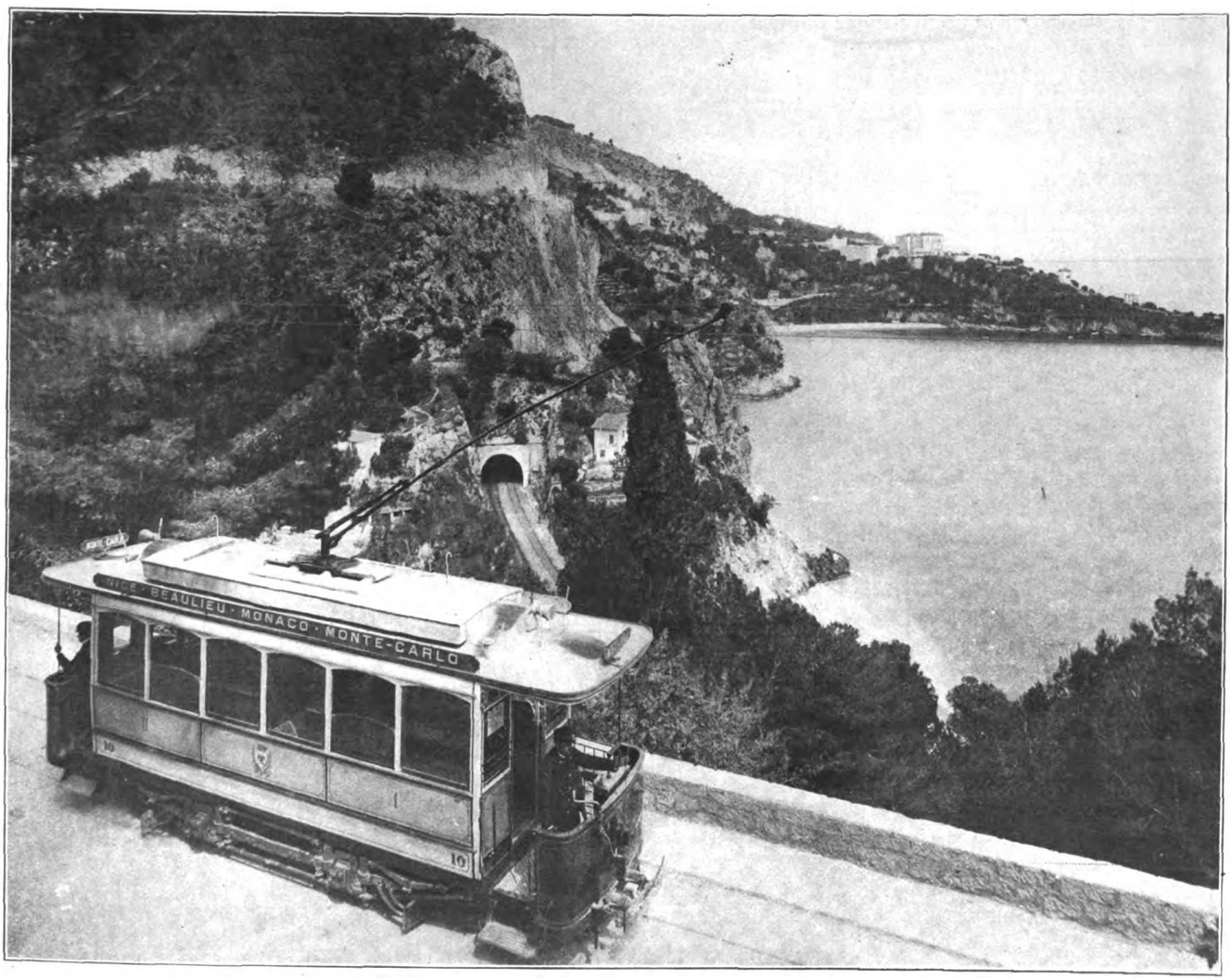
1. Mediterranean Coast Line. 2. Rouen Line. 3. Rome Tramways.

By C. L. Durand.

THE MEDITERRANEAN COAST LINE.

AN electric traction enterprise of considerable interest has been recently completed in the south of France, consisting of a series of tramway lines which are now in operation on the Mediterranean coast in the neighborhood of Nice and Monte Carlo. In addition to the traction lines of the different towns, the line which runs along the coast has now been finished over a long distance, and at present all the localities extending from Cagnes as far as Menton are connected by a continuous line thirty miles in length. The route along the coast, as will be observed in the views which are presented here, is one of the most picturesque on the Continent, and is often cut through the solid rock of the cliffs which overhang the sea. Starting from Cagnes, the coast line passes through Nice upon the tracks of the existing lines, then reaches Monaco and Monte Carlo and runs from thence to the terminus at Menton. This important system has been equipped by the Compagnie Française Thomson-Houston.

It is on the section from Nice to Monte Carlo that the most important part of the work was done in widening the route, as the latter passes along the shore where in many cases the cliffs overhang the sea. At a great number of points the cuts in the rock and the tunnels required to be widened out to accommodate the tracks, and the work also included the construction of embankments in masonry and bridges over the deep gorges of the mountain torrents. On this section the traffic is greatest during the winter season, and for this reason, outside of the through traffic from Nice and Monte Carlo, the traction company has organized services to the intermediate points, such as Montboron, Villefranche and Beaulieu. Thus, between Nice and Montboron the trains circulate at intervals of about three and one-half minutes. For this reason it was decided from the start to lay the road in double track from Nice to Villefranche, and as the work has been carried on very actively there is no doubt that at the present time nearly the whole of the line between Nice, Monte Carlo and Menton will be running double track. Over the whole of the coast lines the track is of Broca rail, about ninety-five pounds



MEDITERRANEAN COAST LINE—VIEW ON LINE BETWEEN NICE AND MONTE CARLO.

Digitized by Google

per yard, flush with the road surface, except between Monte Carlo and Menton, where there is a section about one mile long which is laid with Vignole rails placed upon ties.

The trolley line is placed in the centre of the track from Nice to Beaulieu and from Nice to Cagnes. For the rest of the line, that is, between Beaulieu and Menton, it lies to one side. This latter section includes the passage through Monaco. The line is supported on bracket poles over the whole distance.

The part of the road which passes from Nice to Cagnes first goes through the western suburbs of Nice, starting from the centre of town and following the city line for a certain distance, then proceeding along the coast it crosses the Var river and continues along the national route till it reaches the terminus at the railroad station of Cagnes. A depot has been established at Cagnes so as to allow the numerous small farmers of the region to utilize the tramway for transporting their products. Special trains for this purpose have been organized, so as to bring the fruits and vegetables into the market of Nice at an early hour of the day. The branch line of Contes is of interest on account of its freight traffic. This line passes up the Paillon river and is some ten miles long in all. On the route is situated the lime and cement works of the Société de Contes-les-Pins, which gives the tramway company an annual traffic of nearly 70,000 tons of freight, consisting of lime and cement. This freight is taken by the cars to the port of Nice for loading on the boats or the railroad, or in other cases it is brought by private branch lines into different storehouses in the city. The freight service of the tramway company is soon to have a large development, owing to an agreement which has been made between it and the Southern Railway Company, together with the Chamber of Commerce of Nice.

Outside of the coast line and the city lines of Nice, the Compagnie Thomson-Houston has also electrified the line which runs from Nice to Cimiez. This line starts from the centre of town and ends at the Zoological Gardens of Cimiez. In this case the gauge of the track has been increased from two feet to three feet (or the regular narrow gauge), and the trolley now replaces the storage battery system which was formerly used on the line, thus bringing this locality within fifteen minutes of the centre of town, in spite of the heavy grades which are found here. Since the electrification of the line, some of the finest hotels and villas have been erected upon the hill, and the traffic has become considerable upon this section.

The direct current at a mean tension of 550 volts which is needed for the lines belonging to the company is furnished by a certain number of substations placed along the road. They transform and convert the three-phase current at high tension, 10,000 volts and twenty-five cycles, coming from the Société Energie Electrique du Littoral Méditerranéen, which operates a number of hydraulic plants in the mountain region not far from the coast. At present six substations have been erected to supply the road. First, at Nice, at the Sainte Agathe depot, where is located the central transformer station, along with a

ONE OF THE ROCK TUNNELS ON THE MEDITERRANEAN COAST LINE.

steam plant and a large storage battery. Second, at Californie, midway between Nice and Cagnes. Third, at Beaulieu, midway between Nice and the western limit of Monaco, where there is also a transformer plant, along with a battery of accumulators. Another substation is located at Cap d'Ail, about a mile from the western boundary of Monaco, containing a bank of transformers. At upper Monte Carlo is located a generating station belonging to the Energie Electrique du Méditerranéen, where the transformers have been located. An extra feeder, about two miles in length, runs from this point to the last-mentioned substation, so as to replace the latter in case of need. The sixth substation is located at Cap Martin, between the east limit of Monaco and the terminus of the coast line at Menton. Here there is a bank of transformers and a battery of accumulators. A seventh station will soon be installed at Villefranche. The Sainte Agathe substation of Nice receives high-tension current from the hydraulic plant of Mescla, lying in the mountain region to the north of the city. Both the hydraulic station and the substation have already been described in detail in a preceding article. In 1902 a large battery of accumulators was added to the Sainte Agathe plant, which is designed to act as a reserve and also to work in parallel with the direct-current generators by means of a positive and negative booster. The battery is made up of 281 cells having a capacity of 1,030 ampere-hours at a one-hour discharge rate. The cell itself has been made of ample size, so that a greater number of plates can be used, and thus the capacity can be increased if need be to 1,300 ampere-hours at the same rate. A French firm, the Compagnie des Accumulateurs Union, supplied this battery. It is operated in connection with a booster group formed of a fifty-horse-power shunt motor coupled to a two-commutator machine of thirty-five kilowatts.

In the same plant, the two 150-kilowatt converters, which were designed for supplying the underground conduit line of Nice, are to be replaced by two motor-generator sets of 250 kilowatts, owing to the increase of traffic on this line. Each of these units is composed of a synchronous motor wound for 10,000 volts, direct-coupled to a 250-kilowatt generator which delivers direct current at 550 to 625 volts.

The substation at Beaulieu contained when first installed a bank of six transformers of the single-phase type, each of fifty-five kilowatts capacity and operating at fifty-five cycles. These transformers lowered the tension from 4,000 to 340 volts, and were used to supply two rotaries of 150 kilowatts, operating at 750 revolutions per minute, and delivering direct current at 550 volts on the average. Lately the substation has been increased by the addition of a bank of monophase transformers of fifty-five kilowatts, working at the above ratio, and also a new rotary converter of 150 kilowatts, with switchboard panels for the direct-current and alternating-current sides. There has also been added a storage battery composed of 275 cells having a capacity of 780 ampere-hours on a one-hour discharge, and the cells have space enough left so as to add plates to a total of 1,014 ampere-hours capacity. The battery is of the same type as above. With the storage cells is used a positive-negative booster like the group in the last-mentioned plant, con-

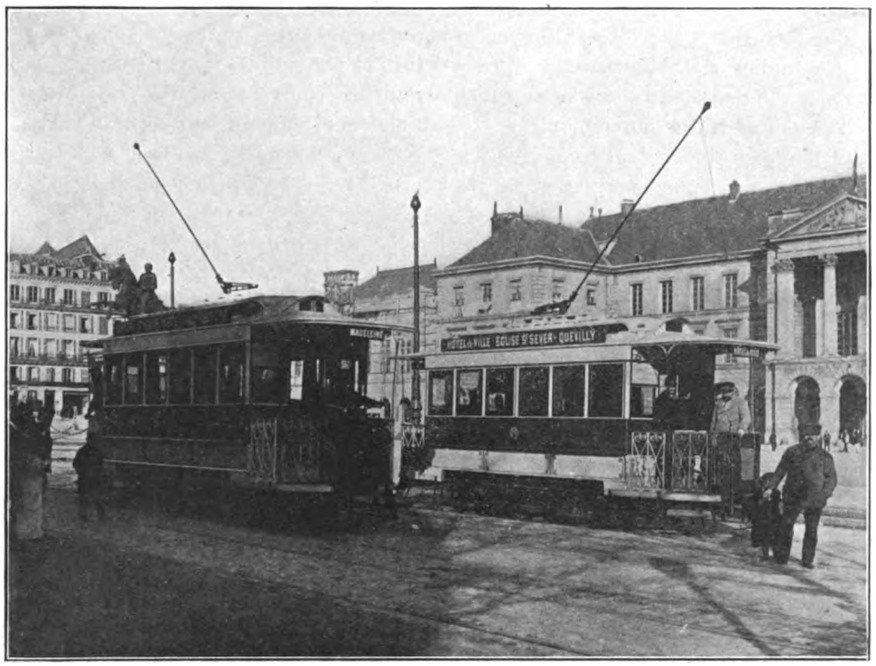
Digitized by Google

sisting of a direct-current 550-volt motor coupled to a generator with double commutator. There is also a three-phase transformer of 450 kilowatts capacity, operating at twenty-five cycles. This transformer is designed to be used as a reserve. Should an accident happen to the 5,000-volt cable which brings the working current into the station, the plant can use alternating current at 10,000 volts, coming from a high-tension line. In the usual practice, a bank of special transformers in the Sainte Agathe plant is used to lower the tension from 10,000 to 5,000 volts. Underground cables take the latter current from this plant to the substations of Beaulieu and Californie. This transformer has sufficient capacity to supply the three 150-kilowatt rotaries. It has an air-cooling system, using a motor-driven fan. A set of special switches allow of feeding either from the 10,000 or the 5,000-volt lines.

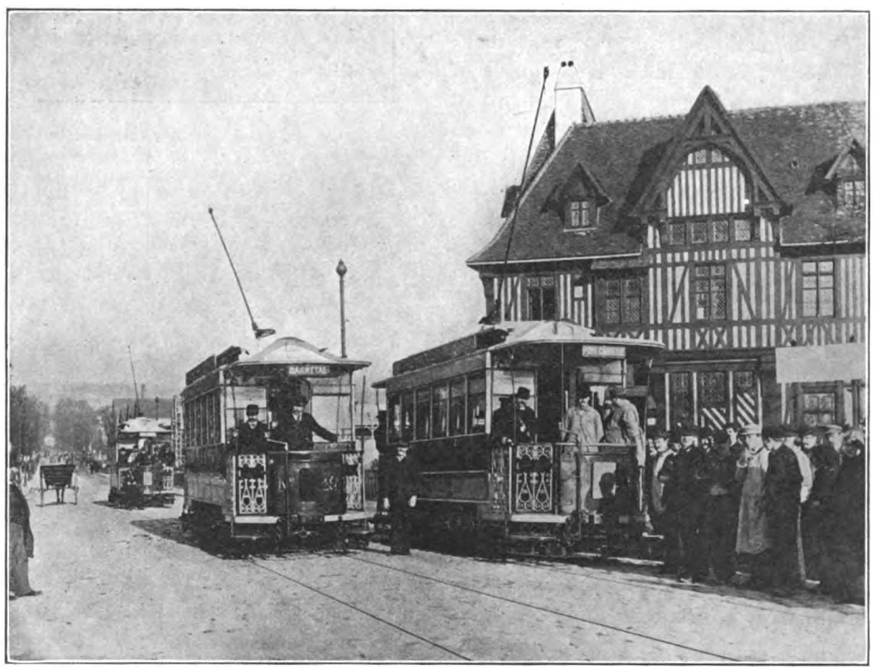
The substation which is located in the upper Monte Carlo plant gives a large supply of direct current. Part of it is sent over a feeder, two miles in length, to a smaller substation located on the coast at Cap d'Ail. The Monte Carlo outfit comprises six single-phase transformers of the oil-tank pattern, each delivering fifty-five kilowatts, and lowering the tension from 9,500 to 350 volts. The latter current is sent into the rotaries of 150 kilowatts operating at 500 revolutions per minute and converting to direct current at 500 to 550 volts. In addition to the above apparatus the plant contains a battery of 262 cells of accumulator of 410 ampere-hours at a one-hour rate, which is used with a booster designed to charge it. Only a part of the power of the Monte Carlo plant is taken for the regular traction line, and the remainder is used for a rack-and-pinion road which climbs the slope of La Turbie.

The drop in the feeder of 150 square millimetre section which connects the Monte Carlo plant with the substation at Cap d'Ail is made up by a booster set which has recently been erected here. This group is made up of a shunt-wound motor of seventy horse-power, operating at 700 revolutions per minute and delivering 500 volts, direct-coupled to a direct-current machine which is designed to furnish 350 amperes. A series winding is used upon the field of the generator which allows it to furnish 125 volts for an output of 300 amperes.

One of the principal substations of the line is located at Cap Martin. It comprises two groups of three static transformers with oil-tank, each giving fifty kilowatts, and two rotary groups of 150 kilowatts of the six-pole Thomson-Houston pattern, working at 500 revolutions per minute and delivering 500 to 550 volts direct current. These two rotaries are connected by a clutch to a countershaft provided with a pulley so that it can be belt-driven from a steam engine which acts as a reserve. The engine is of the horizontal, single-cylinder type, and is rated at 250 horse-power. A boiler plant has been installed in order to supply the engine, and it produces 5,000 pounds of steam per hour on the usual run. A special design of the rotaries which is used in this case allows them to be used either as converters for alternating current into direct current, as generators which are driven directly from the engine, in case the transmission line should fail to supply current. The plant is completed by a battery of accumulators composed of 265 cells of 320 ampere-hours on a one-hour rate. The battery can be run in parallel on the



ROUEN TRAMWAYS.



ROUEN TRAMWAYS.

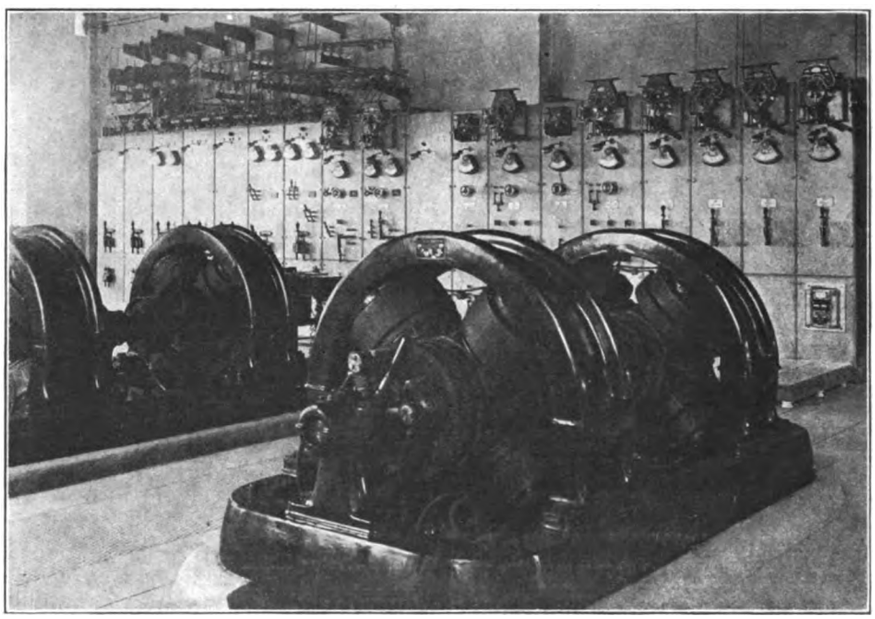
Digitized by Google

direct-current line by the use of a positive-negative booster of fifteen kilowatts, consisting of a shunt motor running at 850 revolutions per minute and taking 500 volts, coupled to a double-commutator generator having a capacity of 175 amperes on each side. The drop in the feeder which supplies the Monaco-Cap Martin section is compensated by a booster which has been placed in the latter plant.

Not long ago the general council of the Maritime Alps department ceded to the Compagnie des Tramways a system of traction lines, part of which penetrates into the mountain region near the coast. These lines will be constructed at the expense of the department, and the tramway company is to furnish the electric outfit. The general council is now actively engaged with this question, and there is no doubt that operations upon the lines will be commenced in the near future. From the fact that the lines have a total length of nearly forty miles, it will be seen that the system will be of some importance for the region. The three lines which lie entirely within the mountain region are the Nice-Levens, the Menton-Sospel and the Pont de Peille-Escarène systems, while the remaining roads include the branch from the main line going to St. Jeau, the line along the coast from Cagnes to Antibes which will connect the Nice tramways with the Cannes traction system, and the road from Antibes to the Cap d'Antibes.

The completion of the coast lines made it necessary to provide a large outfit of cars, and there is now a large amount of rolling stock upon the lines. The Compagnie Thomson-Houston had already furnished 100 motor-cars, three freight locomotive cars and twenty-two freight trailers. Since the new part of the line has been finished, the following material has been supplied; six motor-cars of double-axle type and central platform, each of which is fitted with two motors, besides twenty trailers of the closed pattern, of which ten are equipped with air-brakes, allowing them to be attached to the preceding motor-cars, and ten equipped with electromagnetic brakes; also twenty-two trailers of the open-car type with cross seats, also using electromagnetic brakes. More recently the company supplied twenty motor-cars of a short type, mounted on two axles with the least distance between them, and designed to operate in pairs, with a single motorman. This solution has been adopted on account of the difficulty which is experienced in making the double-bogie cars of large capacity circulate upon the coast line, seeing that the roadway is narrow, and this does not allow of a sufficient spacing of the double track in the curves to enable the long cars to pass each other with ease. The outfit of the new cars includes two Thomson-Houston motors operating at seventy-three revolutions per minute and an outfit of series-multiple control apparatus. For passing upon the underground conduit lines at Nice, a plow outfit has been added to the cars. Besides the hand and air-brakes, the car is fitted with a safety hand brake which is worked from each platform. It acts upon each rail by means of a rubbing shoe with hard-wood surface.

At present the Sainte Agathe depot covers a large amount of ground in order to accommodate all the cars of the line. The repair shops have been installed in special buildings covering a surface of 2,000 square yards, and are well equipped for making all the needed repairs to the cars, including the winding of the motor coils.



Rome Plants.—Substation, Receiving Current from Tivoli Hydraulic Plant.

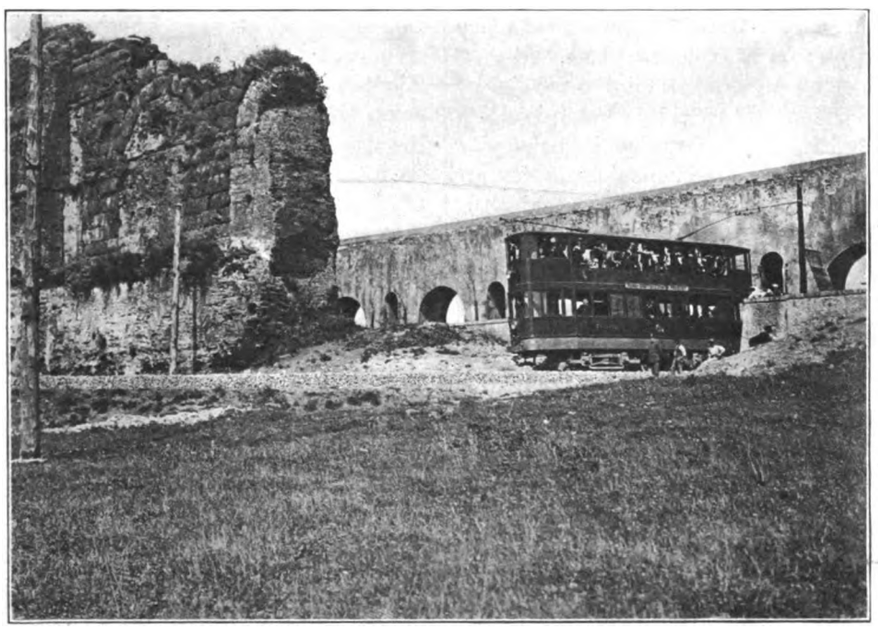
THE ROUEN LINE.

The city of Rouen contains a well-equipped system of tramway lines, controlled by the Compagnie des Tramways, which formerly operated an animal traction line of small importance, but when it was decided to electrify the existing lines and add a number of others the Rouen system took rank among the other lines in France, and at the present time it is one of the most important.

The old portion of the Rouen tramways comprises eight lines having a total length of sixteen miles, and to this was added a new portion to the extent of seven miles, making a total of twenty-three miles of road which was to be equipped with motor-cars. Thus it will be seen that the system needed a large outfit, both in the way of generating apparatus and in rolling stock. An entirely new track was laid for all these lines, and it is formed of Broca rail weighing ninety pounds per yard, with a five-foot gauge. The curves in the road are numerous, and on account of the narrow streets which are found in the old quarters of the town, they are often very short, and go down as low as a sixty-five-foot radius. An overhead trolley line is used, which is formed of hard-drawn copper of 8.25 millimetres. It is suspended axially above the tracks by steel cross-wires, and these are attached to iron poles, being well insulated from the latter. The poles are of the steel-tube pattern with four sections of decreasing diameter, and are some twenty-two feet high. Their lower part is provided with an ornamental cast-iron base of elegant design, while the joints of the tubes are covered with rings. The bronzing of the poles adds greatly to their appearance. On the quays of the Seine the poles are provided with a double bracket of the same type as is employed at Havre. Every other pole has an arc lamp mounted at the top in place of the usual metal ball, and this system of lighting has proved a great advantage in the handling of the cargoes on the wharves at night. On some of the main streets the poles are used to carry incandescent lamps, and owing to an agreement between the tramway company and the municipality,

Digitized by Google

the lamps are supplied with current by the Société Normande d'Electricité. The line has been installed with great care, so as to give it an attractive appearance as much as possible and thus overcome the usual objections to the overhead system.



ROME TRAMWAYS—ONE OF THE EXCURSION CARS ON THE SUBURBAN LINE.

The feeders which are used for the Rouen lines have a 200-square-millimetre section and a total length of 20,000 feet. They are well insulated with rubber and placed directly in trenches and are four in number, ending in different points of the town. The return cables are of bare wire of 150 square millimetres, placed in a wood conduit which is filled with asphalt. These cables end at the same points as the others just mentioned.

One of the illustrations shows the standard type of car which is used on the Rouen lines. This material has been furnished by the Thomson-Houston Company. This equipment consists of sixty cars of the double-platform type, with side entrance.

ROME TRAMWAYS—VIEW ON THE SUBURBAN LINE.

The interior of the car is divided into two compartments for first and second classes, separated by a sliding door. The cars contain twenty-four places in the interior and sixteen on the platforms. Each of the cars weighs about eight tons, and the total length is twenty-five feet or more. The trucks of the cars have been constructed in the Paris shops of the company, and are of a light and strong build. As regards the motor equipment of the cars, a slow-speed motor of the Thomson-Houston pattern is employed. The twenty-five horse-power motor is of the usual single-reduction ironclad type and weighs about 1,500 pounds.

Current for all the traction lines is furnished from a single station which has been erected for the purpose on the left bank of the Seine, not far from the river, where it has an advantage in the way of a coal and water supply. The station contains three main generating units of 300 kilowatts each, of the Thomson-Houston type. The boiler room is equipped with Babcock & Wilcox boilers and a Green economizer. An efficient condensing system is used in connection with the engines, and the condenser water is sent into a spray cooling apparatus, on the Sée system, by means of a pump. The latter is driven by a 500-volt motor.

Before the electric lines were installed, the Compagnie des Tramways of Rouen, who controlled the system, belonged to an English syndicate and operated a few animal traction lines. In order to change over and enlarge the system it was necessary to expend more than $1,000,000. As the company was unable to furnish this amount it was aided by the Compagnie Française Thomson-Houston. At the present time the electric tramways are in a flourishing condition and the tramway company is controlled entirely by French capital.

ROME TRAMWAYS.

Nearly all of the leading cities of Italy have adopted electric traction, and among these may be mentioned Florence, Milan, Palermo, Naples and others. The tramway lines which have been installed at Rome within recent years are now in successful operation. First were installed the lines which circulated in the outskirts of the city, and after these had been running for some time it was decided to lay the tracks so as to bring the cars to the central districts. The Societa Romana Tramways Omnibus has control of these lines and the electric equipment is supplied by the Compagnie Française Thomson-Houston, with material furnished from their Paris factories. Besides the lines which now circulate through the principal thoroughfares, several lines have been installed in order to connect the city with a number of suburban towns. One illustration shows a scene on the suburban roads, one of

Digitized by Google

which runs to Frascati and another to Albano and Genzano. These lines are largely used by tourists, who find it a great convenience to reach many of the historic localities in this way, with a great saving of time. The cars which are used on the suburban lines are of heavier build than the standard cars, and the latter have about the same general appearance as the cars last described for the Rouen lines. As to the suburban cars which run to Frascati and other localities, they are of the double-deck pattern, as will be observed, and have a large capacity in the interior and on the covered platform. The trolley system is used here as well as for the lines all over the city, and the trolley wire is supported from poles or from rosettes placed on the houses. The city lines are run in double track, and the grades are numerous, and some of them very steep when circulating among the seven historic hills of the city, and reach as high as 8.4 per cent. The curves are sometimes sharp as well, and sometimes they reach as low as seventy-five feet radius. For the rails, the Phœnix groove rail has been adopted on the lines within the city; this rail weighs seventy-two pounds per yard, and the gauge of the track is five feet. At each rail point the rails are connected by Chicago rail-bonds, and every 150 feet the two rails of a track are connected across by a seven-millimetre copper wire. Every 300 feet the four rails of the double track are joined in the same way, so as to make a good connection. This method has been found to work well in practice.

Current for the whole system of lines for the city of Rome is obtained at high tension from a hydraulic plant and transformed in a substation, which furnishes direct current and operates in connection with a storage battery. The high-tension current is supplied from the large hydraulic plant which has been erected within recent years at Tivoli, at a distance of eighteen miles from the city. Here the falls afford a supply which has been utilized by a large company, and a number of turbine units have already been installed in the plant. The city of Rome takes current from the Tivoli station for lighting and motors, exclusive of the traction lines, and the plant also furnishes current over the high-tension lines for different localities lying in this region. The alternator groups deliver 5,000 volts, which arrives at Rome at a tension of about 4,000 volts. One of the illustrations shows a view in the interior of the substation which has been erected to receive the high-tension line and to furnish the direct current for the tramways. The voltage of 4,000 is first lowered to 2,000 by a bank of transformers. Rotary groups receive this current and convert it into 500 volts. These groups, which consist of two four-pole machines coupled together and mounted on the same foundation plate, will be observed here. At present the substation contains three similar groups, and the capacity of each is eighty kilowatts. In the station is mounted a large battery of accumulators, which are connected in parallel upon the main bars of the 500-volt circuit. During a great part of the day the batteries act as an equalizer to take up the shocks of the line, but for two or three hours of the evening they are used to operate the part of the traction system by a direct connection upon the lines. A switchboard of eighteen white marble panels completes the outfit of the substation.

FREQUENCY METERS.[1]

BY F. CONRAD.

In the commercial measurements of electrical quantities, that of current is the only one in which the measurement is directly referred to the quantity in question. In an ammeter the effect produced by the current is directly the means of indication. For measurement of potential it is necessary to refer to the current which will flow in a circuit of known resistance. A possible exception to this may be found in the "spark-gap" method of potential measurements. In the measurement of frequency we are dealing with the cyclic changes of another quantity, that of potential, and, as usually the changes occur too rapidly to be observed directly by a potential measuring device, it is also necessary to resort here to an indirect method of observation.

Instruments now in commercial use operate on one or the other of the following principles, namely, the sensitiveness of a vibrating reed to respond to an operating force of the same frequency only, and the change in impedance produced in inductive circuits by change of frequency.

Instruments of the first type usually consist of a number of steel reeds tuned to various pitches over a certain range of vibration. The reeds are placed within the attractive influence of a magnet which is energized by a potential, the frequency of which it is desired to obtain. The general construction of an instrument of this type is comparatively simple, as it has no moving parts on pivots or bearings. To obtain the best results it is necessary that the potential be maintained at a value which does not differ greatly from that for which the instrument has been designed, as with too low a value the amplitude of vibrations will not be sufficient to be readily observed. With too high a value a number of reeds differing in pitch from that of the circuit may start into vibration with varying amplitude as they come into and out of synchronism with the magnetic field. In view of this, and from the fact that at the best the readings are largely a matter of estimation, this type of meter has not come into very extended use in this country.

A simple instrument of the second type would consist of an ammeter connected in circuit with an impedance of known value and across a circuit of known potential. From the current reading obtained and the known value of potential and impedance, the frequency may be obtained by calculation. To make the instrument direct reading it would be necessary to maintain the potential at some fixed value or to introduce some compensating device in the instrument, the latter principle being the one employed in most instruments now in commercial use.

The construction in general consists of an operating element in series with an inductive resistance and a retarding or compensating element in series with a non-inductive resistance. No controlling spring is used, the retarding element taking its place. If the torque of the operating and retarding element varies in the same ratio with changes of voltage, the instrument will give indications which are independent of changes of voltage.

The chief causes which would produce variation of reading with change of voltage are:

1. Increase of non-inductive resistance due to heating on high voltages.

2. Change of permeability of iron in inductive resistance with change of current.

3. Dissimilarity of ratio between torque and voltage of operating and retarding elements.

The first may be minimized by keeping the heating effect of the current low and using a wire of low temperature coefficient. The second will always be present to a greater or less extent, but it may be corrected by combining it with the third in such a proportion that the two will cancel out.

The general construction of the instrument may be such that it will harmonize in appearance and method of reading with that of other instruments which may be used in the same installation, and from the manufacturers' standpoint it possesses the advantage of using parts which are interchangeable with other instruments such as voltmeters and ammeters.

[1] *Electric Journal*, September.

Digitized by Google

THE EFFECT OF IRON IN DISTORTING ALTERNATING-CURRENT WAVE-FORM.[1]

BY FREDERICK BEDELL AND ELBERT B. TUTTLE.

(Concluded.)

RELATION BETWEEN AREA OF HYSTERESIS LOOP AND ANGLE OF HYSTERETIC ADVANCE.

Since only the fundamental in the current wave represents power, and the harmonics are wattless, we have the same power represented by the fundamental as by the complex wave. Hence if values of H be taken from the fundamental current curve, and a hysteresis loop plotted, it will have the same area as though H were taken from the complex wave, as was done in deriving the loops in Figs. 14 and 15. In this case, however, with H as well as B sinusoidal, the hysteresis loop would form an ellipse, the area of which can be shown[2] to be

$$A = \pi XY \sin \psi.$$

Here X and Y represent the maximum values of the sinusoidal magnetizing force H and induction B, respectively.

As has just been shown, the area of this ellipse can likewise be taken as the area of the loop when the complex wave current is taken. It at once follows that

$$\sin \psi = \frac{A}{\pi X Y} = \frac{1}{\pi} \cdot \frac{A}{X' Y} \cdot \frac{X'}{Y} = \frac{1}{\pi} \cdot \frac{A}{X' Y} \cdot \frac{I'}{F}.$$

Here F is the maximum value of the fundamental and I′ the maximum value of the complex current wave; X and X′ being corresponding values of magnetizing force. X′ Y is the area of the rectangle enclosing the hysteresis loop.

For $\frac{A}{X' Y}$ write ρ; and for $\frac{I'}{F}$ write f.

For any hysteresis loop the value of the hysteretic advance may then be derived from the following expression:

$$\text{Sin } \psi = \rho \, f/\pi,$$

where ρ is the ratio of the area of the hysteresis loop to the enclosing rectangle, and f is a form-factor—the ratio of the maximum values of the complex and fundamental current waves. If the result depended upon ρ only, hysteretic advance could be readily and directly determined from area of the hysteresis loop. The results are modified, however, by the presence of f, which is unsatisfactory, for it makes the direct determination in this way impossible. Table II gives values of I′ for curves 5-13.

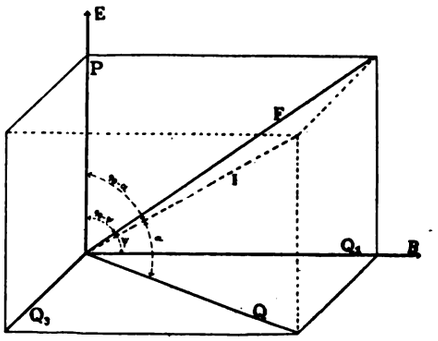


FIG. 16.—VECTOR REPRESENTATION IN THREE DIMENSIONS OF A COMPLEX CURRENT. E IS SINE ELECTROMOTIVE FORCE; F IS FUNDAMENTAL CURRENT; Q_3 REPRESENTS HARMONICS; AND I IS THE EQUIVALENT SINE CURRENT.

VECTOR REPRESENTATION OF COMPLEX CURRENT.

Without iron, where current as well as electromotive force is sinusoidal, as shown in Fig. 1, the vector representation of these quantities as lines in a plane is well known.

Let us take, however, such a case as shown in Fig. 2, in which the electromotive force E is sinusoidal and the current

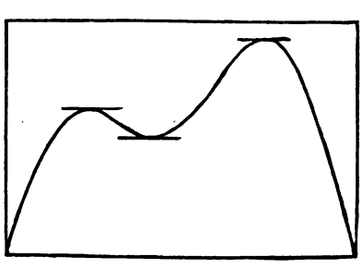


FIG. 17.—TWO CRESTS, ONE TROUGH AND TWO INFLEXIONS.

I, on account of iron, is complex, being composed of a fundamental F and third harmonic Q_3.

Considering first the fundamental F, this may be considered as composed of two components, Fig. 16, a power component P in phase with E, and a quadrature or wattless component Q_1 at right angles to E; that is, $F = \sqrt{P^2 + Q_1^2}$. These quantities E, F, P, and Q_1 are all sine functions of the same frequency and are graphically represented in one plane. The induction B is in the direction of Q_1, and is also a sine function of fundamental frequency. The fundamental F lags behind E by an angle $90 - \psi$ (as in Fig. 2); ψ is the angle between Q_1 (or B) and F. In Fig. 16 and its discussion all quantities represent virtual or square root of mean square values.

The harmonic Q_3 has no power component in phase with E; it is entirely wattless, as has been shown, and hence is to be represented graphically in quadrature to E. But it may be shown[1] that $I = \sqrt{F^2 + Q_3^2}$, which corresponds to a graphical construction in which Q_3 and F are two sides of a rectangle and I the diagonal. As Q_3 is thus at right angles to both E and F, it is drawn in the third dimension at right angles to the plane of fundamental frequency in which lie E, F, P, and Q_1.

The total current is I, the diagonal of the rectangular parallelopiped. I is the equivalent sine wave representing the complex current. In phase it is as represented in Fig. 16, lagging behind F by an angle $90 - \alpha$. In magnitude it is such as to have the same square root of mean square value as the complex wave. We have seen that

$$I = \sqrt{F^2 + Q_3^2};$$

We also have

$$I = \sqrt{P^2 + Q_1^2 + Q_3^2}.$$

In the usual treatment confined to one plane, the plane taken is the diagonal one in which lie E and I. The equivalent sine current I may be resolved into a power component P of fundamental frequency in phase with E, and an equivalent wattless component Q at right angles to E. The component Q is itself complex, consisting of two components each wattless; namely, Q_1 of fundamental frequency and the harmonic Q_3. We have then

$$Q = \sqrt{Q_1^2 + Q_3^2},$$

and

$$I = \sqrt{P^2 + Q^2}.$$

Power is the product of E and P. Considering the fundamental sine curve, we have for power in terms of F:

$$W = E F \cos (90 - \psi).$$

If we consider the equivalent sine curve, we have for power in terms of *I*:

$$W = E I \cos (90 - \alpha).$$

Each is correct, the two expressions being practically identical. An error (numerically small) would be made by confusing the fundamental and equivalent sine curves, and interchanging the values of

---

[1] A paper presented at the two hundred and ninth meeting of the American Institute of Electrical Engineers, New York, September 28, 1906. For first part see ELECTRICAL REVIEW, October 6.

[2] Let the induction and magnetizing force be respectively $y = Y \sin \omega t$ and $x = X \sin (\omega t - \psi)$. Plotted in rectangular coördinates, the resulting figure will be an ellipse. Its area (see translation of Goursat's Mathematical Analysis, p. 185) will be

$$A = \frac{1}{2}\int_0^{2\pi} (x\,dy - y\,dx).$$

$$= \int_0^{2\pi} \frac{XY}{2} \{\sin \omega t \cos(\omega t - \psi) - \sin (\omega t - \psi) \cos \omega t\} \omega\, dt$$

$$= \frac{XY}{2}\int_0^{2\pi} (\sin^2 \omega t \sin \psi + \sin \psi \cos^2 \omega t)\, \omega\, dt$$

$$= \pi X Y \sin \psi.$$

[1] This is independent of the phase position θ of the harmonic. See F. Bedell, "The Principles of the Transformer," p. 391.

Digitized by Google

F and I, or of ψ and a. It is seen that

$$\frac{\sin a}{\sin \psi} = \frac{F}{I} = \frac{F}{\sqrt{F^2 + Q_3^2}}.$$

For the curves in Figs. 5-13, the values for a and ψ are given in Table II; also I, the maximum value of the equivalent sine wave. In constructing the curves, F has been taken as unity; then $Q_3 = \beta$ (see table).

The graphical construction of Fig. 16 will include the representation of higher harmonics if we include them all in Q_3; that is, in place of Q_3, we should have $Q_x = \sqrt{Q_3^2 + Q_5 \ldots Q_n^2}$. Separately and collectively the harmonics are wattless, and are at right angles to both E and F. Their separate representation in three dimensions is not possible; for, in addition to being at right angles to E and F, each one should be at right angles to each other one, requiring an additional dimension for each harmonic above the third. This representation is, however, unnecessary, for, since all are wattless,

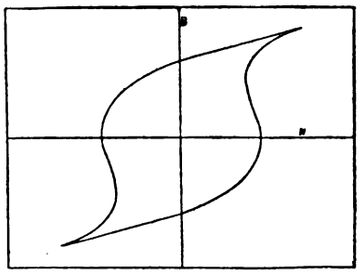


FIG. 18.—HYSTERESIS LOOP CORRESPONDING TO FIG. 17, WITH FOUR MAXIMA FOR H WHICH WOULD RESULT WERE THE LIMITS OF β GIVEN IN FIG. 4 EXCEEDED.

their collective representation as one line, Q_3, meets all requirements.

If we are to represent all quantities in one plane only, the vector representation is correct for each frequency, and for the equivalent sine curve separately; components of different frequencies so drawn are not to be combined vectorially, but are to be added by taking the square root of the sum of the separate squares.

CONCLUSION.

We conclude that an alternating current is distorted when iron is present by the introduction of a third harmonic in advance of the fundamental by an angle θ which is greater than 30° and less than 180°.

Taking the fundamental as unity, this harmonic can not exceed a definite value (see Table I) of about 0.192 for $\theta = 30°$, and 0.333 for $\theta = 180°$.

The angle ψ of hysteretic advance due to the third harmonic can not exceed 30°.

From the shape of the hysteresis loop obtained from the third harmonic only, it is concluded that iron introduces higher harmonics in addition to the third.

Three dimensions, as Fig. 16, are required for the vector representation of the complex current wave.

APPENDIX.[1]

RELATION BETWEEN θ AND β.

We wish to find the condition which holds at the transition state, Fig. 19, separating the impossible case of two

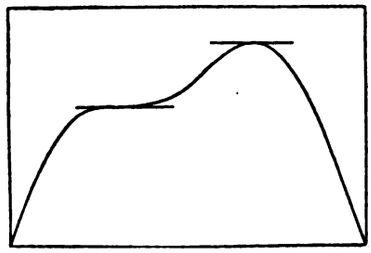


FIG. 19.—ONE CREST AND ONE HORIZONTAL INFLEXION.

maxima and one minimum, Fig. 17, and the possible case of one maximum and no minimum, Fig. 20. The form of hysteresis loop, Fig. 18, corresponding to Fig. 17, shows the impossibility of the former case.

We proceed to find the condition imposed upon θ and β so that the graph of $f(t) = \sin \omega t + \beta \sin (3 \omega t + \theta)$ shall have no trough or minimum in the first half cycle.

By differentiation we have

$$f'(t) = \omega [\cos \omega t + 3 \beta \cos (3 \omega t + \theta)] = 0,$$

hence the positions of the crests and troughs are given by the equation

$$\cos \omega t + 3 \beta \cos (3 \omega t + \theta) = 0.$$

We shall find the condition that this equation may have two roots equal; and, subject to this condition, we shall find

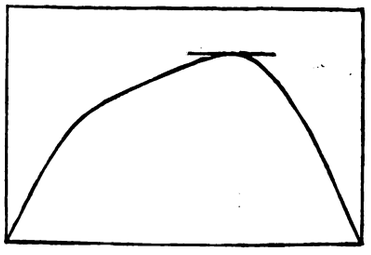


FIG. 20.—ONE CREST AND ONE OBLIQUE INFLEXION.

the next root; this will give the position of the only proper crest or maximum in the first half-cycle.

For convenience let $9 \beta = 1/a$ and write x for ωt.

Then

$$\cos (3 x + \theta) + 3 a \cos x = 0.$$

That is

$$\cos 3 x \cos \theta - \sin 3 x \sin \theta + 3 a \cos x = 0.$$

Therefore

$$(4 \cos^3 x - 3 \cos x) \cos \theta - (3 \sin x - 4 \sin^3 x) \sin \theta + 3 a \cos x = 0.$$

Dividing through by $\cos^3 x$ we have

$$(4 - 3 \sec^2 x) \cos \theta - (3 \tan x \sec^2 x - 4 \tan^3 x) \sin \theta + 3 a \sec^2 x = 0.$$

Replacing $\sec^2 x$ by $1 + \tan^2 x$ we get the following cubic for $\tan x$:

$$\sin \theta \tan^3 x + 3 (a - \cos \theta) \tan^2 x - 3 \sin \theta \tan x + (3 a + \cos \theta) = 0.$$

Now it is known in the theory of equation that the cubic (1)

$$a x^3 + 3 b x^2 + 3 c x + d = 0$$

has two equal roots when

$$4 (a c - b^2) (b d - c^2) = (a d - b c)^2,$$

the equal roots being given by

$$x_1 = x_2 = \frac{b c - a d}{2 (a c - b^2)}$$

and the third root by

$$x_3 = -\frac{3 b}{a} - \frac{b c - a d}{a c - b^2}$$

For our cubic the condition for equal roots becomes

$$-4 (a^2 - 2 a \cos \theta + 1) (3 a^2 - 2 a \cos \theta - 1) = (4 a \sin \theta)^2,$$

whence

$$\cos \theta = \frac{3 a^4 + 6 a^2 - 1}{8 a^3}; \quad (2)$$

and the expressions for the roots become

$$\tan x_1 = \tan x_2 = \frac{2a \sin \theta}{a^2 - 2a \cos \theta + 1}, \quad (3)$$

$$\tan x_3 = \frac{-3 (a - \cos \theta)}{\sin \theta} - \frac{4 a \sin \theta}{a^2 - 2 a \cos \theta + 1}. \quad (4)$$

With the aid of (2), the last expression reduces to

$$\tan x_3 = -\frac{(1 - a^2) (1 + 3 a^2)}{8 a^3 \sin \theta}.$$

It is convenient to let $\frac{1}{a} = b$, then $b = 9 \beta$, and

$$\tan x_3 = -\frac{(b^2 - 1) (b^2 + 3)}{8 b \sin \theta}, \quad (5)$$

wherein θ is given by (2), or by

$$\cos \theta = \frac{3 + 6 b^2 - b^4}{8 b}, \quad (6)$$

or (in a form better adapted to logarithmic computation) by

$$\sin \theta = \frac{(b^2 - 1)^{\frac{3}{2}} (9 - b^2)}{8 b}. \quad (7)$$

This equation, wherein $b = 9 \beta$, gives the desired relation between θ and β. If we assume a given value of θ and solve for β, the value so obtained would be the greatest value of β that could be used with the given value of θ without obtain-

[1] Due to Professor James McMahon.

Digitized by Google

ing a trough as in Fig. 17, which corresponds to the impossible hysteresis loop of Fig. 18.

To determine ψ, the phase displacement of the crest, we proceed as follows:

Eliminating sin θ from (5) by means of (7) we obtain

$$\tan x_3 = -\frac{b^2 + 3}{\sqrt{(b^2 - 1)(9 - b^2)}}. \quad (8)$$

Hence the position of the crest is given by

$$\omega t = \pi - \tan^{-1}\frac{b^2 + 3}{\sqrt{(b^2 - 1)(9 - b^2)}} \quad (9)$$

Now the crest of the fundamental curve ($y = \sin \omega t$) is given by $\omega t^1 = \frac{\pi}{2}$. Hence the displacement of the crest due to the presence of the third harmonic is given by

$$\psi = \omega(t - t_1) = \frac{\pi}{2} - \tan^{-1}\frac{b^2 + 3}{\sqrt{(b^2 - 1)(9 - b^2)}}. \quad 10$$

wherein $b = 9\beta$. This gives ψ in terms of β, when θ is determined as in (7).

Since neither (7) nor (10) is readily solvable for b, it is best to assign values to b and compute corresponding values for θ and ψ. Equation (7) shows that b can not be less than 1 nor greater than 3; and equation (6) shows that $b = 1$ corresponds to $\theta = 0$, and $b = 3$ to $\theta = \pi$. Table I gives values of θ and ψ computed from (7) and (10), by letting b run from 1 to 3 at convenient intervals, not always equi-distant. The corresponding values of β run from 0.111 to 0.333.

Dedication of the New Building for the Engineering Departments of the University of Pennsylvania.

Exercises dedicatory of the new building for the engineering departments of the University of Pennsylvania will be held on Friday, October 19. The building is located at Locust and Thirty-third streets, West Philadelphia, and will be open for private view from 9 A. M. to 5 P. M. Luncheon will be served at 12.30 o'clock. The building will be open for public inspection on October 20.

Traction Managers' and Auditors' Association.

The annual meeting of the Traction Managers' and Auditors' Association was held in Syracuse, N. Y., October 4. The association was formed last December, and already has exerted considerable influence upon public service in several large cities. The meeting was well attended by representatives of traction interests in the state.

THE TESTING OF COAL.[1]

BY A. BEMENT.

The purchase of coal under specification stipulating its composition, and the analysis of the fuel delivered under such specification, has now become an important feature of the coal business, and while the practice is of comparatively recent origin in this general locality, experience has demonstrated that there are certain features of specifications and analytical methods which may be corrected and improved. This applies particularly to the business transactions between the dealer who sells the coal and the purchaser who burns it. Another phase of the problem concerns the work being done at the coal-testing plant of the United States Geological Survey at St. Louis, the Illinois Geological Survey and the Engineering Experiment Station, of the University of Illinois. The work of these institutions may be considered as that of research, to distinguish it from the inspection service.

It is the principal object of this paper to emphasize the necessity for improving the practice governing specifications and inspection, and also to suggest certain lines along which the research work should proceed, and it is fuel coal from the eastern interior coal basin that is more particularly considered.

The improvements and corrections which concern terms of specifications, and the inspection service, require that determinations of the following be abandoned:

Moisture,
Volatile matter,
Fixed carbon,
Sulphur,
Evaporative power of the coal.

Every essential requirement of the purchaser may be fulfilled by confining specifications and tests to the three following characteristics; in fact, these three features alone will insure greater protection to the purchaser than obtainable under present general practice:

Per cent of ash in the dry coal,
Size of the coal,
Heating power of the pure coal.

The latter, according to prevailing practice, would preferably, of course, be expressed in British thermal units.

The reasons for the above recommendations are given under the following captions:

MOISTURE.

Moisture is a great and uncertain variable. It not only differs in various coal seams as the coal lies in the ground, but is affected in fuel as received in shipment, by conditions of weather, temperature and time the coal may be in transit. It is approximately correct, however, to say that each coal seam has a characteristic moisture content of its own, which is uniform over at least very considerable areas, but the after influences above mentioned change it, so that there is no assurance of what it may be except under specially defined conditions.

Therefore, the producer or coal dealer can exercise no control over moisture, and as the prime object of fuel inspection service is to insure that the customer is served to the best ability of the dealer, specifications and tests of moisture in coal delivered can offer no protection to the purchaser. As before mentioned moisture varies in different coal seams; for this reason it might appear that its determination would indicate the seam from which the coal came. This is not true, however, for reasons above mentioned. If tests are expected to identify the seam which produced the coal other means must necessarily be employed.

However, in coal inspection service, moisture has been found to be very high in cases where delivery is by wagon, which, owing to lack of sufficient explanation of phenomena at the time, may have led to the opinion that the dealer wetted the coal for the purpose of increasing its weight at the time of loading. If this is the practice, it necessarily complicates the problem, but the writer has had cause to visit every coal yard in Chicago, and never observed any wetting of coal or any appliances for such purpose. It would be a difficult and expensive matter to wet fuel as loaded, and require water pipes located along team tracks, which in some cases extend for several hundred feet, and with the finer sizes of coal it would necessitate a man stationed at each wagon to supply water as fast as the coal was loaded, otherwise it would be impossible to add any great amount, because simply flooding the top of a wagon-load of screenings, for example, would only insure the upper surface being wetted as the water would not penetrate the mass. A further study of this matter has made it appear to the author, that this high moisture in wagon-delivered coal is due to the practice of wetting coal while it is being unloaded, very often done for the purpose of allaying dust, and to the water which is commonly added in the fire room for various

[1] A paper presented to the Western Society of Engineers, Chicago, Ill., October 3.

Digitized by Google

reasons, both prior to the time of sampling.

This matter of moisture also complicates the problem as far as the inspection service is concerned, because it is impracticable for the inspecting company to have its sampler present when a wagon-load of coal arrives, as it would entail an expense which the service could not bear. Also, sampling attempted at the time of unloading could not be properly performed, as the sampler would be unable to gather from a wagon at the sidewalk and prepare a sample as it should be done. Thus it appears, that the determination of moisture, even in wagon-delivered coal, serves no useful purpose. With fuel received in cars, there could, of course, be no opportunity for adding water.

VOLATILE MATTER.

No fuel coal of this locality is purchased for the purpose of making gas or for use in byproduct recovery plants, therefore tests for this constituent are unnecessary, unless there be a great difference in the coal. "Volatile matter" is not very well understood. The best conclusion is that coal is a complicated hydrocarbon which breaks down in distillation into various fractions, depending upon temperature and duration of heating period, and that the difference in coal of this basin is not greater than that due to the varying effect produced by the volatilization test itself; or, in other words, the variation may be caused by the test rather than by the composition of the coal. Thus the volatile matter test is not sufficiently accurate to be of service in this case. It is, of course, true, that it would distinguish between bituminous, semi-bituminous and anthracite coal, but one may do this merely by inspection without any test whatever.

All coal of this basin is high in "volatile matter"; all will make smoke if burned in sufficiently bad furnaces, and all will make smokeless combustion and good efficiency in good furnaces.

FIXED CARBON.

In coal analysis the disposition is to follow precedent. Coal mining became an important industry in the East long before it did in this locality. Much coal in the Appalachian basin is suited to the manufacture of a high grade of coke, and the amount of residue, or, in other words, the coke obtained under the conditions of the process, is a matter of first importance. This has had the effect of emphasizing the importance of "fixed carbon," so that it has been looked upon in many quarters as of more moment than any other characteristic of coal, and these ideas, extending to our locality, have to a considerable extent influenced opinion regarding fuel. The same remarks regarding the uncertainty of the determination of volatile matter apply to that of fixed carbon, because the test for the former is the one giving data for the latter. If coke was made from coal of this locality, it would be possible under certain conditions, to make a useful application of the test for fixed carbon; inasmuch, however, as it is not the case, this constituent is only a troublesome and misleading feature of analysis.

SULPHUR.

Sulphur has been in a measure treated in the past the same as fixed carbon. In metallurgical work it is of extreme importance, and in this connection has received more attention than with fuel coal. This has given a prominence to the sulphur determination which it would not otherwise possess, and upon the assumption that sulphur is in the form of pyrites or very largely so, the conclusion has been accepted that the amount of sulphur is an indication of the tendency of the ash in the coal to clinker. This is true, however, to only a slight extent; in fact, may not even be considered as a working hypothesis in this coal basin, because some of the seams which are the highest in sulphur produce the least clinkering, therefore conclusions regarding the behavior of the ash in this respect are not justified by the amount of sulphur in the coal.

EVAPORATIVE POWER.

This is something which should never, under any circumstances, become a feature of specifications or guarantees, for several very important reasons. In general, too many variable factors enter into the problem. For example, boilers differ, some being more efficient than others, absorbing greater or less amounts of heat from the coal for reasons due to their individual superiority or inferiority. Then furnaces differ greatly; in some cases all of the volatile matter may be burned; in others, a large portion be wasted. Again, fire grates differ in like measure, causing varying losses of fuel which falls into the ash pits, and the combination of grate and furnace has an important influence on the excess of air which necessarily enters, and for this latter reason, also, the useful result obtained from the coal is affected to a marked extent. The above refers to the characteristics of the apparatus itself, but at this point another and most serious variable must be considered, that of the personal equation of the fireman or furnace operator; therefore it is apparent that in such a test, one may be unable to discover whether the result is due to the fuel, the peculiarities of the apparatus or its manipulation. In the case of a coal purchaser who does not realize these facts, the result is always attributed to the object in view, which is, in such instance, to determine the value of the coal. If he had wished to discover whether he employed a good fireman or not, the experiment would have been precisely the same, and he would have then considered the result due to manipulation. It is not only the above features which have an important influence, but the character of the load on the plant is a matter of great moment. In a works where boilers run steadily for twenty-four hours, the result secured, everything being equal, will be much better than in one where the work is necessarily interrupted by stoppages at noon-time, shutting down at night, or with peaks of load as in electric railway service. Any one of the foregoing causes may exercise a greater influence on the evaporative result secured than that due to variation in fuel.

It is not intended in the above to imply that coal-burning experiments are not useful, because there are some things which may be settled as affecting certain plants; for example, fuel high in ash generally costs less per ton than that containing less ash, and it might be a question which would be the most economical to use; or, the matter of the most desirable size of fuel may be in question. These two are the only features which can be settled by burning coal under a boiler, and they should not be made part of a specification or guarantee, but used entirely for the guidance of the fuel user in selecting the best grade.

The behavior of coal under boilers is a problem very little understood, because i is the result of many variable influences, and for this reason it is often felt that the calorimetric test is unreliable, which, however, is not true, because the calorimeter does its work very accurately as far as the coal itself is concerned; its efficient utilization in service is influenced only by the amount and fusibility of the ash associated with it and the size of the pieces of the fuel. This matter has been extensively treated elsewhere.[1]

It is well in this connection to direct attention to the fact that there is a feeling more or less prevalent, that coal from different localities or seams may possess some undefinable peculiarity in its chem-

[1] See Mr. Abbott's paper, presented September 5, 1906

Digitized by Google

ical combination, which causes it to behave differently under a boiler than it would in a calorimeter. Such conclusion is untenable, because the process is identical in each case, that of combination of oxygen with the carbon, hydrogen and sulphur of the coal, and this combination can not be any different under the boiler than in the calorimeter, unless certain influences due to the peculiarity of the boiler apparatus and its manipulation assert themselves, and it is the disposition as far as the coal is concerned, to blame it for effects which are due to causes other than its chemical composition. It is well in this connection to call attention to the fact that the heating power of the coal proper, or in other words, the pure coal in Illinois, only ranges from 14,000 as a minimum, to 14,750 British thermal units as a maximum, and that about eighty per cent of the fuel produced ranges between 14,000 and 14,500 British thermal units per pound. Thus the enormous variation found in service under boilers as far as the amount of water evaporated per pound of coal is concerned, is mostly due to the characteristics of the apparatus, its manipulation, and to the size of the coal and the amount of ash associated with it.

Thus it is very clear that specifications or guarantees covering amount of evaporation per pound of fuel or per cent efficiency, are not only useless but troublesome to the purchaser and dealer.

The three approved tests may now be considered, and while in the above classification they are presented in the order of greatest importance, it will be convenient to change their arrangement.

PURE COAL.

For better understanding, it is desirable to consider coal as the chemical combination of certain elements which are principally heat producing. The association of ash and moisture with these result in an aggregation which may be designated as fuel, although generally called coal, which, from this standpoint, however, is not correct, because neither ash nor moisture produces heat.[1] The expression, pure coal, is the equivalent of what has erroneously been called combustible, the pure coal containing all of the combustible matter, and some water of composition and nitrogen which are not combustible, but as these two ingredients are associated chemically with the combustible the ultimate conception of coal is covered by this term, pure coal. Thus in the heating power determination, it is more to the point to base results on the pure coal than on any of the fuel mixtures, illustrated as follows: Let it be assumed that in one case the British thermal units per pound of dry coal is 13,250, and in another 12,450, from which it would appear that the two lots of fuel were different, but if the percentage of ash content in each is known, and the first sample contained seven per cent and the latter twelve per cent, it appears that each sample has a pure British thermal unit of 14,250, or, in other words, that the coal is the same in each, there simply being more ash associated with it in one case than the other. Basing the heating power determination on pure coal has another very important advantage, as it enables one to judge of the accuracy of analysis, because when the heating power and the source from which the coal comes is known, there is evidence indicating whether or not the analysis has been correctly performed, because, if it has not been, it will be shown by the British thermal unit.

ASH.

An important reason why ash should always be considered as a percentage of the dry coal instead of the moist fuel is, that like the British thermal unit determination, unless it is placed on some common basis, proper comparison can not be made on different lots of fuel; for example, in two samples, the moisture may be eight and thirteen per cent, and ash in the dry coal ten per cent in each, but expressed on the moist coal basis, it appears that one has 8.7 and the other 9.2 per cent of ash, and it would seem that one of the fuels contained more than the other. In this connection the fact should be borne in mind, that no one burns moist coal; the moisture is evaporated and passes away; in fact, dry coal is not burned, the ash remaining; it being the pure coal which enters into the process of making fire.

SIZE OF COAL.

As a general proposition, the value of fuel increases with the size of the pieces, so that a very fine "duff" is of little use, but as the pieces become larger, the actual value increases in a greater ratio than does the heating power, and this continues to egg size and lump. Thus smaller pieces containing the same amount of heat per pound as larger ones, are of less value than the larger coal.[1]

The size of the pieces of coal exercises an important influence not only on the capacity which may be produced by a boiler, but on the resulting efficiency, and the best size to be used in a given case is dependent upon many conditions, such as the strength of draught, kind of stoker or grates, method of firing, etc., and the selection of the proper size of fuel or the method of utilizing the available size often affords an opportunity to effect important economies.

SAMPLING.

One feature of the matter, referring especially to coal inspection service, is proper and reliable sampling. In very many cases the coal inspection service is rendered by a company, which, while acting as the purchaser's representative, is depended upon to furnish the seller with reliable reports concerning the composition of coal supplied. Under such conditions, it is absolutely necessary that not only shall the inspecting chemist be both competent and reliable, but that he shall be as fully responsible for the collection of the samples as he is for the analytical report, and it is also absolutely essential that the purchaser or his employés shall not be allowed to sample any coal or assist in the sampling, because under such conditions, the chemist may not know whether the report which he makes is correct or not, and it is well to emphasize the fact that the sampling is of as great importance as the analysis itself.

Referring to the branch of the subject before mentioned as that of research, there has been in operation for some years at St. Louis, what has been designated as a fuel-testing plant, under the direction of the United States Geological Survey. Its principal published work so far, however, has been largely confined to "tests" under boilers, which have been thought to show the "real steaming value" of the fuel. The author's remarks above regarding testing coal under boilers will refer to this branch of the work.

Probably the reference to coal in the plural has done much to cause confusion, because it has led people to believe that there are very many "kinds" of coal. For example, fuel from Herrin and Carterville in this state would, according to this, be considered as different "coals," when, as a matter of fact, they are from the same seam, and the most exact analytical tests so far made do not indicate a difference. The amount of ash associated with the coal may or may not vary, but the coal is the same, and it is coal and not coals, otherwise, every mine would produce a different kind of coal, notwithstanding the fact that seams in Illinois sometimes run through an entire county without it being possible to detect any variation in the quality; therefore, the expression, kinds of

[1] Journal American Chemical Society, vol. xxviii, page 632.

[1] See Mr. Abbott's paper, presented September 5, 1906.

Digitized by Google

coal, which has been used frequently in connection with coal-testing work, should not only be better defined, but limited in its application to those cases where there is a real difference, which, as is well known, does exist: for example, it must be conceded that anthracite and bituminous are different kinds of coal, but the most liberal application to this coal basin would allow only two kinds, which are the block coal of Indiana, all the remainder being bituminous, the latter also including what is known as semi-block of Indiana.

The state of Illinois has made an appropriation covering cost of investigations to be conducted by the engineering experiment station of the University of Illinois, and there is certain important work which it is hoped will be undertaken, having a bearing on the values of fuel, studies tending to define the laws controlling the influence due to the size when burned with some different kinds of stokers or grates, and similar studies to ascertain corresponding effect due to varying amounts of ash in coal, also degree of fusibility of such ash.

The recently established State Geological Survey will present by all means a very much better coal report than has so far been published by any state, and it will be a great help to the purchasers and producers of coal, if certain values as affecting heating power, ash and moisture are authoritatively presented. As before mentioned, the three essential items are heating power of the pure coal, percentage of ash in the dry coal, and moisture. The British thermal unit values would be the simplest of the three, as these results would apply to pure coal, and which is, no doubt, practically a constant for a particular locality of a seam, therefore, once determined, it will not be necessary to repeat tests. Establishing ash values would be a more difficult matter, because it would not only involve ash in seams as the coal lies in the ground, but the various grades of fuel shipped from those seams. Ash, however, at the mine would be the same in quantity as when received by the consumer. Securing moisture values would be a far more complicated problem, because of greater variation due to temperature, weather conditions and time in transit. For these reasons, it is difficult to arrive at any conclusion regarding the amount of work which may be justified in the establishment of such values. Some idea of the complication may be illustrated; for example the washed and sized coal shipped so extensively from Williamson County has a characteristic moisture content due to the difference in the size of the pieces, the larger ones being drier, and these moisture contents vary over wide ranges between summer and winter, and also according to the length of haul; thus at least average moisture values would be needed for each size, at the city where the coal was received.

A recent expression which has come into use is that of "air-dried coal," which is based upon allowing the sample to become dried in the open air of the laboratory, the idea being that this shows the fuel as it would reach the customer. No standard conditions, however, appear to be employed in this air-drying, and if there were, the values obtained thereby do not indicate the amount of moisture in coal when it reaches the consumer. Some samples of air-drying on Illinois coal have shown the moisture as being between five and six per cent, when as a matter of fact, the same coal is never received with less than seven, and in the winter time it is very much more. This moisture value should be abandoned, as it serves no useful purpose, tending only to increase existing confusion and misunderstanding.

Double Trolley System Not a Sure Cure for Electrolysis.

At the convention of the Central States Waterworks Association, held in Cincinnati, Ohio, during the latter part of September, a discussion upon electrolysis of water pipes was started by Joseph J. Pater, who stated that it was his belief that the only method of doing away with this trouble was to force all electric railroads to adopt the double trolley system. This opinion was dissented from by George Hornung, formerly superintendent of the Newport (Ky.) waterworks, and at the present time a consulting engineer of Cincinnati, Ohio. Mr. Hornung first stated that it was not entirely correct to attribute all electrolytic troubles to the street railway, as any stray current may cause electrolysis to take place, and such currents are almost always present in cities where there are large electric generating stations. It is practically impossible to insulate all the systems perfectly so as to prevent any leakage of current.

It is this very feature which defeats the purpose of the double trolley system, and he described, somewhat in detail, his experiences with that system in Cincinnati. The double trolley system, on account of its complicated structure, is much more difficult to insulate than the single trolley system, and this fact is realized in Cincinnati, where a fallen wire is treated with respect; in fact, Mr. Horning stated that he has known horses to be killed by such wires. He mentioned an experiment conducted on Main street, in Cincinnati, at a time when there were two lines running down that street—one a single trolley, and the other a double trolley system. It was found that by transferring the trolley wheel of a car on the single trolley system to one of the double-trolley wires that the lamps in the car were lighted, and by turning the controller handle the motors, while not able to start the car exerted a considerable torque. This experiment was repeated again several years later, with the same result.

The Maximum Development of the Steam Engine.

Although would-be prophets have frequently set limits to the development of the steam engine, these limits have one after the other been passed in practice. An attempt is made here to determine if there is any physical reason for setting a limit to the increase in steam pressure and temperature beyond which it will not be possible to go. We have already reached a stage where we can use iron worked red hot, but we can not see that such high temperatures appear likely to occur in the steam engine, even though the temperature in the internal-combustion engine be considerably above red heat. The critical temperature of water and of steam is said to be about 700 degrees Fahrenheit, at which point steam and water have the same specific density and possess the same specific heat. When heated above 700 degrees steam dissociates into its elements. Unless the temperature of dissociation be raised by pressure, 700 degrees would appear to be the limit for the steam engine. Steam pressure rises rapidly with increasing temperature, and at 700 degrees Fahrenheit, or 1,161 degrees absolute, the pressure would be 2,840 pounds per square inch—about ten times higher than any that has been used up to this time. At this high pressure steam would be unstable, and it would probably be found to be desirable to allow for superheating in order to prevent this. If 200 degrees Fahrenheit be allowed for superheating, the absolute temperature of the saturated steam would be 961, which corresponds to about 674 pounds absolute pressure. From this reasoning it seems safe to conclude that it is not safe to set a limit to the steam engine until pressures have attained about 650 pounds by gauge, and temperatures 500 degrees Fahrenheit, with an additional superheat of 200 degrees.—*Electrical Review (London), September 21.*

Digitized by Google

Electrical Notes from Great Britain.

(From Our British Correspondent.)

THERE are three organizations in England which have up to the present represented electric tramroad interests. These are: (1) the Tramways and Light Railways Association, which originally seemed to be concerned with company undertakings, but now embraces all descriptions of tramway interests; (2) the Municipal Tramways Association, in whose meetings tramway officials in municipal service, and councillors, together discussed the management, engineering and finance of purely municipal undertakings; and (3) the Association of Light Railway and Tramway Officials. For some time past it has been felt that there is here quite unnecessary duplication—perhaps we ought to say triplication, and steps have been taken with a view to combining the three in one strong organization which would of course be better able to efficiently watch the tramway and tramway official interests. The matter has now come to a head, and at the annual convention which came to a close on September 21, at Leeds, a definite scheme for concentration came before the Municipal Tramways Association. The idea is to form a "Tramways Association of Great Britain and Ireland" presenting "a united front to all opponents." Already in many recent matters concerning the equipment of lines the associations have joined forces in bringing weight to bear upon the Board of Trade and Parliamentary committees.

Petrol 'buses and their odor notwithstanding, the tramway statistics for the United Kingdom show that a continual development of electric lines is going forward, though, as J. B. Hamilton, the president of the Municipal Tramways Association says, "not at the same rate of speed as in several years at the beginning of the century." The last official figures show that, including the year's outlay of $25,000,000 upon new lines, the municipal authorities have spent $165,000,000 on tramways. Tramway men have naturally been closely following the big development that has been taking place in motor-buses, therefore they heard with interest the remarks that Mr. Hamilton had to make on this point in his presidential address. This gentleman had personally had an opportunity of examining the returns showing the percentage of motor-omnibuses in operation, to those in stock, of one of the largest London companies. He also made observations concerning the vehicles of the other companies as well, and this is what he said: "the most fortunate companies had a maximum of about seventy per cent of their total stock on the road at any time, whilst many of them had only between fifty and sixty per cent." In his opinion, unless a very great improvement in reliability and economical operation takes place, the motor-bus will not long retard the extension of tramway enterprise, even in London.

The recent crop of bad accidents to street cars rendered the subject of electric car brakes one of timely interest for the Leeds meeting. A paper was read by Henry Mozley, tramway manager at Burnley, who has had special experience with different kinds of braking appliances. Full particulars of tests that he had made were given, and the following conclusions were set out as the result of his practical investigations:

1. Bogie cars are easier to control on steep inclines than four-wheel cars, whatever the character of the brakes.

2. Magnetic brakes, particularly those which affect the wheel brakes, are unsuitable for tramways either for service or safety purposes. They can only be considered as auxiliary to the rheostatic brake, and not as independent track brakes. They are highly destructive to the motors. They are treacherous and uncertain in their action.

3. The only form of brakes which will safely control a car on gradients greater than one in fourteen or fifteen are:

a. Hand brake with adequate actuating cast-iron blocks on the wheels.

b. Mechanical track brake with adequate leverage provided with cast-iron slippers.

c. Rheostatic brake for emergencies only.

Sweeping statements are always excellent things when one wants to promote a fiery discussion, and in this Mr. Mozley succeeded.

Other matters brought forward in the course of this tramway convention included: "Depreciation and Renewal Funds in Relation to Tramway Undertakings," by G. W. Holford, of Salford; "Municipal Tramway Operation," by R. A. Smithson; and "Tramway Track-work," by R. C. Bullough.

There is at present running at Olympia in London, where last year's great electrical exhibition was held, an engineering and machinery exhibition about which a great deal of fuss is being made in newspapers and some trade papers. It may no doubt be a useful show from some points of view, but to electrical engineers it is of only very small interest. A probable explanation of the comparative absence of electrical firms from among the exhibitors lies in the resolution passed by the National Electrical Manufacturers' Association that its members would not show at any exhibition except those conducted under its auspices. We are not sure whether that decision was intended to relate to such an exhibition as the present one; from the fewness of electrical exhibitors we should imagine it was. The British electrical manufacturer generally speaking is not very keen about exhibitions. The manufacturers' association mentioned does not hold upon its membership roll a number of the most powerful British electrical manufacturing organizations, so these were not bound by resolution. However, these have not thought it worth while to be represented at the engineering and machinery exhibition. The promoters of the exhibition sought to include electrical engineering exhibits, and a few of these might have helped to occupy some of the space which is now vacant—there is not even a spanner in the entire gallery round the great hall—its sole occupants are a brass band. The daily papers are talking of so many miles of exhibits, and quoting estimates of the aggregate weight of the machinery on view so as to draw the public to Olympia, but it is not a show to appeal to the public like last year's electrical exhibition which was so popular. Engineering students will of course find many things there to interest them.

English electricity supply companies, municipal electricity committees, and their managers and engineers are alive at last to the necessity for acting more enterprisingly—shall we say with more of your hustling?—in order to develop the electricity selling business. The prize papers published as part of the scheme of the Cooperative Electrical Development Association, of Cleveland, Ohio, have been studied with considerable interest and they are bound to do good on this side of

Digitized by Google

the Atlantic as well as that. We have been so busy for years (and are still) turning out new electrical engineers that there is no lack of technical assistance obtainable at cheap rates, and the man with genuine salesman ability and just enough technical knowledge to keep him from making a fool of himself, is going to be valued more and more in this electricity supply business. We are not sure that it would be incorrect to couple poets and downright energetic business-getters together in one thing (perhaps not more) —they are born, not made.

For sometime past several schemes have been on foot for supplying ample and cheap electric power to the Rand district. The Rand Central Electric Works, Limited, a German concern very largely, though nominally a London company, is making extensive preparations, but this effort pales into insignificance at the side of the other gigantic schemes which are in process of elaboration. One of these big projects is said to be almost ready for an appeal to the public, and within the next month or six weeks, if the reports be correct, $15,000,000 of shares will be offered by the company which has resolved to proceed with the works for electrical transmission from Victoria Falls to both Pretoria and Johannesburg. The distance from the Falls to Johannesburg is 600 miles "as the crow flies," but the necessary deviations will make a transmission of 700 miles. One report says that 150,000 volts is the proposed pressure, and that the first instalment of plant will be equal to 30,000 horse-power, it being intended to add to it as the demand necessitates. ALBERT W. BRIDGE.

London, September 29, 1906.

Instructing Telephone Operators.

To the traffic department of the New York telephone system the girl who wishes to become an operator must direct her steps. The qualifications necessary are good eyesight, good hearing, distinct enunciation, fair penmanship and general neatness. At least medium height is required, and a bit over is an advantage. Recruits should be between seventeen and twenty-one years of age, and should have a good common-school education. Of course satisfactory references as to good character are required.

To teach these recruits the art of telephone operating the company maintains a school where more than a hundred embryo hello girls are always in training. They are taught telephone geography in order that they may accurately locate the point to which a call should be sent, and start the call without an instant's loss of time. All are taught to do things in exactly the same way; to respond to the signal of the calling subscriber with the one phrase, "Number, please," to answer all calls and inquiries and complaints courteously, always using the rising inflection, as allowing the voice to fall conveys a disagreeable impression at the other end of the wire. The thought is installed into their minds that in telephoning a great deal depends on courtesy. They are taught that "A soft answer turneth away wrath."

After this course of training, lasting more than a month, the latter part of which is given over to actual operating on the practice-board in the school, the girls are graduated and apportioned among the exchanges needing new operators. In this allotment, so far as possible, the girls are sent to exchanges near their homes. This bit of courtesy on the part of the telephone company saves a good many nickels and much time to the operators in the course of a year.

While going to school, the operators are paid a salary of $5 a week, which is increased as they progress in the regular force, the average pay of the operators being about $10 a week. From the ranks of the regular operators promotions are made from the grade of senior operator to supervisor.

The comfort of the operators is well looked after. At each exchange the company maintains a kitchen, dining room, sitting room, supplied with periodicals, an emergency hospital, a locker room with an individual locker for each operator, all of the quarters being well ventilated, well lighted, clean and pleasant. Hot tea and coffee are furnished to the operators, and they can obtain these at any time. In addition to the regular lunch hour, the girls are allowed a relief period of thirty minutes in the morning, and another in the afternoon, which they spend as they see fit in these rooms. This welfare work in each exchange is under the direction of a matron.

The regular operating force is drawn on frequently nowadays to provide operators for the numerous small private exchanges which are located in nearly every establishment of any size in the city. At the present time in New York city there are about 25,000 telephone operators.—*H. K. McCann, in N. Y. World.*

Single-Phase Equipment for the Washington, Baltimore & Annapolis Railway.

The announcement that the Washington, Baltimore & Annapolis Railway has finally adopted the single-phase system and has placed contracts for the entire electrical equipment required for this line will attract considerable interest in engineering and railway circles.

In the former plans for this system of single-phase equipment between Baltimore and Washington it was proposed to use a trolley potential of 1,000 volts, current being delivered at this voltage at a frequency of sixteen and two-thirds cycles per second. The present contract calls for a trolley potential of 6,600 volts at a frequency of twenty-five cycles per second. On the cars a four-motor equipment was proposed, each motor having a capacity of 100 horse-power. The new car equipments will consist of quadruple General Electric A-603 motor equipments for direct or alternating currents, each motor having a capacity of 125 horse-power. While the first proposed motor equipments would have driven the cars at about forty miles per hour, the new equipments, totaling 500 horse-power, will enable express trains on the road to attain a speed on tangent level track of sixty miles per hour.

The details of the new road have been carefully worked out by the Roberts & Abbot Engineering Company, of Cleveland, Ohio. Single-phase equipment was chosen only after the most careful engineering study had made it apparent that this system would prove most economical and best adapted to meet the special service conditions existing on this road.

Some sixty miles of road will be operated by the new company. The main line will be constructed between Baltimore and Washington, with a branch line, from a point on the main line near Odenton, extending to Annapolis. This station on the new line will be known as Academy Junction. Over the main line between Baltimore and Washington an express and local service will be established, express cars being operated under a fifteen-minute headway and making the run in seventy-two minutes. The roadbed will be double-tracked throughout, with sidings arranged at suitable intervals so that the locals may be side-tracked to enable the expresses to maintain schedules. The rolling-stock equipment is to be very complete. Nineteen express cars, capable of making sixty miles per hour on a tangent level track, will be operated. In addition two work-

Digitized by Google

cars will be equipped, each sufficiently powerful to haul a train of five ordinary passenger coaches at forty-five miles per hour, while four lower-powered cars will be used for local service. These last-mentioned cars will run at a speed of forty-five miles per hour. The express and work cars will each be equipped with four General Electric A-603 (125-horse-power each) alternating-current-direct-current motor equipments with the Sprague-General Electric type M train control. The local cars will be similarly controlled but will be driven by two instead of four General Electric A-603 motors.

Power for the new road will be purchased from the Potomac Electric Company, of Washington, D. C., and will be delivered by that company at 6,600 volts, three-phase to a transformer substation located about three miles from Chesapeake Junction. In order to obtain a balanced load on the three-phase generators, the current as received at the substation will be changed from three-phase to two-phase by groups of two transformers connected three-phase on the 6,600-volt primary side and two-phase on the secondary side. Half of the transformers will have the secondaries wound for 6,600 volts and the other half for 33,000 volts. The 6,600-volt windings will all be connected in parallel on the same phase supplying single-phase current to the trolley as far as Academy Junction. The 33,000-volt secondary windings will all be connected in multiple on the second phase to the 33,000-volt transmission line, which will supply current to a step-down substation located at Academy Junction. The Chesapeake Junction substation will contain seven 800-kilowatt, water-cooled transformers, three with 33,000-volt secondaries and four with 6,600-volt secondaries, one of the latter transformers forming a reserve.

At Academy Junction there will be four water-cooled transformers, twenty-five cycles, 800 kilowatts, reducing the single-phase 33,000-volt current of the transmission line to 6,600-volt current suitable for delivery to the cars. These transformers will supply the Baltimore and the Annapolis sections of the line.

The substation at Academy Junction will be located adjacent to the car barns. For greater safety in inspecting and handling the cars, all of the trolley circuits in the car barn will be arranged for 600-volt direct current, and for this purpose two 300-kilowatt motor-generator sets will be installed in the transformer substation, changing the 6,600-volt alternating current to 600 volts direct current. The motor end of these motor-generator sets will be connected direct to the trolley circuits, one phase being led from the trolley coming from Chesapeake Junction and the other from the Academy Junction transformers. A feeder regulator will be placed in one phase so that the motor-generator sets will act as balancers, permitting the Academy Junction transformers connected on phase B to feed into the trolley line supplied by the Chesapeake Junction transformers on phase A. In addition to acting as balancers and to supplying current to the cars in the barns, the motor-generator sets will also supply direct current to the motors in the repair shops located at this point.

Government regulations within the District of Columbia prohibit the use of the track return so that within this section the cars will be operated with a double trolley. This portion of the tracks, as well as that within the city of Baltimore, is at present operated by direct current, and the new cars are designed to operate on direct current over these sections of the line.

The present Washington, Baltimore & Annapolis Railway Company which is constructing the line is quite distinct from the initial corporation. The new company, under the head of its president, George C. Bishop, has considerably broadened the former plans. Land has been purchased for a wider right of way along the route, and new bridges are being built, so that the roadbed will be excellent. The engineering work is in charge of the Roberts & Abbot Engineering Company, of Cleveland, Ohio, and contracts have been placed with the General Electric Company for the complete electrical equipment. The construction and operation of this road will be watched with great interest, as it is one of the largest and most important installations of the single-phase railway system ever undertaken.

The New Plant of the Home Telephone Company, Detroit, Mich.

The plant of the Home Telephone Company, Detroit, Mich., is being built by the Electric Construction Company, St. Louis, Mo. The same interests control both the telephone and the construction companies. The Commonwealth Trust Company, of St. Louis, Mo., is financing the proposition, and its resident representative is W. W. Grayson, formerly of the Kinloch Telephone Company.

A site for the central exchange property has been purchased at the northwest corner of Madison avenue and John R. street. This gives 105 feet on Madison avenue and 100 feet on John R. street. The plans and specifications contemplate a building to cover the entire lot, three stories high, and devoted entirely to local and long-distance service. It is expected that the building will be ready for occupancy by May 15, 1907. The first floor, containing 10,000 square feet, is devoted to public and executive offices. The second floor is devoted to the long-distance board, hospital, rest room and lockers for the operators, terminals, battery room and office of the long-distance wire chief. The third floor is for switchboard exclusively. Under the building is a large basement for shops, storage purposes, etc.

For its east exchange the company has purchased property at the corner of Field and Sylvester streets, and for the Delray office property has been purchased at the corner of Artillery and Lafayette streets.

Contracts have been awarded for central office switchboards and substation telephones. The total present switchboard capacity is 15,000 lines, with an ultimate capacity of 40,000 lines. The number of substation telephones covered by the contract is 10,000. The contract has been awarded to the Dean Electric Company, of Elyria, Ohio, and the total amount of the award is about $500,000. Contracts have also been awarded for underground cables which are to be drawn into the conduits at present being constructed by the company. The contracts have been awarded to the John A. Roebling's Sons Company, Trenton, N. J., and to the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

Evening Courses in Direct-Current Testing at the Polytechnic Institute, Brooklyn.

The evening sessions in direct-current dynamo-testing were begun on Thursday evening, September 27, at 7.30 o'clock, at the Polytechnic Institute, Brooklyn, N. Y., under the direction of the class instructor, Sydney W. Ashe. This class extends over a period of twenty successive evenings, from 7.30 to 9.30 o'clock, and is similar to the course given during the day. The course involves a series of tests of the construction, regulation, efficiency and operation of direct-current dynamos and motors, together with a consideration of the efficiency and distribution of light, and the candle-power of arc and incandescent lamps.

From those desiring to have their work credited toward the degree of electrical engineer, engineering reports upon the tests performed will be exacted.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Artificial Dispersion of Fogs by Electricity.

The problem of artificially dispersing fogs has been studied by Maurice Dibos for some years past. As long ago as 1899 he endeavored to accomplish this by means of compressed air discharged from the bow of a steamer. Still later he took up the electrical method, using both alternating and direct currents, and succeeded in clearing zones from 100 to 150 metres in diameter. As soon as the discharge was stopped the fog at once closed in again, but dispersed upon renewing the discharges. Although what has been done in this direction is small, it points to possible important developments which would be particularly valuable in important commercial ports. The article gives a review of all the work that has been done upon this problem, and gives some data showing the amount and kind of solid matter found in the air of certain large cities.—*Translated and abstracted from L'Electrician (Paris), September* 22.

Experiments with the Heusler Magnetic Alloys.

Some interesting experiments have been conducted by K. E. Guthe and L. W. Austin with a number of samples of the Heusler magnetic alloys. After a brief review of preceding work with these alloys the latter are described. They consisted mainly of copper, manganese and aluminum, but contained from one to one-half per cent of iron, from a trace to about four per cent of lead, and a small amount of silicon. A few other elements, such as carbon, phosphorus and silicon, could be detected in certain of the samples. Experiments to determine the modulus of elasticity were unsuccessful, due to flaws in the samples; and while not even an approximate value for Young's modulus may be given, it is apparently very large. Magnetization curves were obtained, the induction being carried to high values. These curves resemble closely those for iron, the curve for one sample being very like that for a hard substance. Two of the samples were but slightly magnetic. Curves for permeability and induction were plotted. The greatest value for permeability found was for one sample in which it reached about 575 at an induction of 1,800. Curves for magnetostriction were obtained. It was found that the expansion of the samples was not proportional to the magnetization, but increases more rapidly. It is relatively larger the softer the material. From the result it seems fair to conclude that the harder the alloy, the higher Young's modulus. The thermoelectric forces were also determined. It was found that these were unaffected by the magnetic condition of the sample. The conclusion is drawn from the investigation that in these alloys certain properties seem to be absent which have always been thought to be closely connected with magnetic substances.—*Abstracted from the Bulletin of the Bureau of Standards (Washington), August.*

Grounded Neutrals with Series Resistance.

The advantages and disadvantages of grounded neutrals on polyphase systems are discussed here by P. H. Thomas, particular reference being made to the system of the Interborough Rapid Transit Company, of New York city. Broadly speaking, the advantages of the grounded system are the limitation of the rise of potential to earth that occurs when one line of a system becomes grounded, and the causing of a short-circuit if one line wire becomes grounded, thus opening the circuit-breaker on the grounded feeder. The disadvantage of a grounded neutral is the fact that a single ground is sufficient to cause a short-circuit and an interruption of the service. On systems which can be repaired without disconnecting the feeders the grounded neutral would therefore be objectionable, but for high-tension wires which must be disconnected anyhow for repairs, this disadvantage is not so great. In plants having a large number of feeders, any one of which may be cut out without affecting the system, it is possible to arrange the grounded neutral so as to open a particular feeder without shutting down the rest of the system. This is done by inserting resistance in the ground wire of the neutral. This resistance tends, however, to prevent the realization of the advantage of the grounded neutral, since it hinders the free flow of current to the earth. With comparatively high resistance, short-circuit troubles are limited and the circuit-breakers open quietly, but the current taken is not sufficient to prevent a rise of potential to ground on the rest of the system. As this resistance is made relatively less, the short-circuit current becomes greater, and the rise of potential is better controlled. On the Interborough system a resistance of about six ohms, allowing nearly 1,000 amperes to flow, has given the most satisfaction. Additional complications arise when several generators are employed, for if but one resistance be placed in the ground wire a serious overload may occur when only a few generators are in operation. It seems better to connect each generator to the ground through its own resistance, but when this is done switches must be provided for disconnecting the idle generators from the neutral bus.—*Abstracted from the Electric Journal (Pittsburg), September.*

Continuous-Current Dynamos with Auxiliary Poles.

The magnetic effect of the auxiliary poles on the field of a continuous-current dynamo is discussed here by A. Lioubille. It is shown first that in a two-pole machine having two field coils there are two points in the yoke midway between the poles having the same potential as the centre of the armature core. If, therefore, two auxiliary poles be placed at these points they will, if not excited, in no way affect the magnetic distribution of the dynamo. Exciting the two coils causes merely the superposing of the auxiliary field upon the main field, and this is shown to be the case both theoretically and experimentally, because, while the theory assumes that the reluctance of the circuit remains constant at all points, the inductance will be affected appreciably only in the yoke, and the latter is not generally saturated. The study does not take up the question of magnetic leakage, which undoubtedly would be seriously affected by the auxiliary poles. This effect will be very complicated, but it may be reduced considerably by the plan proposed by R. Pohl, in which the auxiliary poles are shifted around until they are brought close to the main poles of similar sign.—*Abstracted from L'Industrie Electrique (Paris), September* 10.

Digitized by Google

The Use of the Wehnelt Interrupter with the Righi Exciter for Electric Waves.

In making a quantitative investigation of the performance of the Righi exciter, as usually employed, it is usually necessary to make the measurements by a very sensitive galvanometer. To get around this disadvantage, A. D. Cole considerably increased the energy of the vibrations by adopting a Wehnelt interrupter and modifying the exciter so that it would operate cool. The latter condition was obtained by circulating oil through the oil cup. Considerable difficulty was found in devising an interrupter of this type that would operate satisfactorily and not go to pieces after a short time. Various forms of adjustable electrode were tried, sealed into glass or covered with rubber, but none was satisfactory. Small discs cut from the bowl of a clay pipe were but little more durable. Compressed asbestos and a hard kind of talc were tried and rejected. Good results were obtained finally by using small discs cut out of a piece of close-grained slate. A small hole was drilled through the centre of the disc, which was then cemented to the end of a glass tube. A platinum wire passed through a cork inserted in the opening, the cork being forced into the upper end of the glass tube. This tube was allowed to project into weak sulphuric acid, a dilute solution being more convenient for handling, and the increased resistance being an advantage, rather than a disadvantage. The other electrode was formed of a strip of lead bent into U form. An alternating current of 100 volts was used for exciting this interrupter. Although it could be used without any resistance being inserted, better results were obtained when a resistance of about seven ohms was placed in the primary circuit, the platinum wire being pushed out through the slate until about two millimetres projected into the acid. The amount of resistance used in series with the interrupter must be varied with the length of platinum wire exposed. This device proved very satisfactory in action.—*Abstracted from the Physical Review (Lancaster), September.*

Oscillographs and Some of Their Recent Applications.

A convenient form of oscillograph is described here by B. A. Ramsay, the apparatus permitting not only continuous records of current and electromotive force to be obtained, but short typical curves to be made, at the same time the curves are plainly visible. Or it may be adapted for projecting curves on a screen. The device is particularly adapted for studying high potentials up to 30,000 volts. The oscillators are mounted on a tall corrugated porcelain insulator, over which a porcelain cover is set. A plate of porcelain is interposed between the oscillator and the box containing the sensitive surface, in order to prevent troubles from brush discharges. Two vibrating systems are mounted independently, so that either may be taken out for adjustment or adjusted within the magnetic field. Instances are described in which a device of this kind proved of much commercial value. It was found that the wave form from a certain alternator was rather irregular, and these irregularities were greatly magnified when it was connected to unloaded cables. A slight change in the shape of the pole face remedied the trouble. It was found that the luminous efficiency of an alternating-current arc is forty per cent higher when supplied from an alternator with a flat-top electromotive-force curve, than from a machine with a peaked curve; so that where arc lighting forms a considerable portion of the load it is important to select an alternator having a suitable wave form. On the other hand, transformers have a higher efficiency with peaked wave form. Some interesting investigations were made showing the shape and phase of the current and electromotive force during electrolysis. An interesting result is given, in which the current leads the electromotive force by about forty-five degrees and shows peculiar irregularities when at its higher values. A simple synchronous motor has been devised for use with this apparatus, which is an induction motor with a short-circuited rotor, the core of which is, however, deeply slotted at four points. It has a two-phase winding and starts as a split-phase induction motor, but runs up into synchronism and operates as an attracted iron motor.—*Abstracted from the Electrician (London), September 21.*

Phenomena Observed in Crookes Tubes.

No satisfactory explanation seems to have been made of the phenomena characterizing prolonged discharges in a Crookes tube. These are considered here by N. T. Bacon. They are, first, a discharge of peculiar rays from the anode, a discharge of different peculiar rays from the cathode, gradual attenuation of the discharges, recrudescence of discharges on heating the walls of the tube, and coating the walls with platinum black. To explain the attenuation of the discharge and its reappearance upon heating, it has been suggested that the gases in the tube might be absorbed in the pores of the glass vessel; but this hardly seems rational, because the walls of such vessels are very thin, and if absorption could take place there would probably be a kind of osmotic transfusion from the glass through the outside. It seems reasonable to ascribe the gradual attenuation to increasing vacuum, since it is partially overcome by heating the tube; and it might be that the gases accumulate on the glass, forming a sort of surface film, such as is known to be formed under atmospheric pressure. The same explanation might account for the heating of platinum sponge in an atmosphere of hydrogen, as the gas might be condensed even to the point of liquefaction. If molecular elasticity be more or less imperfect in the solid state, a molecule of hydrogen, striking an imperfectly elastic platinum molecule, would rebound with diminished velocity, the lost kinetic energy going to raise the temperature. In the pores of the platinum sponge the hydrogen molecule will naturally strike again and again the imperfectly elastic mass, with further evolution of heat and loss of velocity, until it reaches nearly the orbital velocity of the vastly heavier platinum molecule, and may thus be reduced even to the liquid condition. Such a film would give off molecules when heated, and, knowing platinum black to have this action on gases in higher degree than glass, the vacuum in the tube might be increased by the platinum coating, and the heating of the walls of the tube would partially restore the latter to its activity. The higher the vacuum the more important relatively this action becomes, as the exposed surface of imperfect elasticity remains constant, while the number of gaseous molecules diminishes. This idea may sufficiently explain the recrudescence on heating the walls of the tube, but it does not explain the emission of rays, and hardly seems sufficient for the continuing gradual increase of vacuum. These might be accounted for on the hypothesis of a resolution of atoms into electrons or emanations, under the discharge in a Crookes tube, and radiation of these, to which the glass walls might be pervious. It is possible, for these reasons, that there may be present some of those ethereal forms of matter postulated to account for the curious changes attending the transformation of radium to helium. From present indications, it is not improbable that under these limiting conditions the electric discharge can only take place by a disruption of atoms. There is the intermediate possibility of the mere disruption of molecules into nascent atoms, but this would not continually intensify the vacuum, though it might be an intermediate stage.—*Abstracted from the American Journal of Science (New Haven), October.*

Digitized by Google

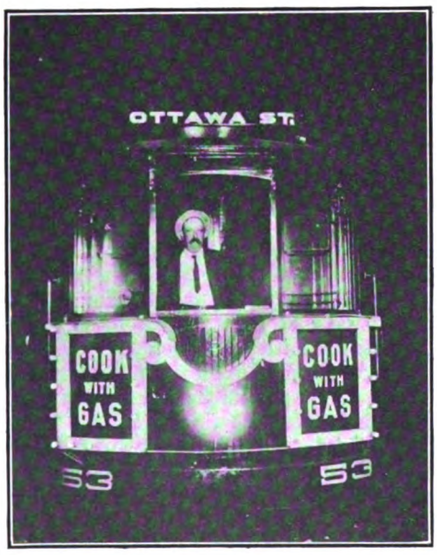
Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

The accompanying illustrations will convey two distinct impressions. One is that which appreciates the spectacular and out-of-the-ordinary in advertising, and the other that which appreciates the attempt to create desire and educate by means of an orderly and artistic presentation of facts and figures. Each of these ideas is effective—very effective.

The Muskegon Traction and Light Company, Muskegon, Mich., which owns the gas company in Muskegon is the user of electric cars, electric signs and electricity to sell gas. This form of publicity, it is understood, has been very successful—so successful, in fact, that the company is considering increasing the number of cars thus illuminated. All of which shows



A Novel Gas Advertisement.

the rapidity with which these advertising bugs are boring into our sensibilities. First, there was danger of arrest for sticking a paster or hanging a circular inside of a car; then some enterprising soul suggested a few dignified cards announcing special products; then whole systems were turned over to syndicates controlling every bit of available space in the car so that if the traction company has an announcement it must cut out the light from one of the windows; and now the outside of the cars are attractively calling attention to the other commodity the company has to sell. This is certainly a period of utilitarianism, and under the guidance of the admasters the public service companies are carrying two persons where one walked before; burning two lamps where hitherto a single candle flickered and providing a gas spigot where not so long ago the wood box and scuttle were in the way of a man's feet and peace of mind.

The folder illustrated herewith is from the Philadelphia Electric Company. Notwithstanding some natural prejudice against blanket advertising, no one can say that this is not attractive and convincing. The color design is simple black and red, and the stock is a soft gray. The folder combines an argument; facts and figures in connection with recent installations, and a return postal suggesting an enquiry.

TRACING RESULTS

TRACING the results of using Electric Power with current from The Philadelphia Electric Co., is as sure and satisfactory as tracking the footprints of an animal in soft earth. Tracing results is a pleasant occupation if it shows dollars saved or dollars earned. Do you know how much your power is costing you? Not ABOUT how much but EXACTLY! Will you let us show you? It won't cost you a cent to find out, and even if you don't decide to use our Power, you will have learned whether your present supply is economical or the reverse. During the past three months we have introduced Philadelphia Electric Service and shut down many of the largest private plants in the City. Examine the List printed below, and then send for particulars.

THE PHILADELPHIA ELECTRIC COMPANY

TENTH AND SANSOM STREETS — BOTH 'PHONES

The following are a few of those who have lately contracted for Philadelphia Electric Service:

NAME	LAMPS	H.P.
The North American Co.	4000	500
The Jefferson Hospital,	3000	375
Standard Roller Bearing Co.		200
Record Publishing Co.	2000	450
Armour & Co.	1000	200
R. H. Foerderer & Co.		200

Dear Sirs:

Providing that there is neither expense to us, nor obligation in the matter, kindly make comparison of the cost of our present power supply with Philadelphia Electric Service. What method did you pursue in shutting down the plants mentioned?

Yours truly,

Name

Address

A Folder from the Philadelphia Electric Company, Opened.

A Folder from the Philadelphia Electric Company, Closed.

Digitized by Google

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A Metallic Support for Cross-Arms.

A device of special interest to constructors of power transmission lines, interurban railways and even electric light systems is shown in the accompanying illustrations. The device is a steel gain, which is clearly shown in Fig. 1. In this illustration it will be seen that the cross-arm is attached to the pole by means of a metal fixture composed of two plates engaging each other and at the same time engaging the cross-arm and the pole. The curved steel plate embraces the pole, while the gain plate, which is provided with projecting braces or tongues, supports the cross-arm. The tongues of the gain plate pass through apertures in the pole plate and fasten into the pole. Shoulders on these braces clamp against the pole plate and afford a most rigid support for the gain. The pole plate normally has a greater radius than the largest pole top, and when drawn into place not only conforms closely to the circumference of the pole, but, by pulling the gain toward it as it is clamped into place, provides sufficient spring tension to compensate any shrinkage in the pole or cross-arm.

Again referring to Fig. 1, it will be seen that the device is attached by one through bolt, which passes through the cross-arm, the gain plate, the pole plate and the pole, and is held by the usual square washer and nut. The pole plate is afforded an additional support by the two lag screws, one placed above and the other beneath the gain.

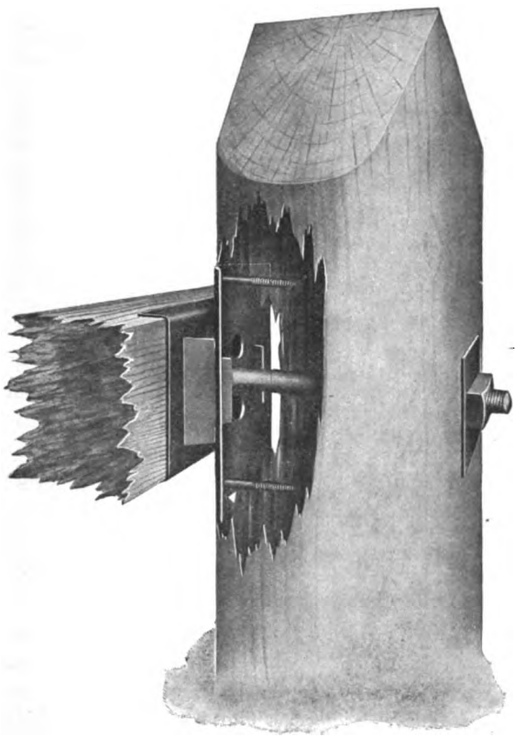


FIG. 1.—STEEL GAIN IN POSITION.

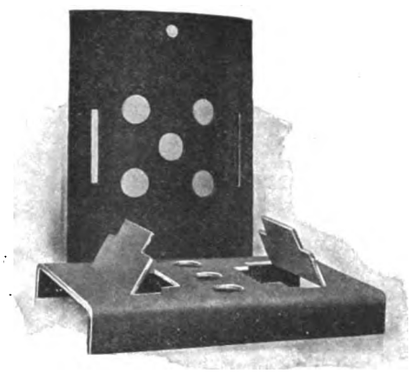


FIG. 2.—PARTS OF STEEL GAIN.

The advantages claimed from the use of the steel gain are numerous. The device, when properly fastened in place, supports a five or six-foot cross-arm so rigidly that cross-arm braces are unnecessary. This is a decided advantage, as the cost of cross-arm braces and the cost of cutting a gain are saved. A further saving is effected in mounting the arm with this steel gain, as the relation of the gain to the pole plate is such that the arm is brought into perfect alignment without the usual sighting and without the use of a square. Still another advantage is derived from the fact that this steel gain, when in place, adds to the strength of the pole instead of reducing the strength at a point where it is most needed.

While the advantages of construction are of great importance, undoubtedly the most valuable feature of the device is noticeable after the power transmission line, or whatever other line the device is used on, has been put into operation. The use of a single metallic cross-arm brace or a pair of metallic braces causes a noticeable loss of current by leakage. This leakage is greatly increased during damp, rainy or snowy weather. The steel gain, by eliminating the cross-arm braces, reduces this troublesome feature in power transmission work and makes it possible to use a shorter arm.

Although the steel gain is new so far as heavy work is concerned, a smaller and lighter gain has been used in telephone and electric light work for a little more than two years. In the lighter branches of construction it affords the same advantages, and it has proven itself an economical and satisfactory support for cross-arms. Various sizes are made to accommodate telephone and electric light arms, as well as the heavier arms for power transmission lines. The pole plates of the lighter gains are not extended as are those shown in the illustration, but they are sufficiently long to afford a rigid support.

When shipped from the manufacturer the two plates are assembled, the tongues of the gain plate engaging the pole plate so that the device may be considered as a single unit. Both the pole plate and the gain plate are made of No. 12 Bessemer steel, and the weight of the large gain for five-inch arms is approximately three and one-half pounds. The gains are furnished plain or galvanized, as ordered.

Digitized by Google

The Marshall Electric Manufacturing Company's Standard Dial Switch.

The Marshall Electric Manufacturing Company, Boston, Mass., has recently designed, and is now putting on the market a new form of indicating surface snap switch for 250 volts. The dials on these switches are securely locked in position by a plug or projection rigidly fastened to the switch spindle spring plate, which projects through a corresponding hole in the dial, so that there is no possibility

STANDARD DIAL SWITCH.

of the dial being misplaced and giving the wrong indication.

These switches are also equipped with eccentric binding posts, giving an unusual thickness of metal through which the binding screws are threaded. The cover is lined with hard paper drawn in a smooth, continuous cup without seams or corrugations.

These switches are carried in stock at the New York office, 227 Fulton street; at the Chicago office, 169 Adams street, as well as at the Boston works.

A Fifty-Ampere Dry Cell.

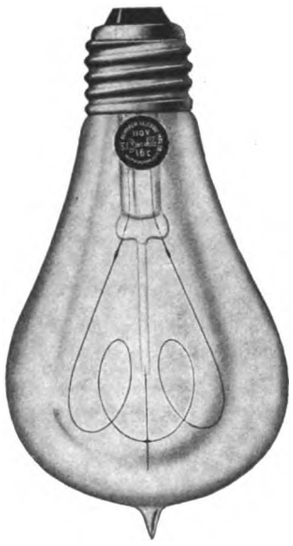
The French Battery Company, Madison, Wis., is placing on the market a new dry cell designated as the "Auto Special," which has an initial output of fifty amperes. Besides this large output the tests made are said to have proved that the recuperative power is in every way equal to the high discharge. This is a cell of standard size, two and one-half by six inches.

While introducing this battery, the company realizes that there is only a special class of consumer desirous of buying a battery with this high amperage. The company is, therefore, making four different types of battery. These types are manufactured on different principles, and show, therefore, different results in discharge. The company makes the "Bell" type, giving from twelve to fifteen amperes; the "Telephone" type, giving from twenty-two to twenty-five amperes; the "Ignition" type, giving from thirty-two to thirty-five amperes, and the "Auto Special," giving from forty-five to fifty amperes.

The company is now located in its new factory building, which has been erected to give facilities for supplying the increasing demand for these batteries.

The Franklin Electric Manufacturing Company's Street Railway Incandescent Lamp.

The accompanying illustration shows the incandescent lamp developed for street railway use by the Franklin Electric Manufacturing Company, of Hartford, Ct. This lamp will be demonstrated in building 4, section B, booth 30, of the manufacturers' exhibition at Columbus, Ohio, in conjunction with the meeting of the American Street and Interurban Railway Association, to be held next week. A feature of the demonstration is a vibrating machine designed to reproduce the



ANCHORED FILAMENT STREET RAILWAY LAMP.

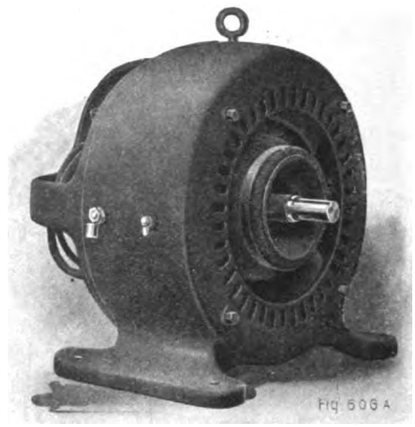
conditions under which the incandescent lamps operate in street railway service. This exhibit is intended to show the effectiveness of the Franklin company's lamps in this field.

In this lamp the filament is anchored at its lowest point and is supported directly from the stem. This is accomplished by means of a small glass column extending from the stem past the upper portions of the filament coil. The filament is securely fastened to an anchored wire welded into the glass column, and the greatest possible rigidity of filament support is thus obtained.

Through this method of construction the lamp sustains vibration equally well at all parts of the filament. Any possibility of the filament drooping or touching the bulb is removed. The lamp is made of specially selected materials throughout, and is constructed particularly to resist hard usage.

Small Generators Arranged for Direct Connection.

To meet the demand for a small direct-connected steam or gas-engine-driven generator for isolated plants or private residences, the Crocker-Wheeler Company,



C.-W. FORM I MACHINE ARRANGED FOR DIRECT CONNECTION.

Ampere, N. J., has developed a type of machine especially arranged for this purpose, consisting of a magnet frame and armature with shaft. The commutator end of the shaft is carried in a bearing supported by a rigid bracket which is bolted to the side of the frame, and the inner end of the shaft is finished to receive the engine coupling. The general appearance of this machine is well shown in the accompanying illustration.

The magnet frame of this machine is of cast iron, circular in form and of compact and pleasing design. The machines are of the multipolar type, and the frames are cast with feet for attaching to the engine subbase. The poles are round and of cast steel, welded into the magnet frame, provided with removable shoes which hold the field coils in place.

The brushes are held in a brush box pressed against the commutator by an adjustable spring. The studs carrying the brush-holders are firmly attached to the rocker arm and thoroughly insulated. All brushes may be shifted simultaneously by rotating the rocker on its seat.

The field coils are wound on forms and thoroughly insulated, the outer surface being protected from mechanical injury by a covering of stout insulation coated with moisture-proof varnish.

The armatures are of the iron-clad type with formed coils laid in open-top slots. The slot insulation is composed of pressboard, oiled muslin and mica cloth.

The machines will run continuously under full load with a rise in temperature above the surrounding atmosphere not ex-

Digitized by Google

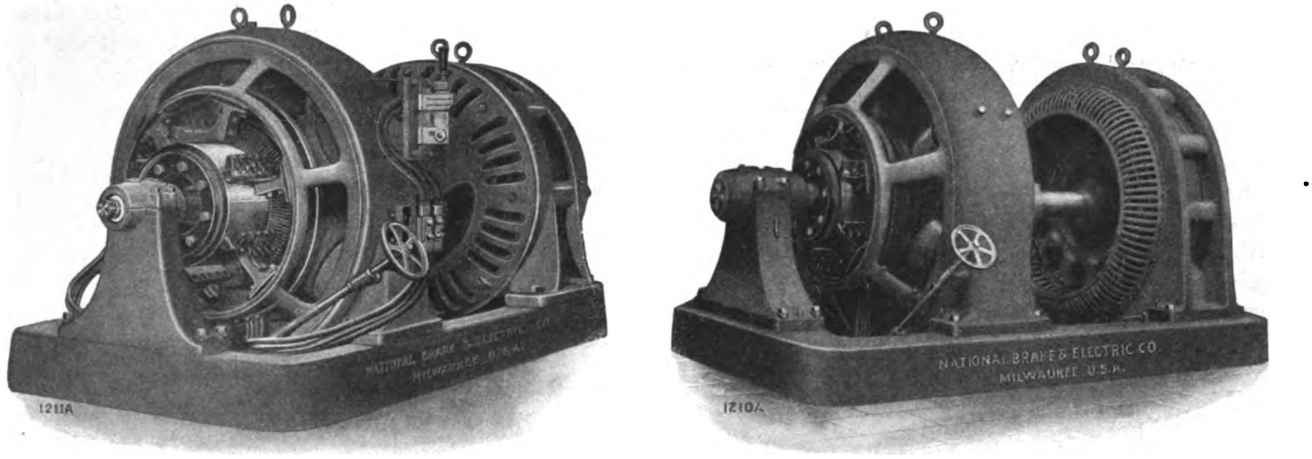
ceeding forty-five degrees centigrade in any part. They will carry twenty-five per cent overload for one hour, and with the brushes set in proper position will work under any variation of load between no load and full load without sparking, and will stand fifty per cent momentary overload without injury.

National Motor-Generators in the Substations of the Columbus, Ohio, Railway and Light Company.

The power plants and systems of the Columbus, Ohio, Railway and Light Company are among the most modernly equipped stations in the Central West, embodying as they do the newest and latest practice in equipment and operation. The company was incorporated in Ohio in 1903 and acquired by lease the Columbus Railway Company and the Columbus Edison Company. On July 1, 1906, the company also acquired operating control of the Central Market Street Railway, which was one of the Appleyard properties, but was obtained by the Ohio syndicate at a receiver's sale. The Central Market Street Railway owns sixteen miles of track and leases fifteen miles. The Columbus Railway and Light Company owns 107 miles of track, making a total of 138 miles in the combined system.

The system consists mainly of broad-gauge lines on which 331 cars are operated. On the standard-gauge lines, about sixty cars additional are operated, making a total of nearly 400 cars in use. The majority of these cars are equipped with General Electric No. 67 motors, with a scattering of General Electric No. 52 and No. 800 and Westinghouse No. 12 and No. 49.

Current for operating the railway and lighting system is generated in four stations with an aggregate output of 10,000 kilowatts. The smallest of these is the Milo station, just outside of the city limits, which had a capacity of 800 kilowatts. The Milo station has within the past month been converted into a substation, and a National 500-kilowatt motor-generator set installed to supply current to the system in this district. This set is of the three-bearing type and consists of a 750-horse-power, three-phase, sixty-cycle, 600-revolutions-per-minute synchronous motor, receiving current at 4,100 volts and driving a 500-kilowatt direct-current generator which generates current at 575 volts and 870 amperes. The construction of these machines provides for a liberal rating and low temperature rises and at the same time gives a compact set of very rugged appearance and graceful lines.



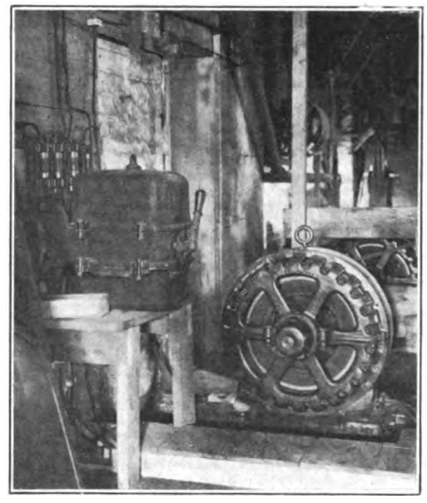
NATIONAL MOTOR-GENERATORS IN THE SUBSTATIONS OF THE COLUMBUS RAILWAY AND LIGHT COMPANY.

The Columbus Railway and Light Company has also recently installed a National induction motor-generator set in a new substation at the corner of High and Town streets. This set is used for bridging in on the underground Edison lighting circuit. This set comprises a 375-horse-power motor wound for three-phase, sixty-cycle, 4,100-volt current and driving a 250-kilowatt, 250-volt, direct-current generator at a speed of 720 revolutions per minute. The present connected lighting load of the company is about 150,000 sixteen-candle-power lamps. In the business section of the city the lighting system is underground.

Electric Power in the Plant of the Springfield Metallic Casket Company, of Springfield, Ohio.

Electricity as a motive power for the operation of industrial plants has, by its obvious advantages, come into general use in all branches of manufacturing. The simplicity of electric motors, the ease with which they can be applied to almost any class of work and the flexibility attending their use has created a large field for electric drive which is rapidly superseding the methods formerly used. An illustration of this fact is found in the plant of the Springfield Metallic Casket Company, of Springfield, Ohio, where the rapidly increasing business created power demands that were considerably in excess of the steam engine equipment, and electric motors were installed in preference to additional steam capacity. This company manufactures high-grade metallic caskets with self-locking covers that can not be removed when once placed in position.

The electrical equipment consists of two Westinghouse type CCL motors of fifty-horse-power capacity each, which are belted to line shafting that in turn drives various machines. This is only one of the many instances where progressive companies have shown appreciation of the superiority of electric drive that led to its adoption.

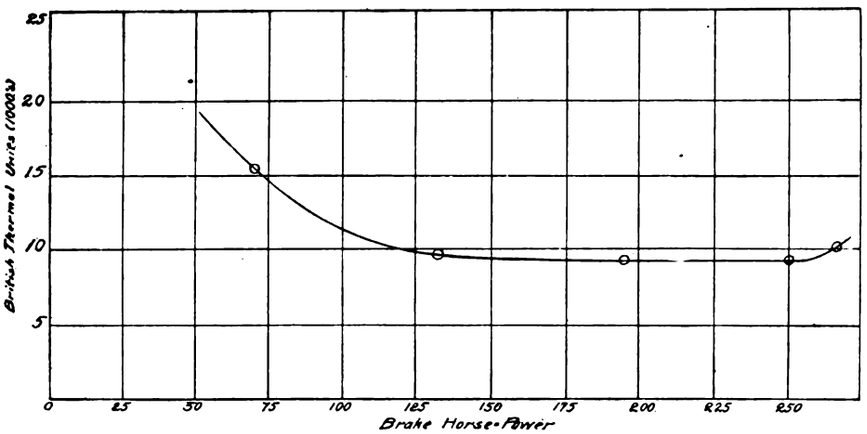


TWO FIFTY-HORSE-POWER WESTINGHOUSE, TYPE CCL MOTORS, IN PLANT OF THE SPRINGFIELD METALLIC CASKET COMPANY, SPRINGFIELD, OHIO.

Digitized by Google

Diesel Oil Engine Test.

The accompanying table and diagram are taken from a report on a 225-brake-horse-power Diesel oil engine installed at the plant of the Kimberly & Clark Paper Company, Kimberly, Wis., recently tested by the Sargent Engineering Company, Chicago, Ill. The plant consists of four Diesel engine units, one a 450-brake-horse-power engine (formed by coupling the shafts of two 225-brake-horse-power engines), coupled to a 300-kilowatt, alternating-current generator, two units of 225 horse-power, each connected to a 150-kilowatt, alternating-current generator, and one unit of 120 brake-horse-power to drive the high-pressure compressors used for starting and injecting fuel oil. All engines run in parallel with each other and with water-wheels. The plant was installed as an auxiliary to the water power, and is used when there is not sufficient water to operate the mills.



HEAT CONSUMPTION CURVE.

An examination of the diagram and table herewith will show some interesting features. The diagram particularly shows the low heat consumption per brake-horse-power-hour, and also the manner in which the fuel consumption follows the load from quarter to half, and from half to full load. In the diagram the abscissæ represent the brake-horse-power developed, the ordinates representing the British thermal units in thousands per horse-power-hour.

Referring to the table, the final data show that the fuel cost of this plant with crude oil at 3.64 cents per gallon is twenty-three cents per 100 brake-horse-power-hours at full load, and thirty-four cents per 100 kilowatt-hours. This engine is sold under a guarantee to deliver 100 brake-horse-power-hours on eight gallons of crude or fuel oil, and 100 kilowatt-hours on twelve and one-quarter gallons.

	Quarter Load	Half Load	Three-Quarters Load	Full Load	Over-Load
Date of run	1-5-'06	1-5-'06	1-5-'06	1-13-'06	1-13-'06
Length of run in hours	1.0	2.0	2.0	4.0	0.75
Revolutions per minute	179.1	177.1	174.5	169.1	161.2
Brake horse-power	68.15	133.7	194.9	249.7	263.8
Electrical horse-power	54.5	113.6	170.6	224.8	237.5
Kilowatts	40.7	84.8	127.3	167.7	177.2
Pounds of fuel oil used in main engine per hour	42.75	57.1	82.5	106.37	126.66
Pounds of fuel oil used in compressor unit per hour	40.5	35.6	35.87	38.93	38.33
One-quarter oil used in compressor unit per hour	10.12	8.9	8.97	9.73	9.58
Total pounds of fuel oil used per hour.	52.87	66.0	91.47	11.61	136.24
Pounds of fuel oil used per brake horse-power	0.776	0.493	0.469	0.464	0.516
Pounds of fuel oil used per electrical horse-power	0.97	0.580	0.53	0.516	0.573
Pounds of fuel oil used per kilowatt-hour	1.29	0.778	0.718	0.69	0.77
Pounds of jacket water per hour	2,033.5	2,528.3	3,324.0	3,894.5	5,306.0
Pounds of jacket water per brake-horse-power-hour	29.5	18.9	17.1	15.6	20.1
Average temperature inlet water	34.0	34.0	34.0	38.8	40.0
Average temperature outlet water	126.6	135.5	137.9	180.0	170.0
British thermal units per brake-horse-power-hour	15,103.0	9,594.0	9,127.0	9,029.0	10,041.0
British thermal units per electrical-horse-power-hour	18,877.0	11,287.0	10,314.0	10,041.0	11,151.0
Thermal efficiency of engine and dynamo, 2,545 British thermal units per electrical horse-power	13.4	22.5	24.6	25.3	22.8
Thermal efficiency of engine, 2,545 British thermal units per brake horse-power	16.8	26.4	27.8	28.1	25.3
Percentage British thermal units in water jacket	18.2	20.0	19.5	24.3	26.0
Percentage British thermal units in exhaust radiation and engine friction	65.0	53.4	52.7	47.6	48.7
Percentage British thermal units in brake horse-power	16.8	26.4	27.8	28.1	25.3
Pounds of oil per 100 brake-horse-power-hours	77.6	49.3	46.9	46.4	51.6
Gallons oil per 100 brake-horse-power-hours	10.5	6.7	6.4	6.3	7.0
Gallons oil per 100 kilowatt-hours	17.6	10.6	9.8	9.4	10.5
Fuel cost of 100 brake-horse-power-hours in cents with oil at 3.64 cents per gallon	38.6	24.5	23.3	23.0	25.6
Fuel cost of 100 kilowatt-hours	63.0	38.5	35.6	34.2	38.2

The New Plant of the H. T. Palste Company

The H. T. Paiste Company, Philadelphia, Pa., has recently moved into a new factory building containing five stories and basement, 50 by 120 feet, with 30,000 square feet of floor space. H. T. Paiste established his present business in 1887, manufacturing at that time the Paiste switch, which was one of the pioneer snap switches made in this country. Other articles were added to the line, until at the present time the company is manufacturing 400 distinct articles entirely in the line of electric lighting supplies. The company was incorporated in 1894.

In the new building the power plant consists of a ninety-horse-power Coatesville boiler and a sixty-horse-power Ball engine direct-connected to a thirty-five-kilowatt Westinghouse direct-current generator. The electric plant was installed by the D'Olier Engineering Company, of Philadelphia. The different groups of machinery are driven by motors located on the several floors.

The factory has been laid out so as to be as convenient and up to date as possible. Special attention has been given to attractive features, and every effort has been made to create a factory which would attract the highest grade of employés.

A number of the patented Paiste products have become very well known, such as "Holoshade" sockets, panelettes, taplets, Fielding receptacles, "Pushin" attachment plugs, and the standard line of sockets, rosettes, receptacles and cutouts.

The officers of the company are: H. T. Paiste, president and treasurer; Charles I. Hills, vice-president; E. A. Jenkins, secretary.

The company has sales offices and warerooms located in New York, in charge of C. I. Hills; in Boston, in charge of Frank Booth, and in Chicago, in charge of James Wolff.

Digitized by Google

Portable Car Telephones.

The accompanying illustrations show some of the apparatus included in a line of portable car telephones which has been developed by the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Realizing the possibilities of rough usage to which apparatus for this service may be subjected, the company has taken especial care to make all parts heavy and durable, and for that part of the equipment which may be placed out-of-doors and subjected to ex-

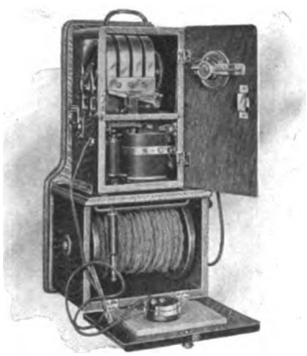


FIG. 1.—RAILWAY TELEPHONE.

posure, special attention has been given to protection both from the elements and the possibility of mechanical injury.

Fig. 1 shows an instrument as it would be hung in the motorman's

FIG. 2.—PORTABLE TEST SET.

cab of an interurban car. The upper portion or portable part of the instrument is shown removed. This portable portion contains all of the apparatus necessary for telephone communication, the lower part of the telephone set containing a cabinet in which are mounted upon a reel a flexible cord and plug. When the upper or telephone box is in place it is connected to the cord in the reel in the bottom box through contact plates on top of the reel box, which make contact with buttons in the bottom of the telephone box. The object of the reel of cord is to enable connection to be made with plug receptacles on the pole near the car. The

FIG. 3.—IRON-CLAD JACK-BOX.

cord terminates in a plug similar to the plugs used in telephone exchange switchboard work, this plug, however, being made much larger and heavier. There is a guide for the cord as it is wound on the reel and a crank on the outside of the reel box for winding up the cord.

The receiver is of the watch-case type, and when not in use fits in a receptacle which operates like the usual receiver hook switch to cut out the transmitter when the instrument is not in use. The portable part of the instrument, or telephone box, has a plug and short cord attached to it for use when the telephone is used on the line away from the car.

Fig. 2 shows a portable test set which forms an important part of this equipment, and Fig. 3 an iron-clad jack-box

FIG. 4.—METHOD OF CONNECTING TO AERIAL.

for use in exposed positions. Fig. 4 shows how connections may be made with the telephone wire alongside the track where no jack-box is handy.

Linemen's Portable Telephone-Testing Sets.

The Holtzer-Cabot Electric Company, of Brookline, Mass., and Chicago, Ill., has recently developed and placed upon the market two types of portable testing sets for linemen's use. These are known as the "Universal" and "watch-case receiver" types, description of which is given in the following:

The "Universal" type of testing set was designed to meet the practical requirements of telephone linemen and contains many novel features which should commend themselves to users of this class of apparatus. It embodies everything required in all classes of telephone line testing, thereby doing away with the necessity of having separate sets for series and bridging work. The case is substantially

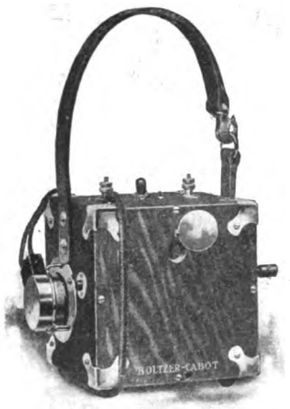
"UNIVERSAL" LINEMEN'S PORTABLE TELEPHONE TEST SET.

made, protected by metallic corner shields, and is provided with a carrying strap which has a snap-catch so that the box may be quickly suspended from the cross-arm or any projection by the use of one hand. The door is held closed by an automatic catch, which is released by a flush pushbutton, preventing the case being accidentally opened. This set is provided with a hand microtelephone, which combines the Holtzer-Cabot bipolar watch-case receiver and standard granular carbon transmitter. This instrument enables the lineman to talk in any position that he may be, as it may be taken from the box and the door closed. This feature has an advantage over the testing sets in which the transmitters are mounted on the cover. The mouthpiece is metallic so that it will withstand hard usage, and in the handle there is a pushbutton which throws

Digitized by Google

the batteries out of circuit when not in use, thus prolonging their life. Three or four-bar generators of the magneto type are furnished as desired. They give alternating current for signaling subscribers, or pulsating direct current for ringing the switchboard; this is controlled by a two-point switch inside the cover. There is also a pushbutton to shunt out the ringer on heavily loaded lines. Each set is equipped with a standard 1,000-ohm ringers, which may be shunted out of circuit when desired by means of the pushbutton. The induction coil is of the standard square-head type, with a resistance of 100 ohms. Two dry batteries are used. The binding posts are conveniently located on the top of the case and may be manipulated by one hand without a screwdriver or tool of any kind.

For certain classes of testing, sets of the receiver type have become popular with linemen, and on account of several practical features which are embodied in the latest model placed on the market by the Holtzer-Cabot Company, an increase in the demand for this article is expected.



RECEIVER TYPE TELEPHONE TESTING SET.

The essential features of this set correspond closely to the "Universal" type. The case has protected corners and a carrying strap furnished with a clasp so that the box may be quickly suspended. The receiver is of the watch-case, bipolar pattern and is used for both talking and listening. A valuable and essential improvement is the addition of a pushbutton in the receiver. This button normally keeps the receiver circuit open, but upon pressing it the circuit is closed. Thus while communication is established the button is held closed by the thumb of the operator, but as soon as the conversation is through the receiver may be laid down and the circuit is automatically opened.

The receiver is wound to 150 ohms and is enclosed in a metal case, making it a substantial instrument for outdoor use. The generator is equipped with combination spring and two-point controlling switch, enabling it to give alternating or pulsating direct current for signaling the subscribers or the central switchboard. The resistance of the ringer is 1,000 ohms, and it may be shunted, if desired, when used on a heavily loaded line. This set has been carefully designed and meets the various requirements of line testing where the more elaborate set is not necessary. It is equally serviceable on both series and bridging circuits.

A New Lamp Guard.

The accompanying illustrations show a new lamp guard recently placed upon the market by Harvey Hubbell, Incorporated, Bridgeport, Ct. The principal features

FIG. 1.—WIRE LAMP GUARD AND COLLAR.

of this guard are simplicity and strength, the rigid way in which it is fastened to the socket shell, and the ample space between the outside of the guard and the lamp.

Fig. 1 shows a contractile collar and an internal thread in the top of the guard. When attached to the socket the collar is placed over the rib of the socket shell,

FIG. 2.—GUARD ATTACHED TO LAMP.

then the guard is screwed on. This causes the collar to contract and hug the rib on the shell, making an absolute lock, and holding the guard securely against the socket shell.

Fig. 2 shows the guard attached to the socket. The connection is made close to the neck of the lamp, giving rigidity where it is needed. There is plenty of space between the lamp and the guard, and the opening at the bottom is sufficiently large to insert the lamp. The rigid support given to the guard prevents the

FIG. 3.—GUARD FITTED WITH SHADE.

lamp bulb from coming in contact with the guard.

Fig. 3 shows the guard fitted with a Hubbell shade.

The wire from which these guards are made is selected from heavy stock, and, owing to the unique method of fastening, very little metal is required; consequently there is comparatively little obstruction to the light. These guards are made for both sixteen and thirty-two-candle-power lamps.

Cook's Automatic Electrical Testing and Resetting Plug.

Frank B. Cook, Chicago, Ill., has placed on the market a new device designated as an automatic electrical testing and resetting plug for application to Cook's No. 8 protector. This device is designed to obviate the possibility of resetting self-soldering heat coils when they are not in condition to give protection to the system.

Occasionally, large currents passing through the heat coils overheat and short-circuit them by charring the insulation on the winding, by fusing together, or bringing into contact with each other certain parts of the heat coil. A short-circuited coil may be replaced in the circuit which it is to protect, but it will not heat enough to operate the apparatus. In the ordinary testing of a telephone line there is nothing to indicate that the heat coil is short-circuited, as the circuits is completed and the line seems to test O. K. In order to give greater protection to the system and to determine whether a heat coil is short-circuited or not, this testing and resetting plug has been designed.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

GREAT WESTERN POWER COMPANY—The Great Western Power Company, of Point Richmond, Cal., composed of a coterie of wealthy men of Contra Costa and Alameda counties, have filed articles of incorporation with a capital stock of $25,000,000, divided into 250,000 shares. W. S. Rheem, one of the directors of the East Shore & Suburban Railroad Company, of Point Richmond, is a leading factor in the enterprise, while associated with him are: Guy C. Earl, of Oakland; W. H. Spaulding, of Oakland; H. G. Young, E. A. Gowe, W. Stairley and L. D. Dimm, of Richmond; F. D. Madison, of San Rafael, and B. C. Carroll, of Oakland.

GRAND RIVER, COLORADO, TO SUPPLY DENVER WITH POWER—A despatch from Springfield, Ohio, states that ex-Governor Herrick is at the head of a $10,000,000 company organized to develop Grand river power in Colorado for the cities of Denver, Leadville, Colorado Springs and Cripple Creek. Particulars of the project are lacking, but it is understood that there will be electric plants built along the Grand, and the power transmitted to the above-named cities at a cheaper rate than they are now getting for light and other purposes. Smaller towns alcng the way are to be supplied as soon as the company can make sufficient provision for creating the necessary power.

NEW OHIO RAILWAY PROJECT—John G. Webb, George Holzberg, H. H. Harris, James S. Webb and George Whysall, all prominent traction men, have incorporated the Marion & Western Railway, Light and Power Company, of Columbus, with an authorized capital stock of $2,000,000. The new company is controlled by the same interests which own the Columbus, Delaware & Marion, and will construct a line from Prospect, on the Columbus, Delaware & Marion, to Richwood, Union county. The distance is but a little more than seven miles, and the road will tap one of the best sections of the state. Richwood has but one railroad, the Erie, and has long been trying to get a traction communication.

EXTENSIVE TELEPHONIC IMPROVEMENTS FOR LOS ANGELES—Plans that call for the expenditure of $1,000,000, and the installation of a complete automatic telephone service throughout the city have been adopted by the stockholders of the Home Telephone Company, of Los Angeles, Cal. President J. M. C. Marble, who has been one of the guiding spirits in the formation of the company, has resigned, owing to press of business, and A. B. Cass, vice-president, elected president. Mr. Marble remains on the directorate of the company. W. C. Patterson, a director, is elected vice-president, succeeding Mr. Cass. The company will build two new stations, one at Olive street, below Seventh, and one on Adams street. These will have an aggregate capacity of 35,000 telephones, and will be sufficient to accommodate the needs of the company for several years. Both of these stations are to be in operation by the first of the year. Arrangements are to be made during the coming year by the Home company for connections with the United States Long-Distance Telephone Company, of San Francisco and Oakland, which will give service from all of the Home lines in this vicinity to the northern cities. The statements made at the meeting of the stockholders showed that the concern has expended for equipment a total of $4,465,000.

NORTH GEORGIA ELECTRIC COMPANY FILES LARGE MORTGAGES—The North Georgia Electric Company, of Gainesville, has filed with the clerk of the Superior Court a first and refund mortgage to the Knickerbocker Trust Company for $7,500,000. The bond issue was authorized at a meeting of the stockholders which was held in Atlanta on August 25. It was voted by 7,951 of the 8,637 shares. The bonds are to mature at the end of fifty years, and are to bear interest at the rate of five per cent a year, payable semi-annually, and are to be secured by the mortgage on the company's property which has just been filed. The object of the bonds is to equip the company's general business; to put it in a position to contract for and build and equip electric railways and electric plants; to sell power and light to private and municipal corporations and to the general public and to establish waterworks. The company has water power in the Chestatee river and the Chattahoochee in Heard county, and the Etowah near Cartersville, and also in Cherokee county. It is proposed to have a plant in or near Atlanta, where power may be distributed to Fulton and De Kalb counties. Of the bonds, 2,500 are to be $1,000 denomination each; 5,000 of $500 each, and 25,000 of $100 each. The mortgage is signed by A. J. Warner, of Gainesville, president of the North Georgia Electric Company, and B. L. Allen, third vice-president of the Knickerbocker Trust Company.

MERGER OF OHIO TRACTIONS—The Canton-Akron Railway Company, the Canton-New Philadelphia Traction Company and the Tuscarawas Traction Company, all controlled by the Tucker-Anthony syndicate, of Boston, Mass., passed out of existence on September 29 when the formal transfer of the properties was made to the Northern Ohio Traction and Light Company. General Manager Currie, of the Northern Ohio, will be general manager of the entire system. Preliminary to the merger the Northern Ohio company, at a recent meeting, increased its capital stock from $7,500,000 to $10,000,000, that being one of the first movements required. Of this new stock, $1,038,000 will be issued to take over the common stock of the Canton-Akron. The other details are being worked out according to the original plan, the Canton-Akron Consolidated Railway increasing its capital to $2,500,000 and the same amount of bonds being put out. This stock and the bonds will be used for the purpose of taking over the stocks of the absorbed companies and for retiring the underlying bond issues when due. The Northern Ohio assumes the interest on the bonds. As soon as possession has been obtained, through service over the entire system will be started and travel by through cars will be possible from Cleveland to New Philadelphia. The Northern Ohio upon the merger controls the principal line in Summit, Cuyahoga, Wayne, Tuscarawas, Stark and Medina counties. It also operates lines in all the principal cities and villages in these six counties, with Akron as a centre of operation.

ELECTRIC LIGHTING.

HOVILLA, GA.—F. E. Bailey is installing an electric light plant.

MILWAUKEE, WIS.—The common council has voted $50,000 from the $150,000 light bonds to purchase an electric light plant site.

READING, PA.—The Mahanoy city council has awarded the contract for street lighting for ten years to the People's Light, Heat and Power Company at $60 per arc lamp.

WILMINGTON, DEL.—It has been reported that work will be started in a short time on the proposed plant of the Commercial Light, Heat and Power Company, and that a large force of men will be put to work.

ATLANTA, GA.—Capitalists from this city have made a proposition to the authorities at Americus, Ga., looking to the establishment of power, gas and electric plants in that city, and also the building of a street railway.

SHERBROOKE, QUEBEC—At a meeting of the city council a resolution was passed instructing the city engineer to prepare plans and specifications for a dam and electric power plant on the Magog river, about six miles from Sherbrooke.

PHILADELPHIA, PA.—A large dam on Blue Mountain will be constructed, at a cost of $8,000, to furnish power to operate an electric light plant, which will supply power and light to Bethel, Millersburg, Strausstown and Rehrersburg.

TOPEKA, KAN.—The Topeka Electrical Company has begun the work of laying conduits in the down-town district of the city.

Digitized by Google

A site will be selected and the company's plant erected before December 1. The company hopes to begin operations on January 1.

ROCHESTER, N. Y.—Mayor Cutler has signed the new lighting contract with the Rochester Railway and Light Company, to take effect July 1, 1907. By its terms the Mayor has secured a reduction of $20 per lamp, amounting to a total saving to the city in five years of about $300,000.

ORANGE, N. J.—The Orange common council has practically decided to receive bids for a municipal lighting plant on October 25. A form of proposal was considered, calling for bids for three engines and electric generators, switchboard poles, wires and equipment for 350 arc lights.

LOCKPORT, N. Y.—The common council has approved the proposition of the Lockport Gas and Electric Light Company to furnish arc lights to the city for three years at $55 each per year, and gas to all consumers at $1 per 1,000 cubic feet. The present prices are $75 and $1.30, respectively.

WATERTOWN, N. Y.—The chamber of commerce has adopted a resolution favoring the consolidation of the Watertown Electric Light Company, the Watertown Gas Light Company, and the Remington Pulp and Paper Company, into the Watertown Light and Power Company, with a capitalization of $2,300,000.

FRANKFORT, N. Y.—At a special meeting of the town board of the town of Frankfort and commissioner of highways, a consent was granted the Hudson River Electric Power Company, allowing it to use the right of way owned by the Utica & Mohawk Valley railway through the town for its transmission line.

MANCHESTER, N. H.—The Berlin-Shelburne Power Company has been newly organized to take over the electric plant constructed this season at the Lead Mine bridge in Shelburne. The incorporators are: E. A. Noyes and Edmund Woodman, of Portland; Edmund Sullivan, O. B. Brown and J. P. Dubey, of Berlin.

GRAYVILLE, ILL.—The city of Grayville now owns the water and light plant, having purchased it from the Grayville Water Works Company. The purchase price was $10,000, of which amount $3,500 was paid in cash and bonds to the amount of $6,500 issued. The city will make improvements to the plant and give an all-night service.

BROWNSVILLE, TEX.—The city council has granted a franchise for the construction of a waterworks and electric light plant. The grantee is the Brownsville Water, Light and Power Company, composed of local capitalists, who have pledged themselves to take $25,000 stock in the concern. The plant will cost nearly $100,000. Work must begin in three months.

CINCINNATI, OHIO—Attorney Louis Dolle has received fifty additional deeds from owners of property adjoining the Little Miami river, consenting to the location of dams, to be used in connection with an electric plant which will furnish light, heat and power to the villages northeast of Cincinnati. Mr. Dolle also has the consent of owners to employ 148,000 feet of abutting land which will be used in connection with the improvement.

ELK RAPIDS, MICH.—The common council has granted an electric light franchise to William E. Donley of Big Rapids. The franchise is to run for a period of ten years and the plant will be operated on a moonlight schedule. There will also be a morning service from 5 to 7 A. M. from November 15 to February 15, a period of three months, each year. The village let a contract for twenty-five arc lights to cost $75 per year each. Additional arc lights will be furnished at a cost of $70 per year each.

HYATTSVILLE, MD.—A meeting of the mayor and town council was held on September 24, when the mayor on behalf of the council, signed a contract with the Potomac Electric Power Company, of Washington, to furnish electricity for ten years for lighting the streets of Hyattsville. It is expected that the plant will be installed before winter weather arrives. The company is to furnish not less than 100 incandescent lamps of thirty-candle-power each at $12 a year, and such number of arc lamps as may be ordered by the town at $65 each a year.

MARINETTE, WIS.—F. H. Joslin and other Oshkosh parties have closed a deal for the purchase of two water powers on the Peshtigo river at High Falls and Joslin Falls. The consideration was $50,000. The Oshkosh capitalists will develop both powers and transmit the power to Marinette and Green Bay. A power company will be organized, as the project will necessitate the expenditure of several hundred thousand dollars. This will be the only transmission power project in the vicinity. The distance to Marinette is thirty miles and to Green Bay fifty miles.

ST. LOUIS, MO.—It is announced that the King Electric Company which has a franchise in St. Louis county, has been purchased by A. C. Einstein and Paul D. Cable, owners of other lighting plants in the county. Mr. Einstein stated that the property had been bought by him for about $100,000. The King Company has a plant at DeHodiamont and has been for some time the only company operating in the county. The General Service and Development Company formerly owned a plant at Brentwood, which supplied light to Webster Groves. This was recently torn down. The same interests which bought the King Company property now own all the lighting franchises in the county.

GLENS FALLS, N. Y.—After dragging through the courts for several years, the suit of the National Contracting Company, of New York city, against the Hudson River Water Power Company, for damages growing out of the connection of the construction company with the building of the two-million-dollar dam across the Hudson river at Spier Falls, has finally been decided by former Judge Alton B. Parker, who holds that instead of the power company owing more than $600,000 to the construction company, the latter shall pay $383,000 damages to the power company for abandoning their contract and causing the power company almost half a million dollars extra expense. The decision is sweeping and carries with it costs.

COVINGTON, KY.—Owen Ford, of St. Louis, electrical engineer, has made an estimate of the cost of operating and maintaining an electric light plant, and says the city can save money by making its own light for street and public buildings. His estimate, which was received a short time ago, shows that the city can make electricity sufficient to supply about 400 arc lights of 2,000 candle-power each at $54.80 per light per year. This estimate is made on a plant built in accordance with the plans and specifications recently prepared for the city by Mr. Ford, which made provision for from 400 to 500 arc lights of 2,000 candle-power and 2,000 incandescent lights. The cost of this plant, according to his estimate, would be about $106,000. The city is now paying $65 a year for arc lights of about 1,250 candle-power. It is estimated that by building and operating its own plant, according to the figures of Mr. Ford, the city could save approximately $5,000 a year.

NEW MANUFACTURING COMPANIES.

CAMDEN, N. J.—The Fraley Developing Company has been incorporated to manufacture electrical and mechanical devices. The capital is $150,000, and the incorporators are: F. R. Hansell, William F. Eidell and I. C. Clow.

CHICAGO, ILL.—The Universal Lock Socket Company has been incorporated with a capital of $2,500, to manufacture and deal in electrical apparatus. The incorporators are Clayton R. Taylor, William M. Klein and O. P. Lightfoot.

PORTLAND, ME.—The Jackson Clock Telephone Company has been organized at Portland for the purpose of manufacturing and dealing in electrical apparatus. The company has a capital of $1,000,000, and the following are the officers: President, Hayes Lougee, Boston, Mass.; treasurer, John G. Robinson, Melrose, Mass.

HARTFORD, CT.—A certificate of incorporation has been filed by the Gillette-Wibber Company, of New London. The company will conduct a general electrical business. The amount of authorized capital stock is $20,000, divided into 200 shares of the par value of $100 each, and the company will start business with that amount paid in.

ALBANY, N. Y.—The Baldinger & Kupferman Manufacturing Company, of Brooklyn, has been incorporated with the secretary of state to deal in electric light fixtures, etc. The capital stock is placed at $50,000, and the directors for the first year are as follows: Louis Baldinger, Oscar Kupferman and Henry Bonawitz, of Brooklyn.

Digitized by Google

NEW INCORPORATIONS.

COLUMBUS, OHIO—Mansfield & Southern Traction Company. Increased from $1,000 to $250,000.

READING, PA.—West Reading Power Company. $25,000. Incorporators: Walter A. Rigg, Milton Miller and Harry H. Reigel.

CONCORD, N. H.—Derry & Goffs Falls Street Railway Company. $50,000. To build a line from the new Goffs Falls & Hudson road to Derry.

MADISON, WIS.—The Marathon City Telephone Company, Marathon City. $1,920. Incorporators: Nicholas Schmidt, J. G. Lang and H. B. Stemm.

ALBANY, N. Y.—New York Electric Installation Company, New York. $20,000. Directors: T. J. Hogan, Julia C. Hall, and James P. Law, New York.

SPRINGFIELD, ILL.—Harrisburg Independent Telephone Company, Harrisburg. $2,500. Incorporators: John T. Wheatley, W. D. McIlrath and P. H. Brown.

MADISON, WIS.—The Edgar Local Telephone Company, village of Edgar, Marathon county. $2,000. Incorporators: C. C. Barrett, A. W. Putchner and A. J. Cherney.

DENVER, COLO.—Walsenburg Light, Power and Ice Company. $40,000. Directors: William Dick, D. W. Mathews, Antonio Bertolaro, John J. Pritchard and Fred Roof.

SALEM, ORE.—Municipal Water and Light Company, of Roseburg. $5.000. Incorporators: E. V. Hoover, Joseph Nicelli, F. M. Beard, J. W. Wright and A. N. Orcutt.

NEW ORLEANS, LA.—St. Bernard Traction Company. $300,000. Directors: W. J. Kelly, M. Warrines, R. H. Warrines, Henry P. Dart, Oliver P. Livaudais and L. T. Bringier.

COLUMBUS, OHIO—The Haverhill Telephone Company, Scioto county. $2,500. Incorporators: O. E. Insh, A. S. Goodard, W. A. Brush, H. J. Massie and Henry Folsom.

SANTA FE, N. M.—Reliance Electric and Construction Company, Albuquerque. $20,000. Incorporators and directors: M. K. Wyler, H. Bartlett, R. Hicks and J. P. Steele, of Albuquerque.

PIERRE, S. D.—Beaver Bend Telephone Company, Valley Springs, Minnehaha county. $1,000. Incorporators: J. H. Johnson, Ferdinand Larson, H. C. McGilvery, August Anderson.

CHEYENNE, WYO.—Newcastle Electric Company. To operate at Newcastle, Wyo., and control the electric light plant at that place. $30,000. Incorporators: George E. Getchell, W. E. Mouck and J. L. Baird.

PIERRE, S. D.—Pleasant View Telephone Company. To erect a rural line in Lincoln township, Lincoln county. $1,200. Incorporators: Homre Denure, J. F. Hunt, Otto Johnson, of Lincoln township.

DENVER, COL.—The Windsor Light and Power Company, Windsor, $10,000. Incorporators: William J. Barber, William F. Crossler, Harrison Teller and Frank E. Bonifield.

LANCASTER, PA.—Columbia & Manor Street Railway Company. $102,000. Directors: William Morris, Columbia, president; Joseph K. Shultz, Henry Wertz, H. H. Herr, Frederick Shoff, H. M. Kauffman, D. H. Landis, Jacob M. Linderman, E. K. Hershey.

ALBANY, N. Y.—The Indian Fields Telephone Company, of Westerlo. Directors: P. R. Whitbeck, W. B. Lester, C. R. Whitbeck, A. C. Coons, G. E. Dickenson, A. D. Caldwell, Daniel Snyder, W. Udell, of Indian Fields, and R. J. Houck, of Keefer's Corners.

ALBANY, N. Y.—The Mountain Home Telephone Company, of Saranac Like. To operate in the counties of Franklin, Clinton, St. Lawrence, Jefferson, Lewis, Hamilton and Essex. $150,000. Directors: Howard Hendrickson, William A. Hendrickson, Henry M. Keys, Frank E. Griffin, William B. Harris, Henry J. Prince, Jr., Frank E. Derr, of Albany.

HARRISBURG, PA.—Midway & Burgettstown Street Railway Company. To build a line six and a half miles long in Washington county, between the boroughs of Midway and Burgettstown. $37,000. Charles V. Dahlinger, Pittsburg, president. Directors: Charles W. Dahlinger, Pittsburg; John W. Thomas, Sharpsburg; V. A. Powel and J. B. Flack, East Pittsburg, and L. W. Bigham, Pittsburg.

SALT LAKE CITY, UTAH—Light, Power and Water Company. Formed for the purpose of diverting certain of the waters of the Green river for power and irrigation purposes. $24,000. Principal place of business, Elgin, Grand county, Utah. Officers: L. P. Hill, president; W. G. English, vice-president; W. A. Morgan, secretary; C. E. Whisler, treasurer and general manager. Directors: J. F. Ewing, F. L. Cottrell, J. N. Powers and the officers.

TELEPHONE AND TELEGRAPH.

UTICA, N. Y.—The Bell Telephone Company has established an exchange at Barneveld.

ROCHESTER, N. Y.—The entire issue of $2,500,000 of two-year six per cent collateral notes of the United States Independent Telephone Company, has been subscribed for.

AMHERST, VA.—R. T. Seay, of this place has bought the Amherst Telephone Company, and has made a contract with the Bell Telephone Company, whereby he will be able to give long-distance connections.

KEYSER, W. VA.—A new telephone company will operate a line from Keyser to Petersburg, by way of Burlington, up Patterson's creek, with lines into Virginia. J. W. Carskadon is president and J. W. Wagoner is secretary and treasurer.

ROCK HILL, S. C.—Preparations are being made for improving the local telephone system. A new switchboard will be installed, and sixty-foot poles erected on the principal streets. It is hoped to have the work completed by the first of the year.

GLENDALE, OHIO—The Glendale telephone exchange is nearing completion. A new 500-line switchboard has been installed in the company's new quarters, and a double force of operators will be employed as soon as the exchange is ready to receive them.

TOLEDO, OHIO—To better handle its business here, the Central Union Telephone Company will erect a four-story concrete building to be used for a branch exchange. The building will be 40 by 100 feet in dimensions. It will cost between $25,000 and $30,000.

BROCKTON, MASS.—Brockton has been made the headquarters of the first of two districts into which the southern Massachusetts telephone system is being divided. About November 1 the second district will be organized, it is expected, with headquarters at New Bedford.

MARQUETTE, MICH.—The Marquette Telephone Company, an independent concern operating in the three cities and several villages of the county, has voted to increase its capital stock from $60,000 to $100,000. The new capital will be used for improving the system.

WINNFIELD, LA.—A telephone exchange will be put in at Jena, forty miles east of here on the Louisiana & Arkansas Railroad. O. E. White is at the head of the enterprise. A line will be run from Jena eastward to Jonesville, where it will connect with the Cumberland system.

ST. JOHNSVILLE, N. Y.—The contract for the contemplated extension of the Interstate telephone lines to Crown Creek and Oppenheim has been let to George Reese, of Crown Creek, who will begin the work immediately. The Interstate extension to Stark is completed and the immediate extension of the system from Canajoharie is also in contemplation.

BONO, ARK.—The farmers in the vicinity of Bono have organized a mutual telephone company and have elected W. B. Broom president; Riley Stichham vice-president, George A. Lamb treasurer, and P. R. Barnes secretary. There are thirty subscribers and the switchboard and telephones have been ordered. The line will be built at once, and the central office will be at Bono.

Digitized by Google

ELECTRIC RAILWAYS.

ANN ARBOR, MICH.—An electric line to Whitmore Lake and from there to Lakeland is projected by an Ann Arbor capitalist.

NASHUA, N. H.—The Hub Construction Company has begun the construction of the Goffs Falls, Litchfield & Hudson electric railroad in Hudson.

EAST DOUGLAS, MASS.—The contract for building the proposed Worcester & Providence street railway has been given to Pepper & Bowie, engineers and contractors, of Philadelphia.

LIMA, OHIO—The Schoepf system has opened its new Lima and Toledo trolley road for regular service north as far as Ottawa, and put on a bi-hourly service temporarily. It is announced the road will be completed into Toledo by spring.

OSCEOLA, IOWA—The promcters of the Des Moines, Winterset & Creston interurban road have enlarged their plans and now propose to extend a branch of the road from Winterset to Osceola and inaugurate a fast service between Des Moines and Osceola.

SPOKANE, WASH.—J. H. Morrow, general manager of the Columbia & Walla Walla Traction Company announces that the company has secured all the right of way in the Walla Walla Valley and that a line of 104 miles will be ready for operation the coming year.

SPOKANE, WASH.—Jay P. Graves, president of the Inland Empire Railway Company, announces that the line will be extended down the Spokane river to the power plant at Nine Miles Bridge, where a 9,000-horse-power plant is under construction, under the supervision of A. L. Zimmerman, of Philadelphia.

WEBSTER CITY, IOWA—At a special election held in this city to-day, the Boone, Webster City & Interurban Railroad Company was granted the right to operate cars on the streets, and to maintain an interurban service between Boone and Webster City. A five-year remission of taxes was also granted.

TRAVERSE CITY, MICH.—L. K. Gibbs, president of the Traverse City & Old Mission Electric Railway, has received word from his attorney in New York that the contract for constructing an electric railway from Traverse City to the Old Mission summer resort had been closed. It is believed work will be begun shortly.

SHARON, PA.—The right of way for a trolley line from Mahoningtown to Morada Park has been secured, and plans for the line are under consideration. With the completion of this line there will be nearly a complete system between Sharon and Pittsburg. This will give a line through Youngstown to Cleveland, Ohio.

BAKER CITY, ORE.—David Eccles, of Baker City, has taken over the construction of the Eagle Valley electric railway and will build a line, construction work beginning in October. Residents of Baker City have subscribed $100,000 toward the project which will be operated in connection with the Sumpter Valley electric railway.

SACRAMENTO, CAL.—Louis F. Hanchette, John Martin, Eugene de Sabla and their associates have commenced work on their Santa Clara interurban electric road. It is to run from the town of Santa Clara north to San Mateo via Palo Alto. Connection will be made with the San Jose and Santa Clara system, which is owned by the same people.

WALLA WALLA, WASH.—Representatives of the Walla Walla Traction Company have secured an additional right of way to Freewater, Ore., southwest of Spokane, where a terminal site has also been secured. Work on the line between Walla Walla and Freewater is progressing and the company expects to have cars in operation early in December.

UTICA, N. Y.—The annual meeting of the stockholders of the Utica & Mohawk Valley Railway Company was held at the company's office recently. The following directors were elected: Horace E. Andrews, John J. Stanley, John Carstensen, E. V. W. Rossiter, W. K. Vanderbilt, Jr., Walter N. Kernan, Charles B. Rogers, Nicholas E. Deveraux and James S. Sherman.

PHILADELPHIA, PA.—Bids have been invited by the Philadelphia & West Chester Traction Company for the erection of a brick and concrete car barn and repair shop at Llanerch. The building will be substantially fireproof, the walls of brick, the foundations and floors of concrete and the roof beams and post-supporting roof beams of steel-reinforced concrete. The dimensions will be 216 by 124 feet.

BOSTON, MASS.—The Boston & Northern Street Railway Company has filed with the railroad commissioners at Boston a petition for the approval of the terms of purchase of the Georgetown, Rowley & Ipswich Street Railroad Company, and of the Lowell & Woburn Street Railroad Company. The purchase of the first-named road will require the issue of $240,000 additional capital stock, and that of the latter $143,200.

TRENTON, N. J.—Negotiations have been concluded for the sale of the Philadelphia, Bristol & Trenton Street Railway to the Interstate Railways Company. The Interstate Company controls the Trenton Street Railway Company and the trolley systems in Chester, Wilmingtown, Wilkes-Barre, Reading and other places. John C. Rigg, of Reading, is its president. The Philadelphia, Bristol & Trenton road runs from Trenton to Torresdale.

SAN FRANCISCO, CAL.—The United Railways Investment Company of San Francisco has filed a certificate with the secretary of state of New Jersey to change the name of the corporation to the United Railways Investment Company, omitting the words "of New Jersey." The reason for the change, which has been approved by the stockholders, is that the company has acquired interests outside of San Francisco through the purchase of a majority interest in the stock of the Philadelphia Company, of Pittsburg.

PLAINWELL, MICH.—Options are being secured in this vicinity for the construction of an electric railroad from Augusta to Allegan by the way of Richland, Plainwell, Otsego and Allegan. The Commonwealth Power Company, which owns three big power dams between Plainwell and Allegan besides other dams in the state, is back of the enterprise. The road will connect at Augusta with the Kalamazoo & Battle Creek interurban. If built it will tap a good territory, a great portion of which is now without railroad facilities.

FORT DODGE, IOWA—The Northwestern Construction Company has let the contracts for the erection of five substations or powerhouses at Ankeny, Kelly, Fort Dodge Junction, Fraser and a place seven miles south of Fort Dodge, which is still unnamed. The contract calls for the completion of the stations seventy-five days from the twelfth of September. The substations are to be thirty-two feet square and about twenty-five feet high, and are to be built of fireproof brick. The main station at Fraser is to be ninety by ninety feet.

SPOKANE, WASH.—The Northern Pacific Railway Company announces that it will operate an electric railway over the old Union Pacific grade, between Portland and Tacoma, 145 miles, and the Willamette Valley Company has begun the construction of a line between Salem and Mehama, Ore., twenty-five miles. The United Railway Company will build 100 miles of line in and outside the city of Portland, Ore. The Oregon Water Power Company will extend its line from Lents to Trentsdale and establish a ferry over the Columbia river.

POTTSTOWN, PA.—The Schuylkill Valley Traction Company has obtained possession of the Pottstown & Northern trolley line, to be used as a link in its Reading-Philadelphia system. The sum of $28,000 was paid, and the present name of the road will be retained. George Hoeger, of Norristown, was elected president; Harry Rosen, of Reading, secretary, and Dr. Walter Rigg, of Reading, treasurer. Work has been begun extending the road from Ringing Rocks northward to Swamp, to connect with the Schuylkill Valley branch, which will complete the line to Reading.

NEW WESTMINSTER, BRITISH COLUMBIA—At a meeting of the Chilliwack Power and Light Company that company disposed of its entire electric railway rights to the British Columbia Electric Railway Company for $10,000. The principal right purchased was to build an electric railway line from New Westminster to Chilliwack, a distance of about seventy miles. The British Columbia Electric Railway Company has for over a year been endeavoring to secure this charter, but the price was considered too high for the rights that it represented. The early building of a line up the Fraser valley is assured, as plans are already under way for its construction.

Digitized by Google

PERSONAL MENTION.

MR. H. A. HARRIS, of the Automatic Electric Company, Chicago, Ill., was a New York visitor last week.

MR. E. B. KETTLE, manager of the Chicago office of the Sprague Electric Company, was a New York visitor last week.

MR. S. I. WALES, manager of the sales department of the National Brake and Electric Company, Milwaukee, Wis., was a New York visitor last week.

MR. C. O. BAKER, formerly of the Telluride Power Company, of Utah, has been appointed superintendent of the Telluride Electric Light and Power Company, of Telluride, Col.

MR. J. RICHARD SLOAN, electrician motive power department, Pennsylvania Railroad Company, with headquarters at Altoona, Pa., was a visitor to New York city during the past week.

MR. FRANK H. TAYLOR, formerly vice-president of the Westinghouse Electric and Manufacturing Company, has been elected vice-president of the Yale & Towne Manufacturing Company, New York city.

MR. JOHN H. DALE, of the Dale Manufacturing Company, New York, is making a long trip through Europe, combining a good deal of business with a little vacation and rest. Mr. Dale will return in about three months.

MR. C. H. BRISTOL, formerly of the advertising department of the Western Electric Company, Chicago, Ill., is now attached to the advertising department of the Electric Service Supplies Company, Plymouth Building, Chicago.

MR. ARTHUR JONES, president of the Arthur Jones Company, Chicago, Ill., has been in New York for ten days. His company represents the National Brake and Electric Company, of Milwaukee, Wis., and also the Mechanical Appliance Company, of Milwaukee, Wis.

PROFESSOR LUCIEN I. BLAKE, for many years the head of the Department of Physics at the University of Kansas, Lawrence, Kan., has recently taken charge of the laboratories of the Submarine Signal Company, of Boston, Mass. Professor Blake is one of the progressive men of the day, and has made a special study and devoted years of experiment to this branch of electrical work.

MR. VAN RENSSELAER LANSINGH, general manager of the Holophane Glass Company, is contributing a good deal to the educational campaign devoted to good illumination. Mr. Lansingh is down for a lecture before the American Gas Institute, Chicago, October 18, on the "Standardization of Incandescent Lamp Mantles," and lectured before the Boston Edison Company's meeting on Friday, October 12.

MR. LOUIS B. MARKS, the well-known consulting electrical engineer, has been retained as consulting engineer in illumination for the new Carnegie public libraries of New York city by Messrs. Carrere & Hastings, McKim, Mead & White and Babb, Cook & Willard, the advisory board of architects for Mr. Carnegie. This appointment makes a distinct departure in the practice of some of the leading architects of the country, and one which will probably go far toward establishing the claims of the illuminating engineer.

LEGAL NOTE.

SINGLE-PHASE MOTOR LITIGATION—Announcement is made that on September 19 Judge Hazel, sitting in the United States Circuit Court for the Southern District of New York, handed down a decision favorable to the Wagner Electric Manufacturing Company, St. Louis, Mo., in a suit of equity brought against it by the Arnold Monophase Electric Company, of Philadelphia, Pa. The patents involved are those of Professor E. Arnold, Nos. 543,836 and 562,365, and constitute a part of the chain of patents utilized in the single-phase power motors utilized by the Wagner company.

ELECTRICAL SECURITIES.

The dealings in the stock market last week showed a very apparent contraction, and the feeling is extant that whatever operations were conducted were largely of a professional nature. At the same time, the general price tendency has been upward, and compared with a week ago a number of leading industrials have made fairly good rallies. While developments in favor of a speculative improvement were of a favorable nature, the response was disappointing to the bull element in the market. The copper industry continues to show a remarkable degree of prosperity, and the condition of the iron and steel industry is indicated by the fact that the United States Steel Corporation has unfilled orders on hand for 7,600,000 tons. Increases are daily reported in the earnings of practically all the large railroad systems.

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 6.

New York:	*Closing.*
Allis-Chalmers common	17⅞
Allis-Chalmers preferred	44⅜
Brooklyn Rapid Transit	77⅞
Consolidated Gas	138
General Electric	175½
Interborough-Metropolitan common	36¼
Interborough-Metropolitan preferred	75½
Kings County Electric	155
Mackay Companies (Postal Telegraph and Cables) common	73½
Mackay Companies (Postal Telegraph and Cables) preferred	70½
Manhattan Elevated	145
Metropolitan Street Railway	104
New York & New Jersey Telephone	125
Western Union	86¾
Westinghouse Manufacturing Company	152¼

The annual meeting of the Manhattan Railway Company will be held November 14. Books close October 13, and reopen November 15.

Considerable interest has been manifested in General Electric stock, which, until Friday, October 5, sold around 166. From that point it advanced to 183⅞ on Monday, October 8. The rapid advance in stock gave rise to a number of reports. It is stated, however, that there is no foundation for a report of an increase in the dividend, and the only extraordinary benefit contemplated for stockholders in the immediate future consists of rights on the new stock which will be issued to stockholders at par. It is expected that these rights will be worth about $14 a share.

Boston:	*Closing.*
American Telephone and Telegraph	135
Edison Electric Illuminating	234
Massachusetts Electric	69½
New England Telephone	129
Western Telephone and Telegraph preferred	88

The directors of the American Telephone and Telegraph Company have declared a quarterly dividend of 2 per cent. The dividend is designated as quarterly, placing the stock upon a regular 8 per cent per annum basis, as against 7½ per cent heretofore. Following the declaration of the dividend, President Fish said: "It was the sentiment of the directors that in view of the earnings of the company and the outlook it seemed that this was the proper time to put into effect a policy that had been suggested for a long time, of putting dividends on a basis of 2 per cent quarterly with the expectation of continuing them at that rate." The dividend is payable October 15.

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	70
Electric Storage Battery preferred	70
Philadelphia Electric	8¼
Philadelphia Rapid Transit	28⅞
United Gas Improvement	85¾

Chicago:	*Closing.*
Chicago Telephone	110
Chicago Edison Light	140
Metropolitan Elevated preferred	66
National Carbon common	84
National Carbon preferred	116
Union Traction common	5
Union Traction preferred	18

The September daily average of the Metropolitan Elevated was 126,975 passengers, an increase of 2,548.

The South Side Elevated daily average for September was 89,749, a decrease of 727 passengers daily.

Northwestern Elevated daily average of passengers carried for September was 77,508, an increase of 3,201.

Oak Park Elevated September daily average number of passengers, including transfers, was 44,742, a decrease of 1,109.

Digitized by Google

INDUSTRIAL ITEMS.

THE FRENCH BATTERY COMPANY, Madison, Wis., announces the appointment of A. J. Cox & Company, Stock Exchange Building, Chicago, Ill., as its general agent for Chicago. This company enjoys a wide acquaintance in the telephone field.

HARVEY HUBBELL, INCORPORATED, Bridgeport, Ct., has issued a catalogue and price list devoted to electrical specialties. In addition to the price list there are given illustrations of the apparatus and brief descriptive paragraphs, and there are also included a general index and an index to code words.

M. W. DUNTON & COMPANY, Providence, R. I., report an increased demand for their cotton tapes and sleevings, probably due to the unlooked-for rise in raw cotton. They have foreseen this result and have made arrangements whereby they are able to fill orders for their customers as promptly as usual.

THE ATLAS ENGINE WORKS, Indianapolis, Ind., has ready for distribution bulletin No. 132. This bulletin describes and illustrates medium-speed, automatic, four-valve engines. The literature has been carefully prepared and is supplemented by illustrations showing the detail and assembly of these machines.

THE BRISTOL COMPANY, Waterbury, Ct., announces the establishment of a branch office at 753 Monadnock Building, Chicago, Ill. This office will be able to fill rush orders, particularly for instrument supplies, and the representatives in charge will be pleased to offer helpful suggestions regarding the operation of Bristol recorders and supply full information concerning new types and the ranges of the various instruments.

A. W. CLAPP, 1164 Monadnock Block, Chicago, Ill., editor and publisher of "Hydroelectric Plants of the United States, Canada and Mexico," has just completed a trip through the New England states, and is about to make an extended trip through the South. Mr. Clapp is desirous of representing a few electrical supply houses during the coming winter in that section of the country.

THE DOWNWARD LIGHT ELECTRIC COMPANY, Union square East, New York, is marketing a type of incandescent lamp known as the "New Forty-Watt" lamp, which has the following guarantees endorsed by that company, *viz.:* seventy-one per cent more downward light than the standard form of incandescent lamps; 145 per cent longer life; twenty per cent less current consumption. By the standard type of lamp is meant the ordinary 3.1-watt, sixteen-candle-power lamp.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, announces the opening of a Chicago office in the Merchants' Loan and Trust Building, 135 Adams street, Chicago, Ill., with W. M. Connelly in charge. Mr. Connelly was connected with the electrical department of the Homestead works of the Carnegie Steel Company for five years, resigning his position there to become electrical engineer of the Ensley plant of the Tennessee Coal, Iron and Railroad Company, at Birmingham, Ala. After holding this position for three years he resigned to take up central-station work at Birmingham, Ala., and at Houston, Tex., where he organized and was in charge of the sales department. He enters upon his new duties fully equipped to take care of the interests of the Electric Controller and Supply Company in the Chicago district.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the Second Issue of Each Month.)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Ct.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Sadtler, 59 South Tenth street, Philadelphia.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty street, New York. Meetings, fourth Friday of each month.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnston, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Professor Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 12 West Thirty-first street, New York. Annual meeting, December 4-7, 1906.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, 60 Wall street, New York. Annual meeting, Columbus, Ohio, October 15-20, 1906.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, S. W. Mower, 12 Woodward avenue, Detroit, Mich. Annual meeting, Columbus, Ohio, October 15-19.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Ernest H. Davis, Williamsport, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Annual meeting, Atlantic City, N. J., June 19, 1907.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington street, Newton, Mass. Annual meetings held in Boston on third Wednesday in March.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Ontario.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. F. Dostal, Denver, Col.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Ct. Annual meeting in November, 1906.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt street, New York.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water street, Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine street, St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary-Treasurer, George H. Erich, 401 Monadnock Block, Chicago. Next annual meeting, Chicago, January, 1907.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 1, 1906.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada. Next annual meeting, January 14, 1907.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliot, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall street, New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, Rolland A. Davidson, 58 William street, New York city, N. Y.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Dr. Arthur H. Elliot, 4 Irving place, New York. Meetings in New York, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.; assistant secretary, J. A. Harney, Electric Building, Cleveland, Ohio.

IOWA ELECTRICAL ASSOCIATION. Secretary, L. B. Spinney, Iowa State College, Ames, Iowa.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

Digitized by Google

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering; Boone, Iowa.
KANSAS GAS, WATER AND ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Lawrence, Kan., October 16-17, 1906.
KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky.
MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress street, Portland, Me.
MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby street, Boston, Mass. Meets second Wednesday of each month, except July and August.
MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.
MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, October 16, 1906.
MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James F. Barnett.
NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.
NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.
NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee street, Utica, N. Y. Next meeting, New York city, 1907.
NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, 136 Liberty street, New York city.
NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION. Annual meeting, New York city, October 23-24.
NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State street, Boston, Mass.
NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty street, New York.
NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. S. Lane, 536 Ellicott square, Buffalo, N. Y.
NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, B. C. Adams, Madison, Wis.
OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.
OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.
OHIO SOCIETY OF MECHANICAL ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Bullard, Cleveland, Ohio.
OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.
OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York.
ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex.
PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.
PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second street, Philadelphia, Pa.
PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.
PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.
RAILWAY SIGNAL ASSOCIATION. Secretary, H. S. Balliet, 337 Madison avenue, New York. Annual meeting, Washington, D. C., October 16, 17 and 18.
SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Secretary, T. H. Stuart, Waco, Tex.
STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. B. Fairchild, Jr., 114 Liberty street, New York.
UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby street, Boston, Mass.
VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.
VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electrical Light Company, Middlebury, Vt.
WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

DATES AHEAD.

American Society of Mechanical Engineers. New York, N. Y., December 4-7.

American Street and Interurban Railway Engineering Association; American Street and Interurban Railway Association. Columbus, Ohio, October 15-19.

Kansas Gas, Water and Electric Light Association. Lawrence, Kan., October 16-17.

National Machine Tool Builders' Association. New York city, October 23-24.

Railway Signal Association. Annual meeting, Washington, D. C., New Willard, October 16, 17 and 18.

Record of Electrical Patents.

Week of October 2.

832,072. REGULATOR FOR PRIME MOVERS. Lamar Lyndon, East Orange, N. J., Filed June 26, 1905. The prime mover drives an electric generator, the variations in speed of which actuate the controlling device through a relay.

832,084. RAILWAY SIGNALING SYSTEM. Benjamin F. Saurman, Philadelphia, Pa. Filed November 15, 1905. A visible signal on the train is operated by the semaphore.

832,121. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed December 23, 1902. Differential windings on the signaling device are unbalanced when calling, and balanced when talking.

832,135. COMBINED TELEPHONE RECEIVER AND MICROPHONE. Carl E. Ljungman, Robert O. P. Berglund and Walter A. W. E. Hjorth, Stockholm, Sweden. Filed February 14, 1906. The transmitter and the receiver are mounted in a single case divided into two compartments by a curved disc.

832,137. RAILWAY SWITCHING AND SIGNALING APPARATUS. William Macomber, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Filed February 20, 1905. Makes use of a common return wire and indicating wires through which the current is shunted for actuating a signal.

832,138. RAILWAY SWITCHING APPARATUS. William Macomber, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Filed February 20, 1905. Two wires are used, one for operating the apparatus and one for giving indications. Means are provided for making connection between the two.

832,139. RAILWAY SWITCHING APPARATUS. William Macomber, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Filed February 20, 1905. A mechanically operated switch electrically controlled from a distance.

832,140. RAILWAY SWITCHING APPARATUS. William Macomber, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Filed February 20, 1905. A method of operating a track switch by means of an electric motor.

832,147. REAR-LIGHT INDICATOR FOR AUTOMOBILES. Leo F. Murphy, Detroit, Mich. Filed September 5, 1905. The light is controlled by a thermostat.

832,153. ELECTRIC SIGNALING APPARATUS. Chas. J. O'Neil, Washington, D. C. Filed February 4, 1905. Distinctive signals may be set by various positions of one controller.

832,165. RAILWAY SWITCH OPERATING AND CONTROLLING APPARATUS. Wilmer W. Salmon, Buffalo, N. Y., assignor, by mesne assignments, to General Railway Signal Company, Buffalo, N. Y. Filed July 15, 1901. Renewed May 17, 1906. The operating motor has two independent field-windings controlled by a polarized relay.

832,166. RAILWAY SWITCHING AND SIGNALING APPARATUS. Wilmer W. Salmon and Frank L. Dodgson, Buffalo, N. Y., assignors to General Railway Signal Company, Buffalo, N. Y. Filed January 6, 1906. A magnetic switch-lock controlled from a distance.

832,174. RAILWAY SIGNALING APPARATUS. John D. Taylor, Buffalo, N. Y., assignor, by mesne assignments, to General Railway Signal Company, Buffalo, N. Y. Filed January 22, 1904. The signal blade and counterweight are mounted on separate rods, which may be controlled independently or coupled together.

832,175. RAILWAY SWITCHING APPARATUS. John D. Taylor, Buffalo, N. Y., assignor, by mesne assignments, to General Railway Signal Company. Buffalo, N. Y. Filed January 22, 1904. Renewed February 3, 1906. Makes use of an electromagnetic indication-selector.

832,181. ELECTROMAGNETIC DEVICE. William W. Dean, Chi-

Digitized by Google

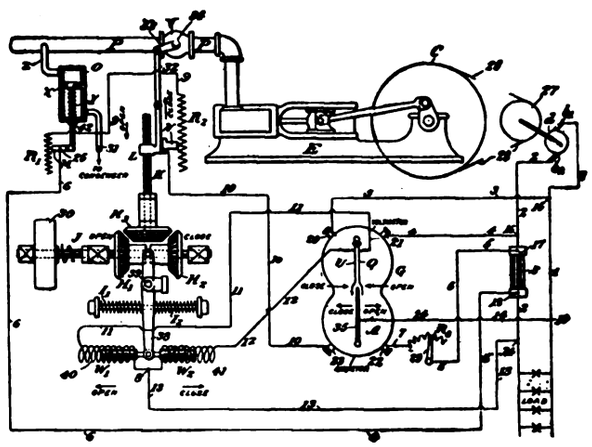
cago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed June 19, 1903. A method of mounting electromagnetic coils such as are used on telephone switchboards.

832,185. RIGHT-ANGLE ADJUSTABLE CROSSING FOR ELECTRIC RAILWAYS. Edward E. Gilmore, Philadelphia, Pa. Filed September 27, 1905. A pivoted adjustable trolley crossing.

832,192. RAILWAY SWITCHING AND SIGNALING APPARATUS. Winthrop K. Howe, Buffalo, N. Y. Filed August 29, 1905. Reciprocating motion is secured by means of a cam plate shifted by a motor.

832,193. RAILWAY SIGNALING APPARATUS. Winthrop K. Howe, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. Filed November 27, 1905. The signals are controlled by a hand-controlled generator.

832,194. RAILWAY SIGNALING APPARATUS. Winthrop K. Howe, Buffalo, N. Y. Filed May 17, 1906. The operating motor has two field-windings for controlling the direction of rotation.



832,072. Regulator for Prime Movers.

832,195. RAILWAY SIGNALING APPARATUS. Winthrop K. Howe, Buffalo, N. Y., assignor, by mesne assignments, to General Railway Signal Company, Buffalo, N. Y. Filed July 20, 1903. Renewed May 17, 1906. The actuating motor is mounted vertically and drives through an anti-friction screw.

832,280. REFLECTOR SHADE. William H. Spencer, Brooklyn, N. Y., assignor to George Frink Spencer, Newark, N. J. Filed May 2, 1905. A method of constructing a reflector suitable for incandescent lamp clusters.

832,297. SAFETY DEVICE FOR ELECTRIC SIGNALS. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. Filed June 16, 1904. The signaling device is operated by passing trains.

832,302. METHOD OF SEALING METAL INTO GLASS OR OTHER VITREOUS MATERIAL. Carl A. Ernst, Schenectady, N. Y., assignor to General Electric Company. Filed June 12, 1903. The wire, freed from occluded gases, is provided with a glass coating.

832,312. SECTION-INSULATOR FOR ELECTRIC RAILWAYS. Edward E. Gilmore, Philadelphia, Pa. Filed September 27, 1905. Renewable wear-shoes are provided.

832,314. COIN-CONTROLLED MECHANISM. Rudolph W. Goeb, St. Louis, Mo., assignor to The Controller Company of America, St. Louis, Mo. Filed February 13, 1903. Locking and delivering mechanisms are electrically controlled.

832,353. COMMUTATOR. Roger S. White, Philadelphia, Pa., assignor to General Electric Company. Filed October 14, 1902. Concentric rollers are employed for collecting the current, placed so that jarring is prevented.

832,354 MAGNETO-ELECTRIC GENERATOR. Joseph A. Williams, Cleveland, Ohio. Filed May 14, 1906. A method of mounting a magneto.

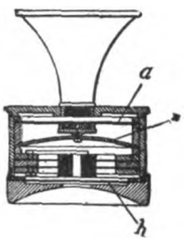
832,357. SYSTEM OF ELECTRICAL DISTRIBUTION. Ernst J. Berg, Schenectady, N. Y., assignor to General Electric Company. Filed April 25, 1900. Means are provided for operating the speed of a generator connected in series with one of the mains, thus controlling the load on the system.

832,363. VAPOR-TUBE STARTING DEVICE. Theodore Bodde, New York, N. Y., assignor to Louis B. Marks, New York, N. Y. Filed March 16, 1904. Employs a stationary auxiliary terminal in contact with one electrode before starting, but automatically disconnected after starting.

832,402. TIME SWITCH. Peter Mattern, Cleveland, Ohio. Filed August 9, 1905. Renewed May 12, 1906. The actuating weight is released by a clock.

832,416. ELECTRIC RAILWAY. Leon W. Pullen, Camden, N. J. Filed May 18, 1905. An electromagnetic surface-contact system.

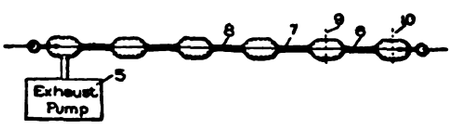
832,425. INTERCOMMUNICATING TELEPHONE. Lambert Schmidt, Weehawken, N. J. Filed September 16, 1905. A name-plate and pointer are provided for indicating the proper connection.



832,135. Combined Telephone Receiver and Microphone.

832,443. TELEPHONE SYSTEM. Paul Arnheim, Hamburg, Germany, assignor to the firm of Telephon-Fabrik Actiengesellschaft, vorm. J. Berliner, Hanover, Germany. Filed June 25, 1902. A selective automatically locking-out party-line system.

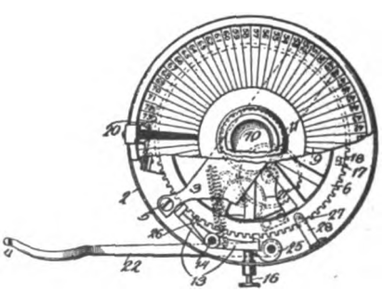
832,462. AUTOMATIC ELECTRIC BRAKE. Augustus L. Duwelius, Cincinnati, Ohio. Filed May 7, 1904. The brake is controlled by a generator driven from the car axle.



832,302. Method of Sealing Metal into Glass or Other Vitreous Material.

832,544. AUTOMATIC TROLLEY GUARD. John R. French, Los Angeles, Cal. Filed November 15, 1905. A trolley-wheel fender automatically brought into position when the wheel leaves the wire.

832,548. SYSTEM OF RAILWAY SIGNALING. Harry L. Johnson, Topeka, Kan. Filed April 29, 1905. An automatic block-signal system.



832,562. Telephone Call-Box.

832,562. TELEPHONE CALL-BOX. Anthony Van Wagenen, Sioux City, Iowa. Filed July 30, 1903. Renewed March 3, 1906. Makes use of a rotatable contact-maker.

832,568. ELECTRIC TIMH SWITCH. William S. Andrews, Schenectady, N. Y., assignor to General Electric Company. Filed December 15, 1903. The switch is operated by a clock mechanism.

832,577. TIME-LIMIT CIRCUIT-BREAKER. Edward M. Hewlett, Schenectady, N. Y., assignor to the General Electric Company. Filed February 11, 1899. Renewed October 18, 1901. A polyphase circuit-breaker, the opening of which is retarded by a clock mechanism.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 16. NEW YORK, SATURDAY, OCTOBER 20, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK

PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO

WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON

NEW ENGLAND OFFICE, M. W. BARBER, Mgr., DELTA BLDG., 10 Post Office Sq.

LONDON

EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
- Double Compounding . . . 621
- Electric Railway Development . . . 622
- Increasing the Standards of Illumination . . . 623

Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw . . . 624
Cooling the New York Subway . . . 628
Wireless Telegraph Conference . . . 631
Stress in Magnetized Iron . . . 632
Electrical Mine Pumps at the Ward Shaft, by Leon M. Hall . . . 632
The Theory of "Moving Coil" and Other Kinds of Ballistic Galvanometers, by Professor Harold A. Wilson . . . 633
The New York City Railway Earnings . . . 634
Hydroelectric Power Plant and Transmission Lines of the North Georgia Electric Company, by R. W. Hutchinson, Jr . . . 635
General Electric Stock Issue . . . 637
Electrical Notes from Europe . . . 638
Combination of Independent Telephone Companies . . . 639
Sound Engineering in Interurban Railway Construction, by Guy Morrison Walker . . . 639
The American Street and Interurban Railway Association . . . 642
Committee on Public Policy of the National Electric Light Association . . . 644
Annual Reunion of the Old Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps . . . 644
BOOK REVIEWS . . . 645
Signaling on the Lehigh Valley Railroad . . . 646
Telephones at Automobile Races . . . 647
Illuminating Engineering Society . . . 648
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 650
METHODS OF GETTING NEW BUSINESS . . . 652
INDUSTRIAL SECTION:
- A Portable Lamp Guard . . . 653
- New Pole Fixtures for Arc Lamps . . . 653
- The Rail Joint Company . . . 653
- Fires Not Caused by Electricity in German . . . 654
- An Allis-Chalmers Hoisting Engine for the Chapin Mine . . . 654
- A New Steam Relay Plant for the Washington Water Power Company . . . 654

CURRENT ELECTRICAL NEWS . . . 655
RECORD OF ELECTRICAL PATENTS . . . 660

Copyright, 1906, by Electrical Review Publishing Co.

DOUBLE COMPOUNDING.

An interesting development in the design of direct-current dynamos which is met occasionally is the use of two series windings, which may, for the moment, be designated as double compounding. The function of one of these windings is to provide a commutating field, and the other to increase the voltage of the machine as the load increases, and thus to overcompound the dynamo.

The use of a series winding placed on the same poles as the main magnetizing coil is almost universal in dynamo construction, and is practised, to some extent, in motor design for special purposes. With respect to the former use, the function of the coil is to counteract the armature reaction, and, if desired, to increase, in addition, the magnetization of the field, thus causing the voltage of the generator to increase with an increase in the load—the practice usually designated as overcompounding. The idea of employing a series winding merely to overcome armature reaction is not new, and when proposed for this purpose it has been thought that with a coil placed in such a direction as to have the opposing field directly opposite to the field set up by the armature that some advantage might be gained; and from this idea arose the early attempts to improve the performance of a generator by the use of auxiliary poles placed generally midway between the main poles; or of an auxiliary series winding placed around the armature so as to set up a magnetic field more nearly opposed in direction to the armature field. The chief advantage to be gained from such an arrangement was the improved commutation which could be secured; for if it were desired merely to maintain a constant total flux through the armature, a coil placed around the main poles would be just as effective. But such a coil would not be as effective as the auxiliary pole in preventing a rotation of the neutral plane, and therefore in preventing a shifting of the plane of commutation with the load.

These early attempts to improve commutation were abandoned, not because they were not effective, but because they became unnecessary, due to improved design. Recently, however, new conditions have arisen in which it seems that an auxiliary commutating field becomes desirable. These conditions have been brought about through the demand for high-speed generators such as are to be driven by steam turbines, and for variable-speed motors. The object of the auxiliary winding is mainly to provide a commutating field fixed in direction, but varying in strength so as to produce the proper conditions for all loads. Such a coil, by acting against the armature reaction, has the effect of a compound winding, and it may be made to balance this; but if a perfect balance be

Digitized by Google

obtained, the generator will not be perfectly compounded because of the drop of potential due to the armature resistance. If the auxiliary pole be made stronger, so as to produce a perfect compounding, or if the effect be carried further and overcompounding be sought, the same conditions will be set up at the commutator, though in a less degree, as were sought to be overcome by the introduction of the auxiliary pole—that is to say, the commutating field will not be directly under the auxiliary pole, but a little to one side, and its position will vary with the degree of compounding. Although the auxiliary pole is employed to maintain a fixed commutating plane, the use of the series winding on this pole for regulation purposes partially defeats the object sought. This difficulty may be got over by placing on the main field a series coil which provides the necessary increase in field strength to give the desired overcompounding. But this plan really gives us a dynamo with three field-windings—one more than we have been accustomed to. They are the main shunt-winding for providing the initial excitation, the main compound winding for producing the necessary variation in this excitation to give the degree of regulation sought for, and the auxiliary compound winding, the function of which is merely to provide a commutating field. This, in a sense, analyses the field-winding as we are accustomed to analyze the armature reaction. Part of the effect is applied in the direction of the main field, and part in quadrature with this. But it should be remembered that this comparison is not exact, for the main series field does not merely balance the demagnetizing effect of the armature, but actually increases the total strength of the field. And the auxiliary winding, also, does not merely balance the cross-magnetizing effect of the armature, but it must do more: it must supply a commutating field.

ELECTRIC RAILWAY DEVELOPMENT.

It has perhaps been inevitable with such rapid growth going on in the electric railway field that, in some places, the work would seem to have been done not wisely, but too well. A few years ago the financial success which had resulted from the electrification of street railway systems gave rise to an extension of these lines into thinly settled districts and to the building of purely country lines; and from these growths there came the true interurban line connecting two important commercial centres. In some sections this building went on apparently when there was no need for the transportation facilities being constructed. Conditions of late have bettered considerably, and there is not now the same feverish haste to secure franchises and build some sort of a line. But, in a good many instances, the builders, taking warning from the experiences of the early roads, have gone rather to the other extreme and, while seeking to construct a profitable line, have invested more money in the road than the opportunities for securing traffic warrant. The earlier builders erred by neglecting the engineering side of railway building, and were content to spike down two lines of rails on ties laid alongside a country road. Grades, road crossings and other obstructions had no terrors for them. What they were seeking to do was to start the cars moving and then sell out. Now, one not infrequently finds an interurban line which for many years can not be expected to carry a heavy traffic laid out and constructed as though it were to be a trunk line. Skilled engineers are secured for building the road, and they seem to let their wishes run away with their judgment, and build as though the road were going to carry all the freight and passengers of a large district. While the earlier roads put a constant drain upon the operating company for maintenance, and perhaps entire reconstruction, the newer method may cause an even greater loss on account of the heavy expense for permanent way and equipment. Although maintenance and repairs may be slight, interest must be paid on the investment, and it is better to have a less imposing line reaching to the point sought than to have a magnificent sample of engineering work going only half way there. The older roads were built to sell. For this reason many did not become profitable when operated. The newer type of road is built to run, and often is not profitable because the profit-making feature has not been studied sufficiently by the builders.

The design of every new road should result from a careful examination of the best type of construction to be adopted and of the probable revenue to be obtained. While every one will admire a beautifully constructed road and handsome cars, every unnecessary dollar expended for these causes a direct loss in interest to the investors. There is no necessity to use a 100-pound rail for a country trolley road, nor are double-truck cars required to handle light country traffic. The conditions in each case must be weighed carefully and the cheapest construction which will give satisfactory service should be adopted in the first case. After that no improvement should be made except such as can be shown to be profitable, either because of the better service or safety, or for other good reasons. The engineer in charge of the construction should not let his desire to build a beautiful road run away with his good judgment, but, on the other hand, he should insist that the builders of the road decide upon a type of construction that will do the work. A straight, heavy-ballasted, double-track road is a pretty thing, but its value is much diminished if it only goes half the way to the place for which it started. On the other hand, a line connecting two cities, which is built so poorly that the cars can not get over it, will not draw the traffic that is sought. There are two of the leading cities of this country, only about forty miles apart, which for years past have been promised an interurban electric line. For various reasons this road has yet to be built. The two cities are already well served by steam roads, and the traffic that would be picked up along the way would be of little importance. The only advantage an electric system would have over the steam roads, besides the greater comfort of traveling in an electric car, would be in transferring from the interurban line to the local lines at the two cities, and perhaps in offering a more frequent service. It is a question whether such a road would offer a service more frequent than that now existing, and as, at present, passengers are deposited at convenient points, the transfer feature of the electric line would

Digitized by Google

not be of much importance, particularly if it were necessary for the passenger to change cars, which he probably would have to do if high-speed cars were run over the electric line, as would have to be the case if this road wished to enter into competition with the steam service. Here is an instance which, at first sight, would seem to offer an excellent opportunity for constructing a high-speed interurban line; yet the fact that this has not been accomplished up to the present time, although it has been promised again and again, shows that, for some reason or other, capital has been rather doubtful about the wisdom of the plan.

In another branch of electric railway development the public seems to be looking for greater changes than the engineers at present expect to take place. Because it sees great work going on at certain points, it seems to think that this is merely the first step in the general conversion from steam to electric power. Such a conversion is, nevertheless, a long way off, and except where special conditions call for special methods, we must be content to let the steam locomotive do the work for which it is best suited. It is contended by some that great advantages will result from the use of the electric locomotive. One of these advantages, it is said, will be a large increase in the traffic-carrying capacity of the road. Such a gain would be of great importance, if it could be made without too great a sacrifice; but it yet remains to be demonstrated in practice how great the gain would be. It figures out very nicely on paper, but what we need is something of a more practical character. In the meantime the electric railway engineer should devote his energies to improving his systems, and thus render them more reliable and less expensive, and in this way bring nearer the hoped-for change.

INCREASING THE STANDARDS OF ILLUMINATION.

It has been noted again and again in the technical journals, and probably every one has observed it for himself, that the standard of illumination in nearly all buildings, both public and private, has been increasing. Where before we were satisfied with a few dim gas jets giving just enough light to avoid chairs and other obstructions, we now demand not merely that the room shall be comfortably lighted, but that it must be brilliantly lighted. The same applies, though in a less degree, to street lighting, but there is not the same objection here, since it is seldom that a street, taken as a whole, is too brilliantly lighted.

The standard has undoubtedly been set by public buildings, and has followed the introduction of electric lights; and while beautiful effects have been sought, those in charge seem to believe that the brighter the lighting the better, and nothing less than a brilliant show would be satisfactory. Hotels, theatres and public halls of all kinds must be so bright that any one can read small print, no matter where he stands. This practice, as has been pointed out, has undoubtedly influenced the lighting of private houses, for any one going from a brilliantly lighted public dining room to his own can not but feel the contrast, and thinks that his own is gloomy and dark, and that he must have as much light in every part of his room as he found in the public room. If he can not correct what he thinks to be the fault by turning on several more lamps, lamps of larger candle-power are substituted; and this man's method is apt to influence his neighbors. Where formerly we were satisfied to take a seat near a lamp to get sufficient light for reading, and to have the room otherwise comfortably, but not brilliantly lighted, we now think that we must be able to read in any part of the room and sit in any position.

This toning up of our standards of illumination not only is leading to an increase in the number of lamps lighted at a time, but has led to the suggestion that our standard sixteen-candle-power lamp is perhaps out of date, and that a lamp having a higher rating should be accepted. It would be well, however, to consider any such step carefully before undertaking it. Our present standard is about double that of Europe, where the eight-candle-power lamp is the one mostly used. This change from sixteen to twenty or more would, it is true, bring the ordinary incandescent lamp more nearly to the same candle-power as the standard incandescent gas lamp, but it does not seem wise to take a false step for such a slight gain. It is a matter of opinion with many that we have already gone very much too far. It would be better for us if we were satisfied with less brilliant lighting of a few rooms, but with a more uniform distribution of light throughout the house. To change from our present standard lamp to one higher would make the problem of securing the best lighting of a room still more difficult, as lamps of large candle-power or high intrinsic brilliancy are not only dazzling, but by their effect upon the retina may actually make it more difficult to see. Smaller units would not only assist in preventing a dazzling effect, but might even make reading and other similar occupations easier, even though the intensity of illumination be less.

The trend towards units of larger candle-power may be attributed not only to the general drifting toward brighter lighting, but to the fact that the newer forms of incandescent lamp are more easily made in the larger sizes; and there is not wanting a feeling on the part of the lighting companies that the more efficient lamps may cut down their sale of current. The latter idea will probably be discovered to be unfounded, for the introduction of the Welsbach burner has really increased the consumption of gas, an indication that the more efficient forms of electric lamp will probably increase the consumption of current. But this increase should come through an increase in the number of lamps used, not through an increase in the candle-power of the standard lamp.

The tendency to use more and more light is not in itself wrong. It is merely the application that is wrong. What we need is a more intelligent use of our sources of light. There should be less contrast between the brilliantly lighted parlor and the dark hall, the dazzling dining room and the gloomy kitchen. What is needed is education of the public in the proper use of lamps, for taste in this matter seems to-day about as crude as it can well be. It is gratifying that with this condition confronting us that that young body, the Illuminating Engineering Society, should be doing such excellent work. The work of this society during the past season was most successful, and at the initial meeting this fall two interesting and valuable papers were presented, one dealing with the subject in question—that is to say, the lighting of buildings.

Digitized by Google

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW, F. I. C.

VI—The Approximate Analysis of Feed-Waters.

The details given in the previous article relating to the sources of natural water supply prove that all natural waters contain variable amounts of suspended or

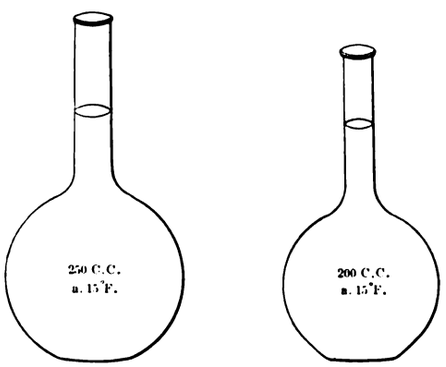


Fig. 23.—Measuring Flasks.

dissolved impurity, and that in some cases these impurities may be present in very considerable quantity.

For the purposes of the boiler engineer it is of importance to know the total amount and the general characteristics of these impurities, although the exact determination of each individual chemical compound may be unnecessary. An approximate analysis of the feed-water will supply the information required, since this may be carried out so as to yield the (1) alkalinity or acidity; (2) total suspended solids; (3) total dissolved solids; (4) temporary hardness; (5) permanent hardness; (6) oils and fats, without the separate determination of the various salts that give the water these characteristics. An approximate analysis of a feed-water, with strict attention to all the details of manipulation named below, may be carried out by an engineer, after some little practice with the apparatus and methods described. A complete chemical examination, on the other hand, can only be carried out by a chemist skilled in water analysis; and no attempt is made in this article to deal with the methods by which the calcium and magnesium salts in water are separately determined. The engineer who attempts the approximate analysis of water is, however, advised to practice with samples of water that have been submitted to independent tests by a competent expert, before venturing to place much dependence upon his own results, since owing to the use of volumetric methods the work is more difficult than the approximate analysis of fuels.

(1) Alkalinity or Acidity — Most natural waters are slightly alkaline owing to the presence of dissolved carbonates of the alkaline earth metals. Such waters color neutral litmus paper a slightly blue tint, and give a pronounced canary-yellow tint to methyl orange, the indicator usually employed for this work. In order to estimate the total alkalinity of the water, 200 cubic centimetres of the sample taken as described in Article V, filtered if suspended matter be present, are measured in the flask shown in Fig. 23. These 200 cubic centimetres are then emptied into a white porcelain basin of about twenty-two ounces capacity. The flask is rinsed out

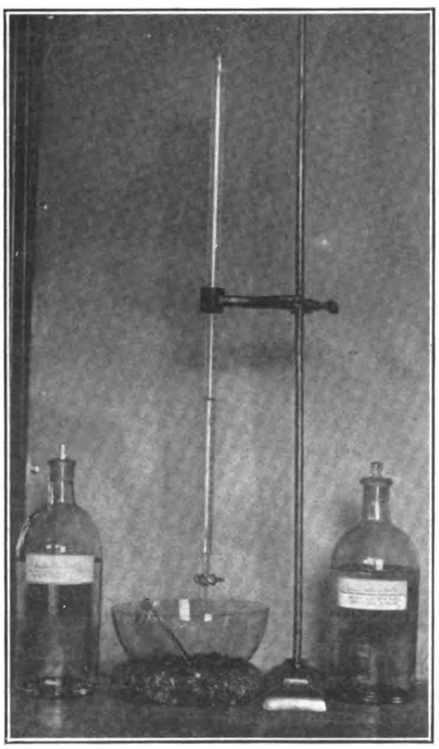


Fig. 24.—Water Testing Apparatus.

with distilled water, the washings are added to the liquid in the basin, and two drops of a concentrated solution of methyl orange are also added to the water. A standardized solution of hydrochloric acid of one-fifth normal strength[1] is now added from a burette drop by drop with constant stirring until the color of the liquid in the basin changes from canary yellow to orange and finally to faint pink, this last change being taken as the end point of the reaction.

The number of cubic centimetres of the hydrochloric acid solution used from the burette are then read off, and the result is calculated as parts of calcium carbonate per 100,000 of water.

In the case of water from peaty lands it will often be found that these give a slightly acid reaction, due to the decomposition of the organic matter of the peat, but that these organic acids are not revealed either by litmus paper, or by methyl orange. Such waters in fact appear to be alkaline with the last-named indicator. It is necessary in the case of these waters, therefore, to use an alcoholic solution of phenol-phthalein as indicator, and to heat the 200 cubic centimetres of water after filtration and measuring, in the porcelain basin, before titrating with the standard alkali solution—carbonate of soda.

Phenol-phthalein is colorless with acids, but yields a purple-red tint with the slightest excess of alkali, and the standard solution of alkali is, therefore, dropped in from the burette with constant stirring of the liquid in the basin, until a permanent purple-red color is obtained. The number of cubic centimetres of the standard alkali solution used is then read off, and from this the result is calculated—not as acid, but as the alkali equivalent of the acid present in the water.

Fig. 24 shows the apparatus used for making these tests. The burette holds fifty cubic centimetres, each cubic centimetre divided in tenths, and is provided with a glass stop-cock. The standard solutions of acid and alkali employed are contained in the glass bottles shown on either side of the burette and titration basin.

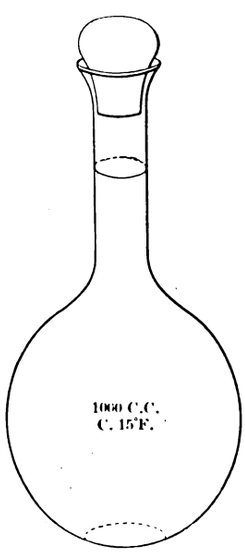


Fig. 25.—One-Litre Measuring Flask.

The solutions of acid and alkali are made as follows:

Twenty-one and one-half grammes of pure anhydrous carbonate of soda are

[1] A normal solution contains the molecular weight of the chemical in grammes in 1,000 cubic centimetres of water.

[1] All rights of translation and reproduction reserved. Copyright, 1906, by John B. C. Kershaw.

Digitized by Google

weighed out, and dissolved with the aid of heat in 250 cubic centimetres of distilled water. This solution is then made up to nearly 1,000 cubic centimetres in the large measuring flask shown in Fig. 25 and is cooled to fifteen degrees centigrade before finally diluting to the mark on the neck, and transferring to the stoppered glass bottle shown on the right in Fig. 24.

This solution is labeled "Standard Alkali 1-5 N.," the exact strength being placed on the label afterward, when the solution has been titrated with the 1-5 N. acid solution.

The latter is made by taking forty cubic centimetres of pure concentrated hydrochloric acid and diluting this to 1,000 cubic centimetres after cooling to fifteen degrees centigrade.

This solution is now transferred to the other storage bottle shown in Fig. 24 and is labeled "Standard Acid 1-5 N." It is checked by weighing out very carefully 0.40 gramme of the pure carbonate of soda (after drying one-half hour in the platinum crucible at a low red heat), dissolving this in the porcelain basin, in a small quantity of hot water, diluting with a large volume of cold water and

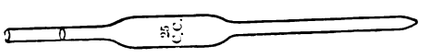


FIG. 26.—TWENTY-FIVE CUBIC CENTIMETER PIPETTE.

titrating with the standard acid solution, using methyl orange as indicator. The change from canary yellow to faint pink—with orange as an intermediate stage—indicates the end of the reaction. It will be found that about twenty cubic centimetres of the standard acid solution are required to neutralize the 0.40 gramme of sodium carbonate—and the test is repeated for the sake of accuracy. Finally the standard alkali solution is itself checked, by measuring off twenty-five cubic centimetres in the pipette shown in Fig. 26 and by titrating this with the normal acid as before.

The following are examples of this method of checking the standard solutions:

1. $\frac{n}{5}$ HCl solution, 0.40 gramme Na_2CO_3 used for each test.[1]

No. 1 required 19.8 cubic centimetres.....
No. 2 required 19.9 cubic centimetres..... } mean 19.85 cubic centimetres.

It was calculated from this that 100 cubic centimetres of the $\frac{n}{5}$ acid solution equaled 2.015 grammes Na_2CO_3 or 1.900 grammes $CaCo_3$, and these figures were placed upon the label below the description.

2. $\frac{n}{5}$ Na_2CO_3 solution, 25 cubic centimetres used for each test.

No. 1 required 24.0 cu. centimetres HCl solution.
No. 2 " 24.1 " " "

Mean.....24.05 cu. centimetres HCl solution.

From this it was calculated that 100 cubic centimetres of the $\frac{n}{5}$ alkali solution equaled 96.2 cubic centimetres of the $\frac{n}{5}$ acid solution, or 1.937 grammes Na_2CO_3, or 1.827 grammes $CaCO_3$.

These values were, therefore, placed upon the label of the standard alkali solution.

In testing waters the basin and burette must be well washed and rinsed with distilled water before each test, and the burette must also be rinsed with the stand-

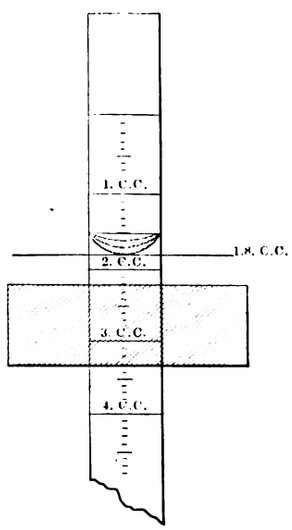


FIG. 27.—MENISCUS OF SOLUTION IN BURETTE.

ard test solution before it is filled for the actual titration. The level of the solution is best read off by holding a black strip of paper one-quarter of an inch below the meniscus, and by reading from the lower curve of this, as shown in Fig. 27.

The following is an example of the calculation for water showing alkalinity:

Water used, 200 cubic centimetres.

Standard acid solution required to neutralize it 3.70 cubic centimetres.

$\frac{3.7 \times 100.000 \times 0.019^1}{200} = 35.15$ parts calcium carbonate per 100,000 of water.

An acid water from peaty land gave the following results:

Water used, 200 cubic centimetres.

Standard alkali solution required to neutralize it 1.10 cubic centimetres.

$\frac{1.1 \times 100,000 \times 0.01937}{200} = 10.653$ parts sodium carbonate per 100,000 of water.

(2) Suspended Solid Matter—Water from rivers and surface drainage generally is often charged with suspended matter, and it is at times necessary to determine the amount of this. A four-inch circle of specially prepared filter paper is folded in radiating rib fashion to promote quick filtrations, and is dried in the stoppered drying tube for one hour at 230 degrees Fahrenheit. Fig. 4 in Part I shows the air bath used; and Fig. 28 shows the tube employed for drying filters, the stopper being, of course, removed during the application of heat. The tube and filter are placed in the desiccator and are weighed together when cold, the stopper being inserted in the tube to prevent absorption of moisture by the filter while being weighed. The filter paper is now removed with small forceps from the tube, is placed in a funnel of suitable size with the least possible handling or rubbing of the folds; and 200 cubic centimetres of the water are measured and poured through it. The large sample of water must be well shaken

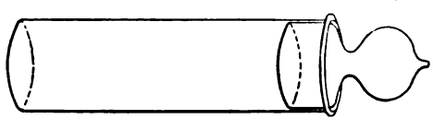


FIG. 28.—FILTER DRYING TUBE.

before withdrawing 200 cubic centimetres for this test. The filter with its contents is finally washed with cold distilled water, dried in the funnel as far as possible by suction, and is then removed carefully from the funnel and placed in the drying tube, for the final heating at 230 degrees Fahrenheit. The drying must be continued until a constant weight is obtained. The gain in weight multiplied by 500 gives the pints of suspended matter per 100,000 of water.

The following is an example of the figures obtained in this test:

Drying tube and filter and residue..... 12.122 grammes
Drying tube and filter alone... 12.067 "

Gain in weight... 0.055 gramme
$0.055 \times 500 = 27.50$ parts of solid suspended matter per 100,000 of water.

The color of the dried residue upon the filter paper will give some indication of its composition; iron oxides being generally red, and clay or alumina compounds being slaty gray in color.

(3) Total Solids—If the suspended matter has been separately determined by the method just described, the filtered sample of water is used for this test. Should the suspended matter not have been separately determined, the unfiltered

[1] The chemical symbol for hydrochloric acid is HCl, for carbonate of soda Na_2CO_3, and for carbonate of lime $CaCO_3$.

[1] The factor 9.5 can be used in these calculations in place of $\frac{100.000 \times 0.019}{200}$.

Digitized by Google

water, well shaken, is employed for the total solids determination. This is carried out by evaporating 250 cubic centimetres of the water to dryness, in a tared platinum basin. Fig. 29 shows the apparatus used for this test. The basin is 2.4 inches in diameter and holds fifty cubic centimetres of water. The water bath is of copper, six and one-half inches in diameter, holds 1,000 cubic centimetres, is provided with rings of various sizes, and is supported upon a piece of iron gauze resting on a large tripod stand.

A bamboo or glass triangle with a long leg fitted into a cork which slides upon the upright of a retort stand is employed as shown in Fig. 29 to carry a piece of glazed paper, in order to protect the water in the platinum basin from dust or dirt. A large cork on the upper side of this dirt-shield serves to hold it in its place. The platinum basin must not be allowed to touch the copper ring of the water bath, but must be supported by three squares of filter paper, folded to form thick wedges and inserted between the basin and the edge of the ring, in such a way that an annular space is left for the escape of the steam from the water in the bath. The platinum basin must be thoroughly cleaned and dried by heating for five minutes in the air bath at 230 degrees Fahrenheit, before weighing. About forty cubic centimetres of the sample water measured in the 250-cubic-centimetre flask shown in Fig. 23 are then poured carefully into the basin already placed in position on the ring of the water bath with the aid of the filter-paper strips already referred to, and the evaporation is commenced.

It is advisable never to fill the basin within one-quarter of an inch of the rim, since many salt solutions have a tendency to creep up and over the sides when being evaporated to dryness. It is also advisable to keep the water bath in steady but not violent ebulition, by regulation of the gas flame beneath it. As the evaporation proceeds, the remainder of the 250 cubic centimetres are gradually added, and finally the 250-cubic-centimetre flask is rinsed out with distilled water and the washings added to the liquid in the basin. The platinum basin is kept upon the water bath until the residue of salts is apparently quite dry. It is then removed, the bottom of the basin is carefully cleaned and wiped dry, any deposit being removed by aid of HCl and a wet towel, and the basin and its contents are heated three hours at 300 degrees Fahrenheit in the air bath. The desiccator must be employed during the last stage of cooling before weighing; as perfectly dry salts are always hygroscopic. The increase in weight of the basin multiplied by 400 gives the parts of solid matter per 100,000 of water.

The following is an example of the figures obtained in the test:

Platinum basin and residue from 250 cubic centimetres of unfiltered water	26.165 grammes
Platinum basin alone	26.023 "
Weight of residue	0.142 gramme

$\frac{0.142 \times 100,000}{250}$ = 56.8 parts of solid matter for 100,000 of water.

Should it be desired to find what proportion of this residue is present as organic matter, the basin and its contents are heated to redness for five minutes upon a platinum-wire support over a large Bunsen burner, the change in color being noticed during this further heating. Organic compounds darken and char

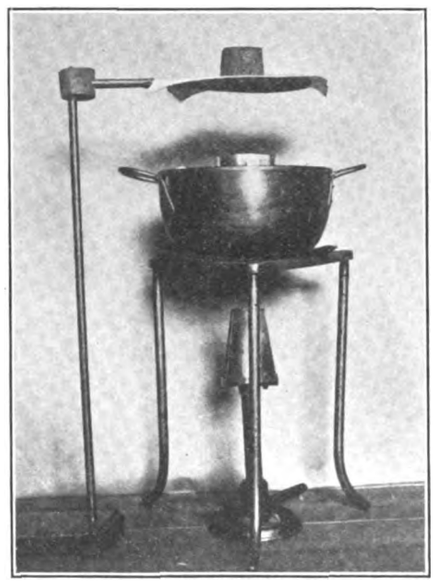


Fig. 29.—Platinum Basin and Water Bath.

under this treatment. The basin is then allowed to cool, the residue is moistened with a solution of ammonium carbonate in water to reconvert the oxides into carbonates, and the excess of ammonium carbonate and water is then driven off by application of gentle heat. Care must be taken during this operation that the basin and its contents do not approach a red-heat, otherwise the calcium and magnesium carbonates will be again reconverted into oxides. Finally the basin is cooled in the desiccator and again weighed. The loss in weight by this treatment, multiplied by 400, gives the parts of organic matter per 100,000 of water.

The following is an example of the figures obtained in this test:

Basin and residue after drying at 300 degrees Fahrenheit	26.142
Basin and residue after ignition and treatment with ammonia carbonate	26.120
Loss by ignition	0.022

$\frac{0.022 \times 100,000}{250}$ = 8.80 parts of organic matter per 100,000 of water.

(4 and 5) Temporary and Permanent Hardness—The temporary hardness of water is caused by the presence of carbonates of lime and magnesia in solution; permanent hardness is due to the corresponding sulphates and oxides of these two elements. The Clark test for hardness is carried out by shaking the water before and after boiling with a standard soap solution, and by measuring the volume of this required to produce a permanent lather. The Clark or English degree of hardness represents the grains of calcium carbonate in one gallon of water;[1] while the French degree of hardness represents the parts of calcium carbonate in 100,000 parts of water, and the German degree of hardness represents the parts of calcium oxide (CaO) in 100,000 parts of water. The Clark test for hardness is not very satisfactory, although still generally employed in this country. The results obtained vary within wide limits, and are much too dependent upon the personality of the tester. For this reason the Clark test with soap solution is now giving place to the more scientific ones described below, in which the weight of calcium and magnesium carbonates and of calcium and magnesium sulphates, as determined by the approximate analysis, are used for calculating the degrees of hardness of the water.

The alkalinity test already described yields the English degrees of hardness, if the parts of calcium carbonate per 100,000 of water as ascertained by the cubic centimetre of standard acid solution used be multiplied by 0.7.

The following is an example of the figures obtained in this test:

Two hundred cubic centimetres of filtered water took 3.7 cubic centimetres of standard acid solution, using methyl orange as indicator.

$\frac{3.7 \times 0.019 \times 70,000}{200}$ = 24.61 English degrees of hardness.

The expression $\frac{0.019 \times 70,000}{200}$ can be reduced to the factor 6.65 to simplify the calculation for temporary hardness. The cubic centimetre of standard acid solution

[1] This figure was chosen by Clark because in his day the gallon was the standard of volume. There are 70,000 grains in one gallon.

Digitized by Google

used, multiplied by 6.65, then gives the temporary hardness in English degrees.

The permanent hardness of water can be approximately ascertained by aid of the results obtained in the tests for total solids, if the filtered water has been used for carrying out this test, and no organic matter be present to complicate the calculation.

The results of this test expressed in parts per 100,000, and multiplied by 0.7, will then give the total hardness in English degrees, and the difference between the total hardness and the temporary hardness yields the permanent hardness. Taking the figures given in Sections 1 and 3 of this article as an example, we have:

Total solids, 56.8 per 100,000 of water. $56.8 \times 0.7 = 39.7$ parts $CaCO_3$ per 70,000 of water, or total hardness in English degrees.

The temporary hardness of this water as found by test 1 was, however, 24.61 degrees, and 39.76 less 24.61 gives 15.15 as the permanent hardness, expressed in English degrees.

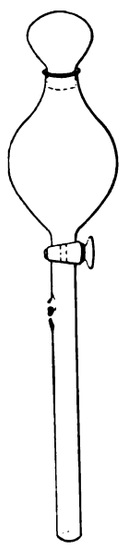


FIG. 30.—SEPARATING FUNNEL.

It is safer, however, to make a special test for the sulphates and oxides which produce permanent hardness. This is carried out as follows:

One hundred cubic centimetres of the filtered sample of water are taken and evaporated to dryness on the water bath in the platinum basin with an addition of twenty-five cubic centimetres of the standard sodium carbonate solution. This treatment decomposes the sulphates and oxides, and converts them into carbonates. The residue is dissolved in distilled water and is gently heated. The carbonates of lime and magnesia present in the residue are left insoluble, and are now removed by filtration. The filter and its contents are well washed with warm water to remove the excess of alkali. The filtrate and washings are collected in the porcelain basin shown in Fig. 24, and after cooling are titrated with the standard acid solution, using methyl orange as indicator. The amount of acid solution required to neutralize the carbonate of soda remaining in the filtrate enables one to calculate how much has been used for decomposing the sulphates and oxides.

The following is an example of the figures obtained in this test:

One hundred cubic centimetres of the filtered water were evaporated with twenty-five cubic centimetres of standard alkali solution.

The filtrate and washings required 22.5 cubic centimetres of standard acid solution to neutralize the excess of alkali.

Now, as 100 cubic centimetres of the alkali solution are equivalent to 96.2 cubic centimetres of the acid solution, 25 cubic centimetres equal $\frac{96.2}{4}$; 24.05 cubic centimetres, and $24.05 - 22.50 = 1.55$ cubic centimetres. This is the volume of acid corresponding to the carbonate of soda which has disappeared in this test.

The calculation for the permanent hardness is therefore as follows:

$$\frac{1.55 \times 0.019 \times 70.000}{100} = 20.60 \text{ parts}$$

$CaCO_3$ per 70.000 of water.

The expression $\frac{0.019 \times 70.000}{100}$ can be reduced to the factor 13.3 to simplify calculation. The cubic centimetre used, multiplied by 13.3, then yields the permanent hardness in English degrees.

It is possible to make the standard solutions of acid and alkali of such a strength that the degrees of hardness can be read off directly from the cubic centimetre of solutions used in making the test.

It is, however, somewhat troublesome to make a solution of hydrochloric acid, 100 cubic centimetres of which shall equal exactly 0.143 gramme of $CaCO_3$, and another of carbonate of soda, one cubic centimetre of which shall exactly neutralize one cubic centimetre of the standard acid solution. Moreover, hydrochloric acid solution is liable to change in strength, when above or below a definite limit of concentration. The writer has therefore thought it best to show how solutions of approximately fifth normal strength may be applied to water-testing without alteration. As already pointed out, by the use of single factors for the fixed values of the calculation, the labor in calculating the temporary and permanent hardness of the water is reduced to a minimum.

In works where many water analyses are made in the course of a day, it will, of course, be found advisable to make the solutions in large quantities and of such a strength that calculation is altogether avoided. In such cases, when using 100 cubic centimetres of water for the hardness tests, the solutions should have the following values:

One hundred cubic centimetres standard acid solution equal 0.143 gramme $CaCO_3$.

One hundred cubic centimetres standard alkali solution equal 100 cubic centimetres standard acid solution.

No simple apparatus can be put into the hands of the fireman or boiler engineer which will enable him to determine for himself the degree of hardness of the feed-water. The use of slips of neutral litmus paper (this is sold in books by chemical-apparatus dealers) will afford some indication of the character and purity of the water supply; but exact chemical tests carried out as described are necessary in order to obtain any information of real value to the boiler engineer.

Special testing sets provided with tabloid chemicals and printed directions which can be read and carried out by any fireman or stoker, are mere inventions of the unscrupulous for the delusion of those engineers who know little of the complex chemistry of the subject.

(6) Tests for Oil—Oil is a most dangerous impurity in boiler feed-water. When using water from condensers for boiler purposes, it is therefore always advisable to test the feed occasionally in order to find if any oily or fatty matter be present.

The sample of water should be cooled before testing, and then shaken vigorously with one-fifth of its volume of petrol or of ether, in the type of separating funnel shown in Fig. 30. The liquid is then allowed to stand fifteen minutes in the funnel supported in an upright position in a retort stand, the water is run off by the separating cock, and the petrol or ether solution which floated on the water and contained all the oil and fat is run into the porcelain basin shown in Fig. 24. This is placed upon the water bath, which is filled with hot water but has no lighted lamp beneath it, since petrol or ether vapor is a most inflammable gas, and all lights must be extinguished in the room where it is present. The petrol or ether evaporates quickly and leaves the oily or fatty matter as a residue in the basin.

If desired, this test can be made quantitative in character by using 250 cubic centimetres of the water for the test, and by transferring the solution of the fat to the tared platinum basin, toward the end of the evaporation. The large porcelain basin and the separating funnel must in this case be rinsed out with the same spirit, and the rinsings added to the solution in the platinum basin.

The oily residue in this, after heating for some time at 212 degrees Fahrenheit, is finally weighed.

To distinguish between animal or vegetable and mineral oils, the residue in the basin should be heated on the water bath with a strong solution of caustic potash. Animal and vegetable oils saponify (*i.e.*, yield a soap) under such treatment, while mineral oils remain unaltered.

The presence of oily and fatty matter in boiling scale can be detected by heating the sample of scale to redness in the platinum basin. If charring occurs, or if a disagreeable odor be noticed, some organic fatty compounds are probably present. Fats and oils of animal or vegetable origin are more dangerous lubricants for engines than hydrocarbon oils of the paraffin class, since the former contain oxygen, and yield organic acids when decomposed at the high temperature occurring in the boiler.

Digitized by Google

Cooling the New York Subway.

A Description of the New Ventilating System and the Experimental Cooling Plant.

WITHIN the past month the Interborough Rapid Transit Company has placed in operation an extensive system of ventilation at the stations along the subway route operated by the company in New York city. During the heated period of the year, when the temperature on the street was very high, the conditions in the subway became at times entirely unsatisfactory to the engineers and officials of the company, as it was found that while there might be a considerable fall in temperature above ground, the temperature in the subway proper did not follow these changes so as to make the relief appreciable. With a view to improving the ventilation of the subway, the general plan of cutting into the vault lights at a number of the stations and installing ventilating gratings was introduced. To secure further cooling of the atmosphere an experimental cooling plant has been established at the Brooklyn Bridge station of the subway system.

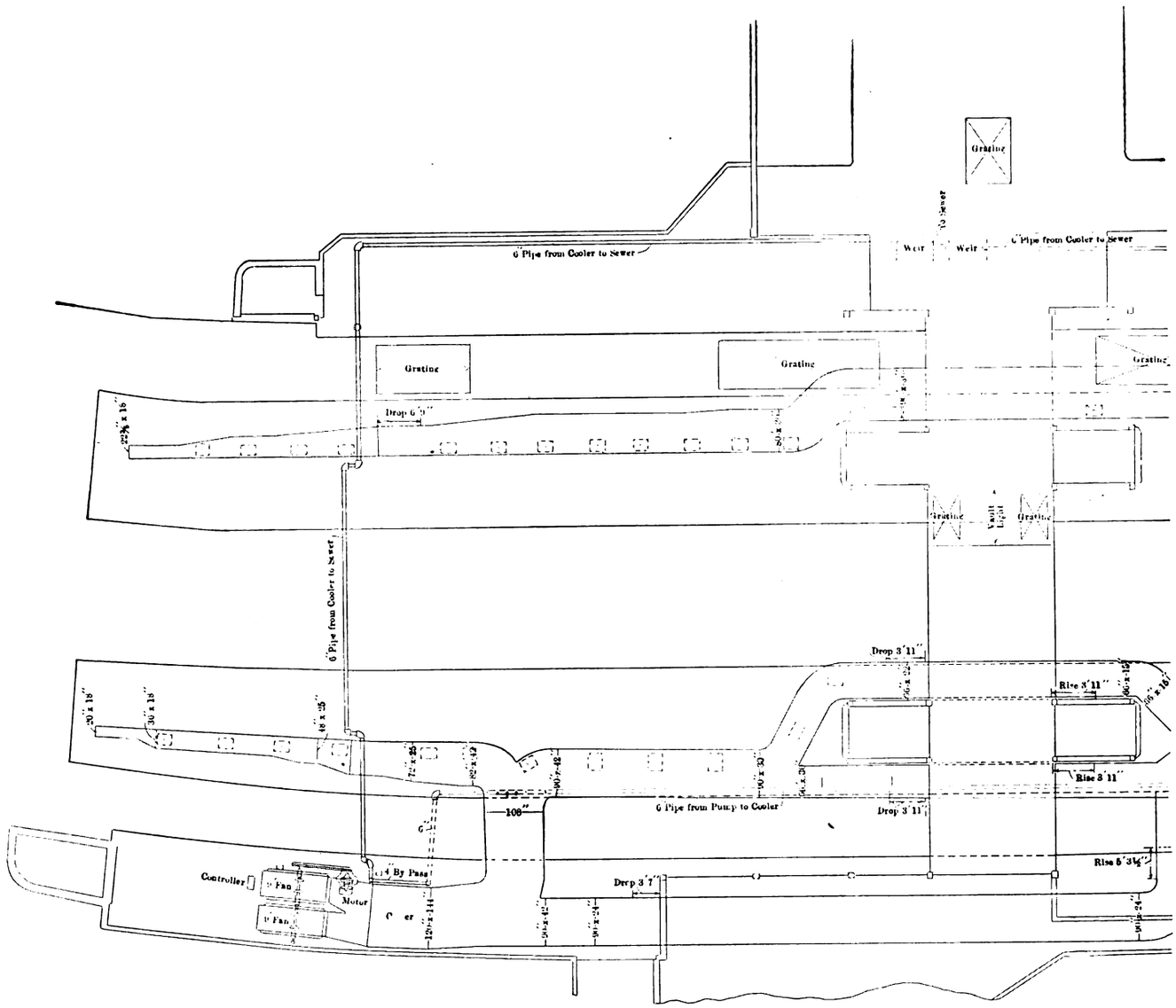


DIAGRAM SHOWING RELATIONS OF THE VARIOUS ELEMENTS OF THE EXPERIMENTAL COOLING

The work of improving the ventilation consisted primarily in cutting openings in the vault lights from the Brooklyn Bridge station to the Ninety-sixth street station, inclusive, and installing gratings therein. About 5,000 square feet of vault lights have been cut out and gratings installed, providing approximately 2,500 square feet of additional effective opening at the stations for the inlet of air. The immediate result of these openings was an improvement in the conditions at the stations. The warm air which had been found under the vault-lights was released, and the temperature in the stations responded more nearly to outside changes. The effect was most noticeable, however, directly under the openings.

In addition to the opening of the vault-lights there were fourteen ventilating chambers constructed adjacent to the subway between the Brooklyn Bridge station and the Columbus Circle station. These chambers provide outlets for the air be-

Digitized by Google

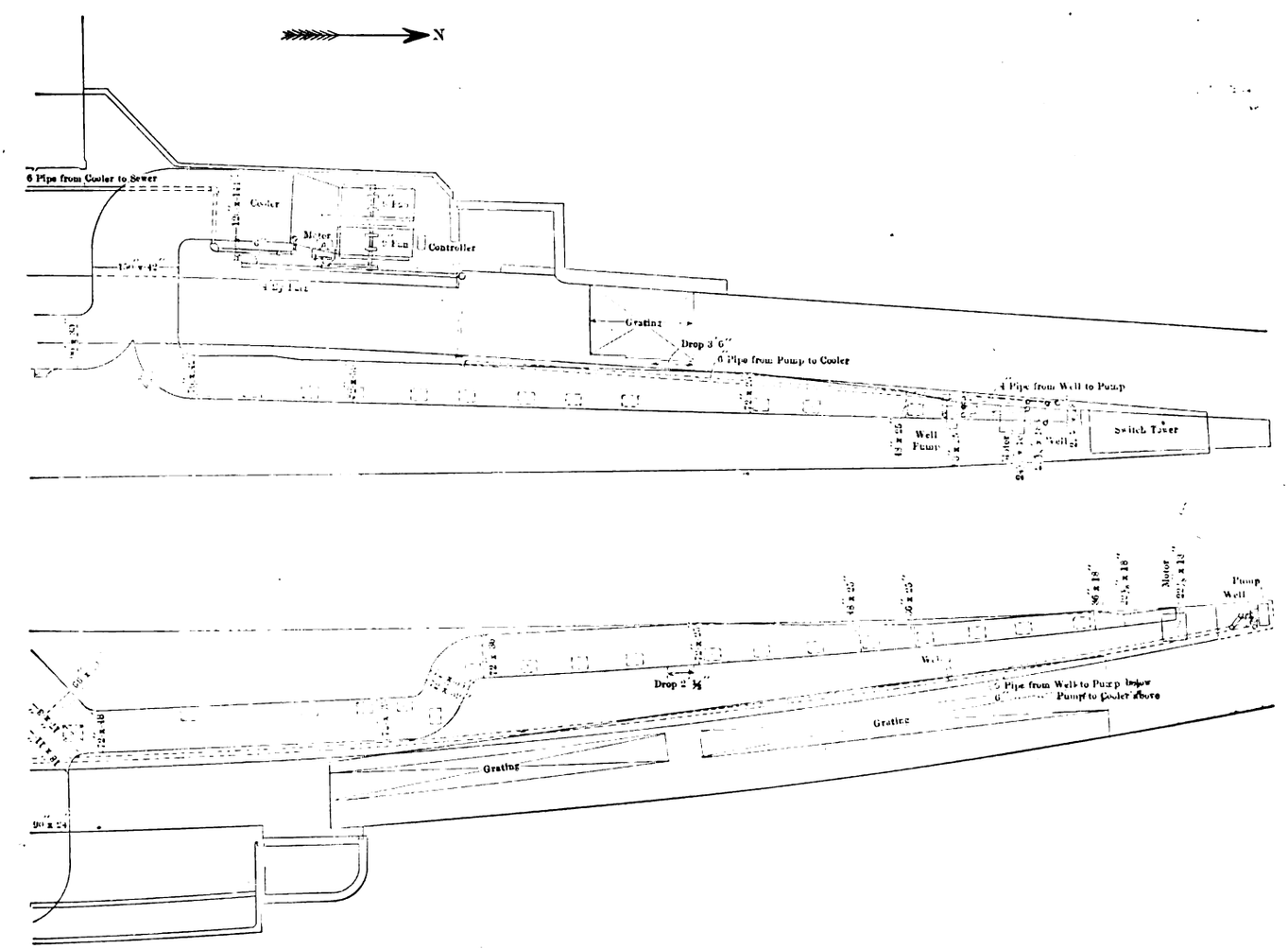
tween the stations. At these outlets the air is exhausted during the daytime by automatic louvres, and at night by motor-driven fans. Where the ventilating chambers have been cut through into the subway an immediate change has been noticed, a local effect being produced similar to that produced by the gratings at the stations.

Between the Columbus Circle station and the Ninety-sixth street station automatic louvres have also been installed. With the complete system of louvres and fans in operation the circulation of the entire system has been very greatly improved.

One of the most interesting features of this work, however, has to do with the experimental cooling plant installed at the Brooklyn Bridge station. The cooling plant consists of two separate units, one for the west half of the station and one for the east half. The accompanying illustration shows the relations of the various parts of these units. Each unit consists of the following parts: two separate housed steel-plate fans nine feet in diameter on one shaft for driving the air. The capacity of the two fans is 75,000 cubic feet of air per minute at 175 revolutions per minute. One C & C forty-horse-power direct-current motor wound for a normal speed of 800 revolutions per minute, running on a 625-volt circuit, for driving the two fans. One Cutler-Hammer "Universal" speed-regulator for controlling the speed of the motor. One forty-horse-power Renold silent chain drive for connecting the motor to the shaft of the fans. A coil of 22,080 linear feet of one-inch galvanized wrought-iron pipe (enclosed in a galvanized sheet-iron casing), over which air is blown for cooling. A system of galvanized sheet-iron ducts with openings for distributing the air in the station. Two wells for supplying water to the coils. One Deane triplex double-acting pump for driving the water through the coils. One fifteen-horse-power direct-current motor for driving the pump. One Cutler-Hammer "Universal" speed regulator for controlling the motor. Wrought-iron water-pipe with fittings leading from the pump to the cold-water coils and from the coils to the city sewer.

The blower fans were furnished by the American Blower Company, New York city. As may be seen from the accompanying illustration, these blowers are in duplicate. The blowers take the air directly from the inside of the station, and are designed to drive 37,500 cubic feet of air per minute each at 175 revolutions per minute. These two fans are driven by one forty-horse-power direct-current motor made by the C & C Electric Company, New York city. The Cutler-Hammer No. 45 "Universal" speed regulator which controls the speed of the motor is well shown in the accompanying illustration.

The warm air from the inside of the station is blown by the fans over the



PLANT INSTALLED AT THE BROOKLYN BRIDGE STATION OF THE NEW YORK CITY SUBWAY.

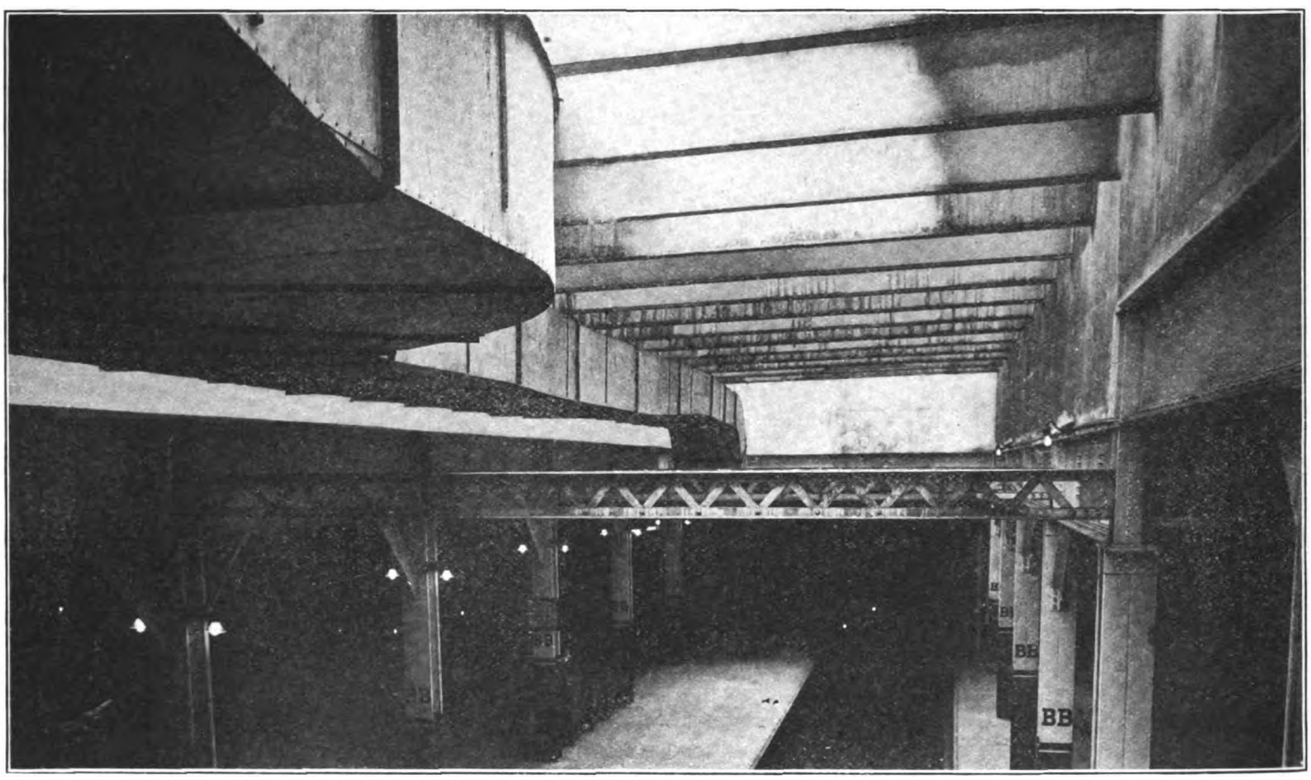
Digitized by Google

cooling coils, which are encased in a galvanized sheet-iron casing. After the air passes over the cooling coils it is again distributed to the interior of the station by means of a system of galvanized sheet-iron ducts which is run above the island platforms and suspended from the roof of the station.

One of the illustrations gives a good idea of the general appearance of the duct system. The velocity of air through the ducts is about 1,720 feet per minute, discharging about 75,000 cubic feet of air per minute. Openings for discharging the air into the station are cut in the bottom of the ducts. These openings are twenty inches by twenty-eight inches, spaced ten feet from centre to centre. For discharging the 75,000 cubic feet of air per minute there are thirty-two such openings, so that 2,340 cubic feet per minute are discharged through each opening, which has an area of 3.89 square feet, the velocity of discharge being 602 feet per minute. In operation the air is discharged at an angle of about forty-five degrees to the horizontal, without the presence of deflecting dampers, which, however, have been placed inside the ducts and cause the air to discharge directly downward. Also, gratings which have been put over the openings will somewhat affect the area of the opening and the velocity of discharge given above. The ducts are reduced in size at each opening, and have a section eighteen inches by twenty inches at the extreme end, which is left open.

The cold-water coils are built in three sections, placed one above the other. Each section consists of sixteen pipes vertically and forty-six pipes horizontally. The pipes are one-inch galvanized wrought iron, put together with galvanized return bends. The sixteen horizontal rows of pipes are connected in multiple at each end with a header or branch T. Each header is of three-inch galvanized wrought iron capped on the ends, with a three-inch T in the centre, tapped on one side for sixteen one-inch outlets. The three sections of the coil are connected up separately to the cold-water main with a gate valve for each section, so that each section may be regulated independently of the others. The water flows through the coils against a current of air, and is then discharged into the city sewer. Each of the three sections of the coil is vented at the top with a three-eighths-inch pipe and cock to facilitate the discharge of entrapped air. The general outside dimensions of the completed coil are about ten feet long by nine feet wide by twelve feet six inches high. The coils are enclosed in galvanized sheet-iron casings, and the completed sets of coils are braced to the subway columns for rigidity.

For securing a supply of cold water four wells have been sunk, two on the north end of each of the two island platforms. These wells have an eight-inch wrought-iron casing extending twenty-nine feet eight inches down from the top of the platform, and a six-inch wrought-iron suction pipe extending forty-six feet from the top of the platform. Each well is equipped with a copper strainer twelve feet six inches long, and the bottom of the pit is four feet two inches below the top of the platform. From the bottom of the pit to the water level the well is fifteen feet two inches, and from the top of the platform to the water level the distance is nineteen feet four inches. From the water level to the bottom of the strainer the distance is about thirty-six feet eight inches. For lifting the cold water from the wells and driving it through the coils two Deane triplex double-acting pumps are used, one for each half of the station. These pumps are six inches in diameter by eight inches stroke, with a five-inch suction and four-inch discharge. The displacement of each pump is 5.87 gallons per revolution, or 200 gallons at thirty-four revolutions per minute, and 264 gallons at forty-five revolutions per minute. Each of the Deane



THE AIR-DUCT SYSTEM USED IN CONNECTION WITH THE EXPERIMENTAL COOLING PLANT IN THE NEW YORK CITY SUBWAY OF THE INTERBOROUGH RAPID TRANSIT COMPANY.

Digitized by Google

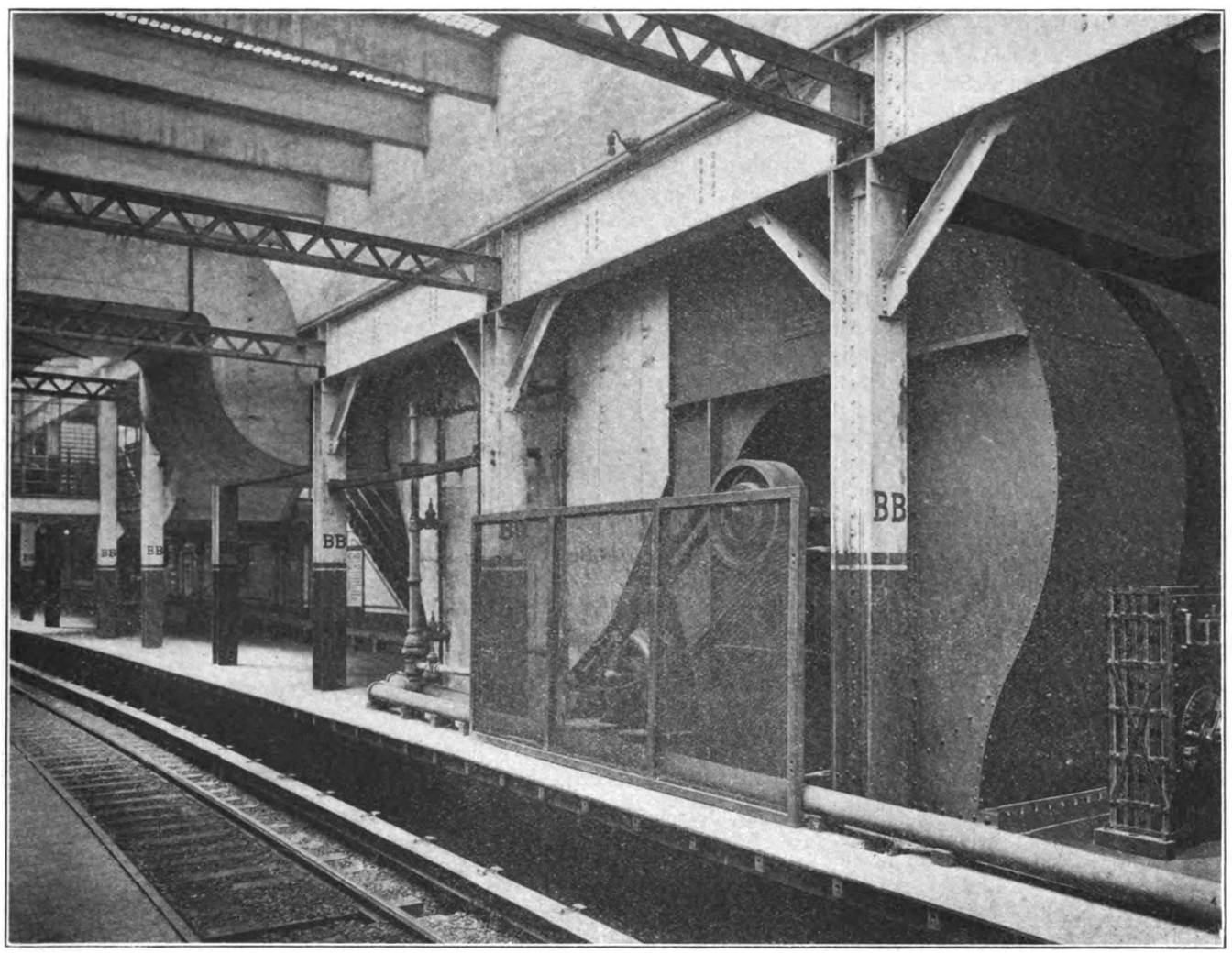
pumps is driven by a leather belt from a fifteen-horse-power, direct-current, variable-speed motor made by the C & C Electric Company. The speed variation of the motors is from 700 revolutions to 1,400 revolutions per minute, the voltage 550 to 750. Each of the two motors is controlled by a Cutler-Hammer No. 24 "Universal" speed regulator.

The blower and motor system, with its speed-regulating controller, and the pumping outfit, with its motor and controller, are identical for both the west and east sides of the station. The two duct systems are also similar in design and dimensions. The coil erected on the northbound local platform is the same as that on the southbound local platform, which has been described, with the exception that the third, or top, section has fifteen instead of sixteen horizontal rows of one-inch pipes, on account of the low ceiling in the station.

The effect of the operation of this cooling system was immediately noticeable. At midnight of August 29, or after the system had been in operation for fourteen hours, the average temperature in the station had been lowered seven degrees down to seventy-five degrees, the same temperature as the outside air. The plant is operated on week-days from 7 A. M. to 8 P. M., and on Sundays from 10 A. M. to 8 P. M. The air as it is discharged from the ducts directly over the platform has been noted to be from three to six degrees cooler than the average temperature in the station. The passengers therefore obtain the immediate benefit of this additional cooling before it has been diffused throughout the station. Because of this the plant is operated only during the daytime. In warmer weather, however, it may be necessary to operate it continuously for twenty-four hours.

An interesting fact has been noted in connection with this cooling system. Before the cooling plant was put in operation the Brooklyn Bridge station was always from two to six degrees warmer than the Fourteenth street and Grand Central stations, while after the plant was operated the reverse condition existed; that is, the Brooklyn Bridge station was from two to four degrees cooler than the Fourteenth street and Grand Central stations.

The installation of the cold-water coils was made by the James Curran Manufacturing Company, New York city. The artesian wells were sunk by F. W. Miller, New York city, and the duct work was sublet by the American Blower Company to the Thompson-Starrett Company, New York city.



EXPERIMENTAL COOLING PLANT, NEW YORK CITY SUBWAY OF THE INTERBOROUGH RAPID TRANSIT COMPANY.

Wireless Telegraph Conference.

About 100 delegates to the wireless telegraph conference now sitting at Berlin are in attendance. The following countries are represented: Argentina, Austria-Hungary, Belgium, Brazil, Hungary, Chili, Denmark, Egypt, Germany, Greece, Great Britain, Italy, Japan, Mexico, Monaco, Montenegro, the Netherlands, Norway, Prussia, Portugal, Roumania, Russia, Siam, Spain, Sweden, the United States and Uruguay. Turkey has failed to reply to the invitation and China and Peru declined to send representatives.

Digitized by Google

Stress in Magnetized Iron.

Maxwell's theory indicates that there should be a stress in magnetized iron directly proportional to the square of the induction. The question was raised some time ago, whether this stress is compressive or tensional. Recently Shelford Bidwell expressed the opinion that this was a compressive stress, comparing it to the action of two magnetized bodies, which are attracted together and will compress any matter lying between them. C. Chree questions here whether this view is correct, and whether the stress should not be tensional, such as would exist if a series of magnets were placed in line, separated a short distance from one another. Each magnet would then attract the opposing poles of its neighbors, and thus would exert and have exerted upon it a tensional stress. In other words, if the centres of the magnetized particles be fixed, they will be subjected to a tensional stress. If the spaces between them be filled with some material, the latter will not be compressed unless the tensional stress of the magnetized particles causes them to be extended. The author considers the evidence which has been presented insufficient to decide finally in favor of either of the two ideas, and asks for further light upon the subject.—*Nature (London), September 27.*

ELECTRICAL MINE PUMPS AT THE WARD SHAFT.

BY LEON M. HALL.

The pumping plant just received at the Ward shaft, Virginia City, Nev., is probably the largest, best and most complete electrically driven mine-pumping installation ever constructed, so that a brief description of the same, together with the reasons for its existence, may be of interest to those engaged in the mining and electrical industry.

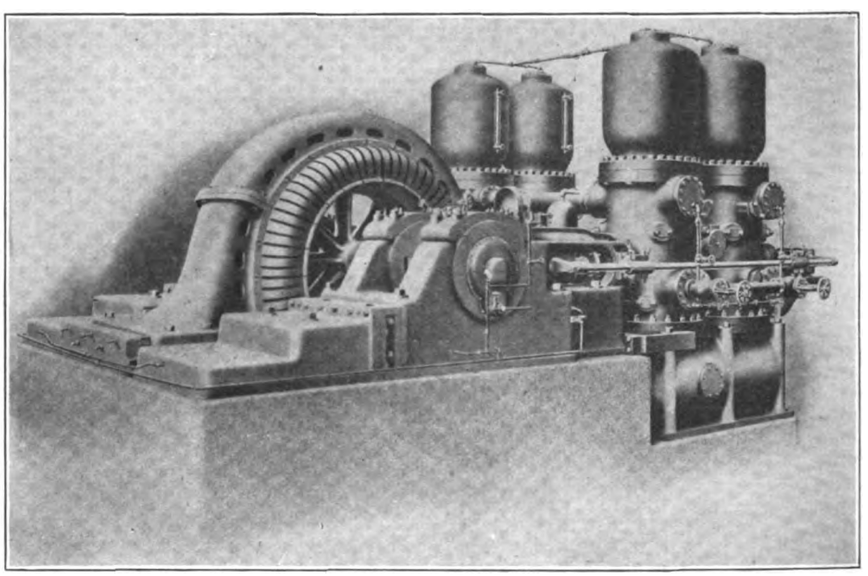
The Ward Shaft Association was formed some three years ago with the ostensible purpose in view of opening the Ward shaft and of draining the middle group of mines on the Comstock, in order to explore this lode to its very lowest depths. This shaft was originally sunk to a vertical depth of 2,480 feet, and just before reaching this point had passed through the vein, which proved to be a mineralized fissure over sixty feet in width. Some fifteen years ago this shaft was abandoned on account of the stagnation then existing in the silver market, and, with the cessation of work, it was allowed to decay and partially fill with rock and refuse of all kinds.

The shaft was rehabilitated and retimbered without much trouble to the 1,600-foot level, at which point a drainage drift was run 275 feet to connect with the South Lateral branch of the Sutro tunnel. Below this level difficulties of all kinds incident to hot water and its attending evils were encountered, and the progress has consequently been slow and expensive. To-day the shaft is in perfect condition to the 2,430-foot level, leaving but fifty feet of the old shaft to recover. From the 2,480 to the 3,100-foot level the work will all be in new ground, probably free from water, so that it is confidently expected that progress will be rapid and the new electric pumps in early operation.

In reopening this shaft a considerable flow of very hot water was encountered, so that quite an extensive temporary pumping plant was necessary, and this will be briefly described in the following:

In order to supplement this plant, a five-step Byron Jackson centrifugal pump, directly connected to a special Westinghouse induction motor, has been installed on the 2,410-foot level. This pump has a capacity of 600 gallons per minute against a head of 900 feet and it will take its supply of water directly from the sinking pump, thereby doing away with the triplex and centrifugal pumps before mentioned. This pump is entirely of bronze, operates at 1,700 revolutions per minute, and under these conditions shows an efficiency of sixty-seven per cent with the water temperature 160 degrees Fahrenheit. This pump will be duplicated immediately for safety of operation, and, with these as an auxiliary, the company confidently hopes to reach the 3,100-foot level at no distant day.

On the 3,100-foot level the excavation



DUPLEX, OUTSIDE PACKED, PLUNGER ELECTRIC POWER PUMP. CAPACITY, 1,600 GALLONS PER MINUTE, AGAINST 1,550-FOOT HEAD AT 195 REVOLUTIONS PER MINUTE.

On the 2,100-level a six-and-three-quarters-by-eight-inch Knowles vertical triplex pump, geared to a 100-horse-power induction motor, was placed and arranged to take its water from a three-step Byron Jackson centrifugal pump belted to a fifty-horse-power induction motor, located on the 2,330-foot level. In turn, this centrifugal receives its supply from a nine-inch Blake sinking pump at the bottom of the shaft. Two 100-horse-power Ingersoll-Sergeant compound air-compressors, driven by two 100-horse-power motors, are in operation on the surface and supply this sinker with the necessary motive power. This temporary plant is raising 300 gallons per minute 855 feet, from the present sump to the Sutro tunnel level.

of a pump station eighty feet long, twenty-four feet wide and twenty feet high is contemplated, in which will be placed the permanent pumping plant, the real subject of this sketch.

The capacity of this permanent installation will be 3,200 United States gallons per minute against a total head of 1,550 feet, and this will be divided between two units each separately driven by a special slow-speed 800-horse-power Westinghouse induction motor. The pumps are of the Knowles express type and are the embodiment of all of the best mechanical and electrical ideas obtainable for this class of work. They are outside, end-packed, duplex, double-acting pumps with plungers six and eleven-sixteenths inches in diameter and fifteen inches stroke. The

Digitized by Google

rotating element of the motor is placed directly on the crank shaft and they will operate at 195 revolutions per minute.

The valves are automatic poppet valves arranged in nests of thirteen each. The valve area (103.35 square inches) is unusually large, so that the consequent movement of the valves is extremely small, all of which is conducive to a high rotative speed with a minimum of wear. The valves, stuffing-box glands and other vital parts exposed to the action of the water are of bronze and are arranged so that they may be readily renewed.

The plant will be equipped with a three-stage electrically driven air-compressor for charging the air-receivers, a vacuum pump and an automatic oiling system. For convenience of erection and repair, the pump station will be fitted with a fifteen-ton traveling crane; in fact, it is intended to include in this plant everything that will ensure reliability and ease of operation.

The over-all dimensions of each pump are twenty-seven feet three and three-quarter inches in length, seventeen feet in width and fourteen feet two and one-half inches in height. The motor is thirteen feet in diameter, and the steel crank shaft, forged from one piece, is thirteen and three-quarter inches in diameter and fourteen feet four and one-half inches long. The total cost complete for operation will be about $125,000. These pumps will be supplied by either one of the two centrifugals located in the sump at the bottom of the shaft and operated by special seventy-five-horse-power Westinghouse motors on a vertical shaft.

The water will be discharged through sixteen-inch outside diameter steel column with welded steel flanges. The thickness of this pipe varies from one-quarter inch at the tunnel level to nine-sixteenths inch at the bottom. The column will be supported by means of heavy-weight iron clamps, six inches in length, which, in turn, will rest upon the wall and end plates. To resist the pressure of 675 pounds to the square inch, male and female flanges are used and each fitted with a lead-filled copper gasket.

The electric current is taken down the shaft at 2,240 volts over a three-conductor, lead-covered, steel-armored cable of 400,000 circular mils capacity. The electric equipment, from the automatic oil circuit-breakers on the surface to the motors themselves, is the best that money can buy, so that, once in operation, with the plants of the Truckee River General Electric Company behind it, results are expected that have never before been approached for this class of work.

THE THEORY OF "MOVING COIL" AND OTHER KINDS OF BALLISTIC GALVANOMETERS.[1]

BY PROFESSOR HAROLD A. WILSON, F.R.S.

A formula which is usually given for ballistic galvanometers is

$$Q = \frac{H T}{G \pi} \sin \frac{\theta}{2},$$

where Q = quantity of electricity passed through galvanometer.
H = magnetic field controlling the galvanometer needle.
G = magnetic field at needle, supposed perpendicular to H, due to unit current in the coil.
T = time of a complete oscillation of the needle.
θ = angle of swing of the needle from rest, corrected for damping.

If ϕ is the steady angular deflection due to a current i, then $i = \frac{H}{G} \tan \phi$; so that

$$Q = \frac{T i \sin \theta/2}{\pi \tan \phi}.$$

The above formulæ are, of course, strictly speaking, only applicable to ballistic galvanometers consisting of a coil of wire having a single small magnet freely suspended at the centre of the coil, and arranged so that at its equilibrium position the axis of the magnet is in the plane of the coil.

In the following paper the proper formulæ for ballistic galvanometers of several types in general use are obtained, and it is found that in several cases they differ appreciably from the above.

In Professor Fleming's "Handbook for the Electrical Laboratory and Testing Room," vol. ii., the formula for a moving coil galvanometer is worked out; but owing to an approximation used in the calculation it is not obtained exactly, and it is afterwards given as applying to both moving-coil and moving-needle galvanometers.

The first type of galvanometer that will be considered is the moving-coil type with a rectangular coil, cylindrical iron core and cylindrical pole-pieces symmetrically arranged. In galvanometers of this type the magnetic field is approximately radial, so that the couple on the coil due to a steady current is proportional to the current and independent of the deflection. The controlling couple is due to the torsion of the wire by which the coil is suspended, so that the work required to turn the coil through an angle θ from its zero position is $\frac{a \theta^2}{2}$, where a is the couple exerted by the wire when the coil is turned through the unit angle. Let $C i$ denote the couple due to a current i, then we have $C i = a \phi$. When a current i is passed through the galvanometer for a short time $d t$, we have

$$C i \, d t = C \, d Q \quad K \, d \omega,$$

where K is the moment of inertia of the coil and ω its angular velocity. Hence

$$Q = \int i \, d t = \int \frac{K \, d \omega}{C} = \frac{K \omega}{C}.$$

We have also

$$T = 2 \pi \sqrt{\frac{K}{a}} \text{ and } \frac{a \theta^2}{2} = \tfrac{1}{2} K \omega^2;$$

hence

$$T = 2 \pi \sqrt{\frac{\theta^2}{\omega^2}} = \frac{2 \pi \theta}{\omega}.$$

Thus

$$Q = \frac{K \omega}{C} = \frac{a \theta^2}{C \omega} = \frac{T a \theta}{2 \pi C}.$$

But $\frac{a}{C} = \frac{i}{\phi}$; so that finally

$$Q = \frac{T i \theta}{2 \pi \phi} \text{ exactly.}$$

Since the couple on the coil due to the current is independent of θ, it is not necessary with this type of instrument that the time during which the transient current passes should be very small compared with T.

Another type of moving-coil instrument in common use has a narrow coil suspended between the poles of a magnet and no iron core. In this case the couple on the coil due to a current, i, will be nearly $C i \cos \phi$, so that $C i \cos \phi = a \phi$ or $\frac{a}{C} = \frac{i \cos \phi}{\phi}$; hence the exact formulæ for this type of instrument are

$$Q = \frac{T a \theta}{2 \pi C} = \frac{T i \theta \cos \phi}{2 \pi \phi}.$$

In these formulæ it is assumed that the plane of the coil at its zero position is parallel to the magnetic field.

It appears, therefore, that the first type of moving-coil ballistic galvanometer considered is superior to the second in respect of the simplicity of the exact formulæ to be used with it, and the absence of error when the transient current lasts an appreciable time.

Moving-needle instruments will now be considered. The formulæ

$$Q = \frac{H T \sin \theta/2}{G \pi} \text{ and } Q = \frac{T i \sin \theta/2}{\pi \phi}$$

apply to what may be called a tangent ballistic galvanometer. The time of the

[1] Paper read before the Physical Society of London.

Digitized by Google

transient current must of course be small compared with T, and its greatest value must not be sufficient to appreciably change the magnetism of the needle.

In many ballistic galvanometers an astatic system of needles is used. First, suppose the system is exactly astatic and that the torsion of a wire or quartz fibre supplies the controlling couple. In this case, $C\,i\cos\phi = a\,\phi$ and $K\,\omega^2 = a\,\theta^2$, so that the formulæ are

$$Q = \frac{T\,a\,\theta}{2\pi C} = \frac{T\,i\,\theta\cos\phi}{2\pi\phi},$$

as with the second type of moving-coil instrument. Also $C = M\,(G_1 + G_2)$, where M is the moment of each needle and G_1 and G_2 the fields due to unit current at the two needles respectively.

One other case will be considered—*viz.*, when the needle system is more or less astatic and is controlled by magnetic fields at each needle. Let the horizontal component of the controlling field at one needle be H_1 making an angle a_1 with the plane of this needle, and let M_1 be the moment of this needle. Let M_2, H_2 and a_2 be the corresponding quantities at the other needle. Then in the equilibrium position,

$$0 = M_1 H_1 \sin a_1 + M_2 H_2 \sin a_2.$$

The controlling couple when the needle is deflected through an angle ϕ is

$$M_1 H_1 \sin(\phi + a_1) + M_2 H_2 \sin(\phi + a_2) = \{M_1 H_1 \cos a_1 + M_2 H_2 \cos a_2\} \times \sin\phi;$$

and if ϕ is the deflection due to a current i, then

$$i\,M_1 G_1 \cos\phi + i\,M_2 G_2 \cos\phi = \sin\phi\,\{M_1 H_1 \cos a_1 + M_2 H_2 \cos a_2\}.$$

Hence

$$i = \frac{M_1 H_1 \cos a_1 + M_2 H_2 \cos a_2}{M_1 G_1 + M_2 G_2}\tan\phi.$$

It can now be easily seen that the formulæ for a ballistic galvanometer of this type are

$$Q = \frac{T\,(M_1 H_1 \cos a_1 + M_2 H_2 \cos a_2)\sin\theta/2}{\pi\,(M_1 G_1 + M_2 G_2)}$$

$$\text{and } Q = \frac{T\,i\sin\theta/2}{\pi\tan\phi}.$$

So far the correction of the observed deflection θ for damping has been neglected. The method usually described depends on the "logarithmic decrement," and is cumbrous and, moreover, inexact unless the damping is very small. The following method has the great advantages of simplicity and exactness; it is not new: the writer learned it about ten years ago from Professor W. Stroud.

Let θ_1, θ_2, θ_3, etc., be the successive swings of the galvanometer needle. Then

$$\frac{\theta_1}{\theta_2} = \frac{\theta_2}{\theta_3} = \frac{\theta_3}{\theta_4} = \text{etc.} = f \text{ say.}$$

To find f observe, say, θ_1 and θ_3, or θ_1 and θ_5. Then

$$f^2 = \frac{\theta_1}{\theta_3} \text{ or } f^4 = \frac{\theta_1}{\theta_5}.$$

Also the corrected value of the first swing is

$$\theta_1\sqrt{f} = \theta_1\left(\frac{\theta_1}{\theta_3}\right)^{1/4} = \theta_1\left(\frac{\theta_1}{\theta_5}\right)^{1/8}.$$

In most cases the angular deflections may be taken as proportional to the deflections on the scale. Let these be δ_1, δ_2, δ_3, etc. Then the corrected value of the first swing is

$$\delta_1\left(\frac{\delta_1}{\delta_3}\right)^{1/4} \text{ or } \delta_1\left(\frac{\delta_1}{\delta_5}\right)^{1/8}.$$

If the damping is small the corrected value is very nearly $\delta_1 + \frac{1}{4}(\delta_1 - \delta_3)$ and this formula is sufficiently exact for most purposes in practice.

The following table contains a summary of the results obtained:

Type of Galvanometer.	Formulæ.
(1) Tangent galvanometer with small needle at centre of coil.	$Q = \frac{H\,T}{G\,\pi}\sin\frac{\theta}{2}$. $Q = \frac{T\,i\sin\theta/2}{\pi\tan\phi}$.
(2) Astatic galvanometer with purely torsional control.	$Q = \frac{T\,a\,\theta}{2\pi M\,(G_1 + G_2)}$. $Q = \frac{T\,i\,\theta\cos\phi}{2\pi\phi}$.
(3) Astatic galvanometer with purely magnetic coil.	$Q = \frac{T\,(M_1 H_1\cos a_1 + M_2 H_2\cos a_2)}{\pi\,(M_1 G_1 + M_2 G_2)}\sin\frac{\theta}{2}$ $Q = \frac{T\,i\sin\theta/2}{\pi\tan\phi}$.
(4) Moving-coil galvanometer with iron core and radial magnetic field.	$Q = \frac{T\,a\,\theta}{2\pi C}$. $Q = \frac{T\,i\,\theta}{2\pi\phi}$.
(5) Moving-coil galvanometer with narrow coil and no core.	$Q = \frac{T\,a\,\theta}{2\pi C}$. $Q = \frac{T\,i\,\theta\cos\phi}{2\pi\phi}$.

It will be seen that type (4) is superior to all the others as regards the simplicity of the exact formula to be used with it. It is also superior in most other respects. Galvanometers are often met with in practice which, strictly speaking, do not belong to any of the simple types considered in this paper. In such cases the exact formulæ are more complicated, and the best plan to adopt is to determine experimentally the relation between θ and Q.

New York City Railway Earnings.

Gross earnings of the New York City Railway Company, lessee of the Metropolitan system, for the year ended June 30 were $21,937,944, an increase of $1,047,820. Operating expenses were $12,624,783, an increase of $353,959, and net earnings of $9,313,161; an increase of $696,161. The charges overbalanced the earnings, amounting to $11,950,903, so that the statement for the year shows a deficit of $2,212,997. In the previous year the deficit was $583,946 greater.

The special franchise tax is not included in the charges. The amount of this for the fiscal year is approximately $537,000. Proceedings are pending which, the report says, are expected to result in a substantial reduction in this amount. The deficit will be further increased by the amount of the special franchise tax when it is ascertained by the courts.

The report covers the first full year of competition with the subway, and President Vreeland notes that the increase of five per cent in the gross earnings "realizes the expected recovery and adjustment of the surface railroad traffic under new conditions, indicating that the increase in the short haul business is rapidly overcoming the loss of long haul traffic that has gone to the subway."

The fixed charges for the year included the increase in the annual rental payable under the lease of the Third avenue line which for four years, from April 13, 1906, is at the rate of six per cent, as against five per cent for the preceding two years. A saving in fixed charges was, however, effected by refunding the bonds of various small subsidiaries. The report adds:

"The equipment of the company during the year was increased by the purchase of twenty-five long open and twenty-five semi-convertible cars, which cars are now in operation. In addition twenty-five large closed cars are now being built for delivery early in the fall. Applications have been made and are now pending for about fifteen miles of double track extensions in the borough of The Bronx and its outlying district, which extensions if granted, will develop new territory and meet the local demand for additional transportation facilities."

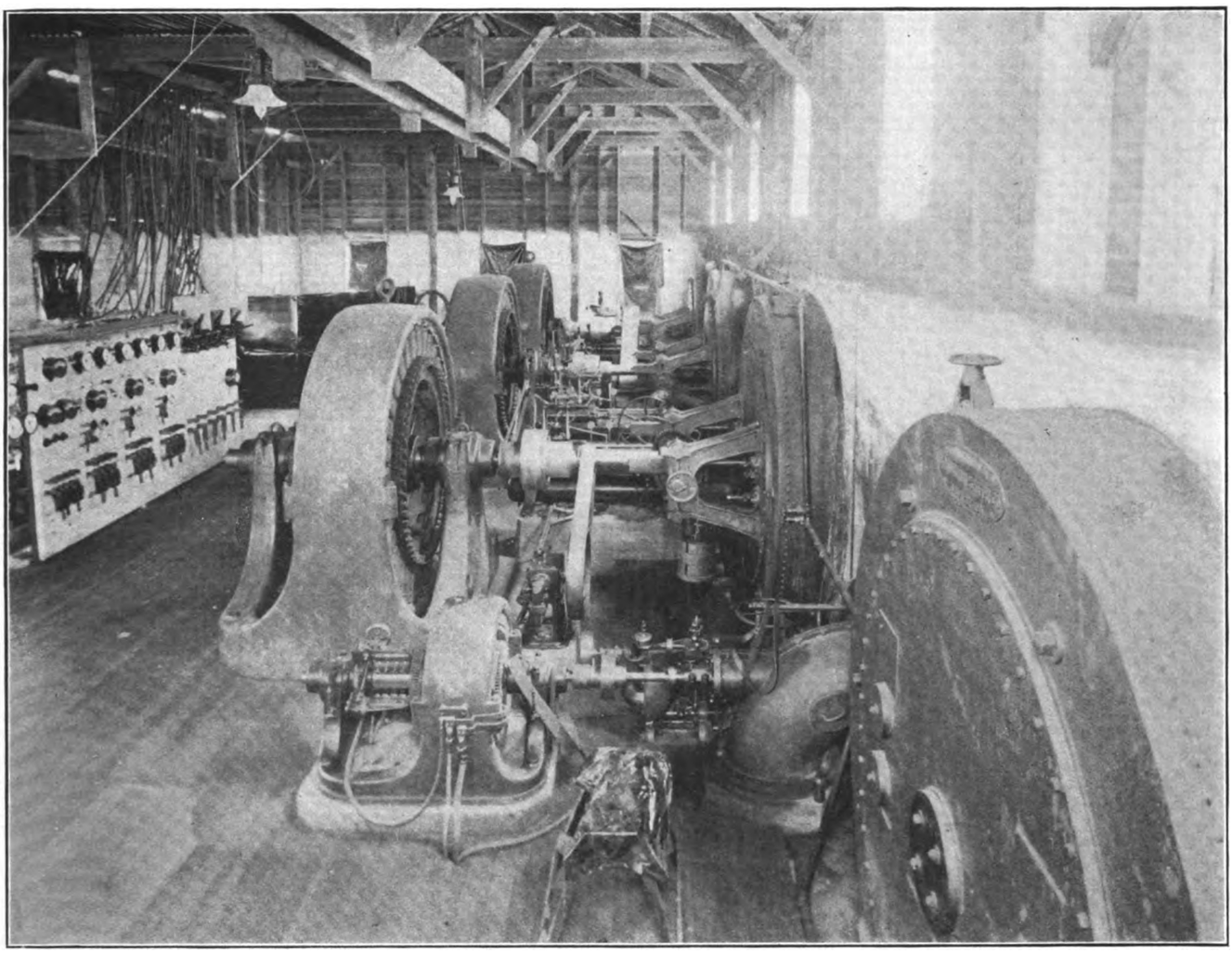
Digitized by Google

Hydroelectric Power Plant and Transmission Lines of the North Georgia Electric Company.

By R. W. Hutchinson, Jr.

PROMINENT among the hydraulic developments in the South, considering energy developed and transmitted, distance of transmission, thoroughness of design, stability of construction and number of power sites that will eventually be linked together, stands out the work of the North Georgia Electric Company, now completing two of its first developments on the Chestatee and Chattahoochee rivers near Gainesville, Ga. This company is now building a steel tower transmission line—the first in the South—to transmit its power to Atlanta, about fifty miles distant.

From a power-transmission viewpoint, the company completely circumvallates the city of Atlanta, controlling as it does the more important powers on the Etowah, Tallulah, Chattahoochee and Ocumulgee rivers, all of which are within the radius of economical transmission to several points of consumption, the largest of which, however, is Atlanta. This monopoly of water powers is a measure of self-protection which, as was outlined in a paper by Dr. F. A. C. Perrine before the American Institute of Electrical Engineers, in June, 1905, Southern water-power companies must adopt to prevent dangerous competition. The water powers in the South are so numerous and some are so variable that, to insure continuous service at or near maximum-load condition, success for the operating company is contingent upon its controlling all of the water power which can economically supply all of the territory that its development covers. The location of the power plant in northern Georgia, very accessible to the Tennessee and Alabama coal fields and hence subject to the competition of high-grade steam coal, demands for successful operation development on a large scale, with operating and depreciation costs per unit of output reduced to a minimum; and also demands a continuous twenty-four-hour-per-day period of operation. In all these necessary factors the North Georgia Electric Company has been far-sighted.



INTERIOR OF GENERATING PLANT, NORTH GEORGIA ELECTRIC COMPANY.

It is considered that Atlanta has a great future, and that it is destined to be the manufacturing and commercial centre of the South, which means that the future need for power will be large; and it is the purpose of the North Georgia company to develop and transmit power as occasion justifies, meanwhile holding in reserve its accumulation of Nature's

Digitized by Google

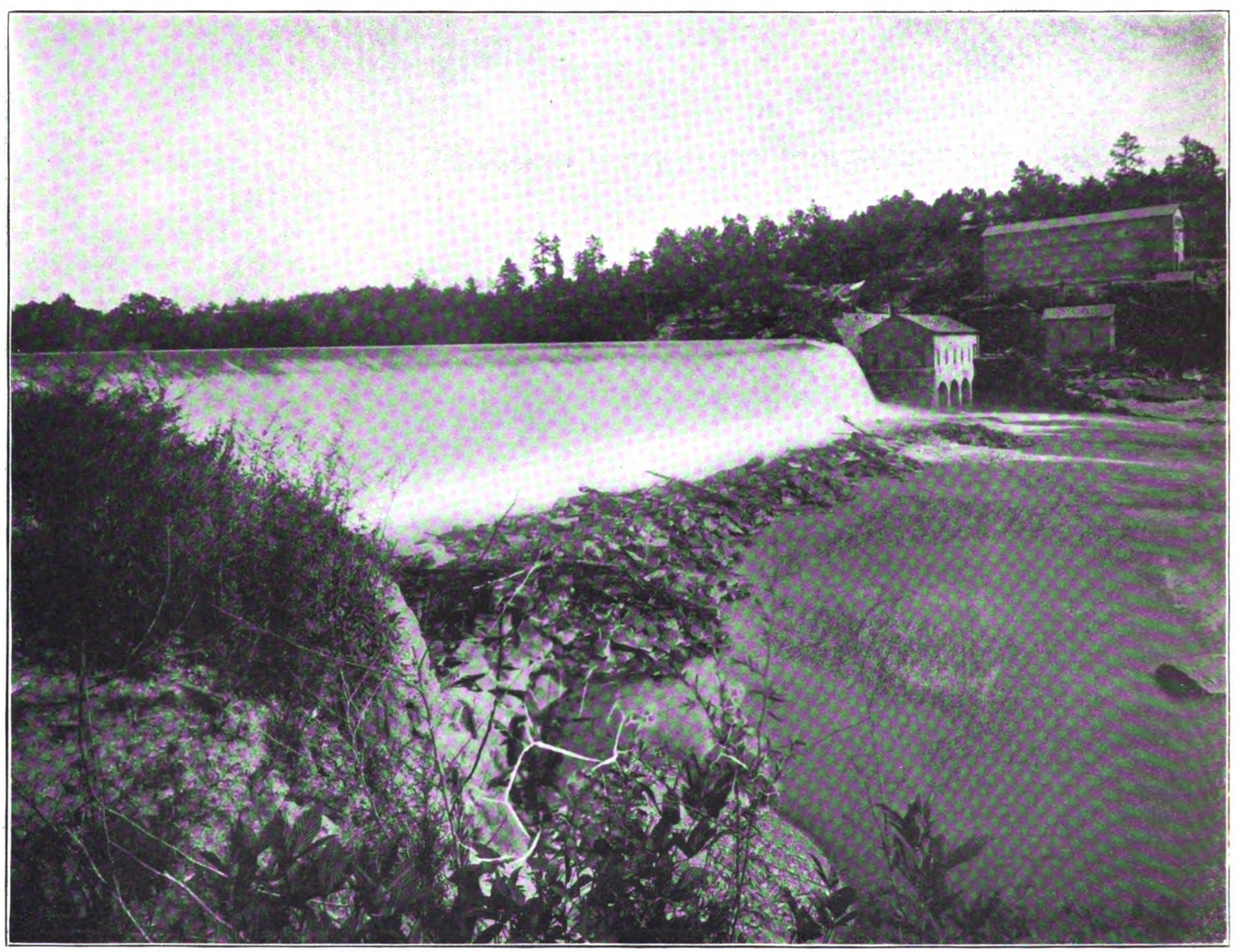
wealth. The powers that have been developed, and those held in reserve, are primarily intended for transmission to Atlanta for utilization in lighting and street railway service—and possibly for future interurban railways which may be economically operated in the territory covered by the transmission lines.

The drainage area of the Chattahoochee river up to the point of the power plant covers a trifle over 544 square miles, the watershed being a rough and mountainous country. The catchment area, however, is relatively large and most of the water falling on the mountain slopes is drained directly into the Chattahoochee. The runoff of the stream near this point is, in ordinary seasons, about 3.5 second-feet per square mile during the spring and summer, and about four second-feet per square mile during the winter. The mean discharge in second-feet averages 2,500 during the winter and 2,000 during the summer season. In exceptionally rainy seasons the discharge may be as high as 17,000 second-feet. Hence it is obvious that to take care of such variations in flow requires a very careful and substantial construction of dam and accessories.

The largest development of the company is on the Chattahoochee river near Gainesville. The dam is a log-crib, rock-filled structure thirty-seven feet high, with double-planked spillway, apron and upstream face. It is approximately 300 feet long and is built perfectly straight. The dam of the other development of the company, on the Chestatee river—a tributary of the Chattahoochee, fifteen miles from Gainesville, is about the same height and is also a log-crib, rock-filled structure.

All the materials of construction used in these dams were obtained from the neighborhood of the dam sites. The base of the dam on the Chattahoochee is about ninety feet in width and is constructed of local stone and cement mortar. A kind of forebay is formed on the sheltered side of the stream by blowing out the river bank, the selection being such that wind and current tend to carry driftwood, trash, etc., to the other side, so that little trouble from this source obtains. The bulkhead of the dam assists in forming the forebay, and carries the racks, head-gates and flood-gates; and also serves to shelter the power-house. A tailrace was formed by blasting out the river bed at the power-house, and an elevation of the bottom obtained the same as that of the river bed below the shoals. In this way the desired head is secured with a saving of several feet in the height of the dam, and hence saving in cost.

The power-house building is a wooden structure of Georgia pine with concrete floor and is covered with corrugated, galvanized-metal roofing which is intended, however, to be temporary. The building is supported on concrete piers just above the tailrace and immediately behind the bulkhead. The floor of the power-house is an extension of the abutment of the dam, and is constructed at such a height above tail-water that the centre line of the generators, when resting on the power-house floor, comes in line with t



Power-House and Dam, North Georgia Electric Company, Gainesville, Ga.

Digitized by Google

centre line of the turbine shafts to which they are direct-connected.

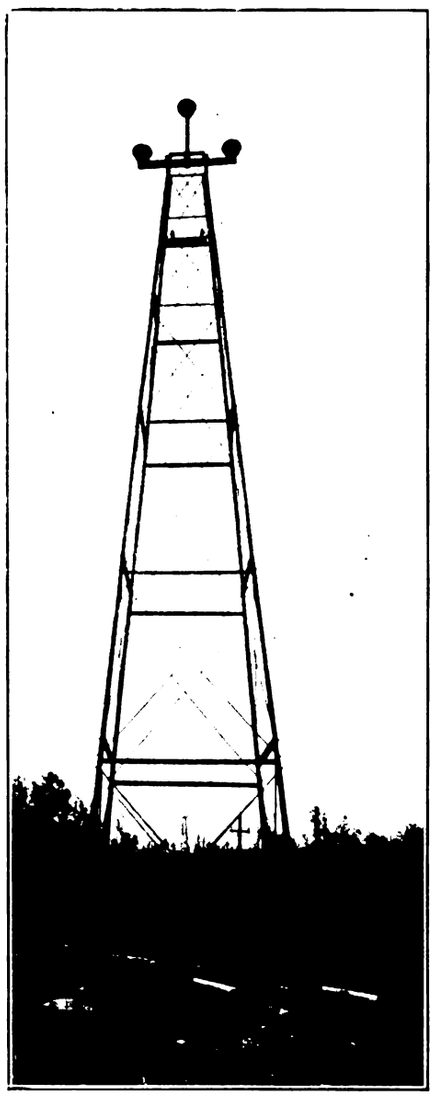
At the present writing three turbines have been installed, the number to be eventually installed being seven. These turbines comprise two wheels on each shaft, of the horizontal type, and made by the S. Morgan Smith Company. The turbine cases, which also serve as penstocks, are built in the dam near one shore in the abutment, and discharge through draught tubes which extend under the floor of an extension of the dam. The turbines are controlled by Lombard oil-pressure governors, which are actuated from the shaft of the wheels. The governors are fitted with small motors, which permit of controlling the speed of the turbines directly from the switchboard. In addition there is a small McCormick turbine which is belted to an exciter and controlled by a Woodward governor. The centre of all the wheels is about twenty-five feet above tail-water.

The generators, which are directly connected to the turbines by means of a flange coupling, are three in number and are of Westinghouse make. They are of the revolving armature type each of 550 kilowatts' output with thirty-two poles, and at their normal speed of 225 revolutions generate two-phase current at 440 volts pressure and 625 amperes per phase. In the near future four more generators of the same output, voltage and amperage will be installed. The generators will be excited by two dynamos, each of fifty-six kilowatts' capacity, which rotate at a speed of 525 revolutions per minute and generate current at 125 volts.

The current from the main generators is conducted to the switchboard, which is located on the floor of the power-house, through terra-cotta ducts. The switchboard and its complement of instruments embody the usual practice in hydroelectric plants of this output. The board and its equipment are of Westinghouse make and comprise separate generator and feeder panels and an exciter panel. The only noteworthy feature in the equipment is the use of air-break switches, which, however, only have to handle current at 440 volts pressure.

The 440-volt current is thence led to two raising transformers which are installed in a brick house just above the power-house. These transformers raise the pressure to 50,000 volts for transmission and also transform it from two to three phase by the Scott method. The transformers are of the oil-insulated, water-cooled type.

A switch house is located a short distance above the transformer house and contains the high-tension oil-switches and the lightning arresters. The arresters are General Electric multiplex type. The high-tension lines leave the transformer and switch houses through circular porcelain bushings, the circuits consisting of No. 1 hard-drawn copper wire. The transmission lines are carried on steel towers spaced 510 feet apart, there being eleven towers to the mile. The circuit is



TRANSMISSION LINE, NORTH GEORGIA ELECTRIC COMPANY.

arranged in the form of an equilateral triangle, with a spacing of thirty-six inches between wires. The steel towers are of the usual windmill tower form, but are worthy of note in that they are built of iron piping and assembled in the field. They are painted and are supported in the ground by placing the four legs of a tower in holes and tamping the earth around them. The single three-phase transmission circuit follows an air-line to Gainesville, a few miles distant, where a few hundred horse-power are utilized by small manufacturing industries and a street railway property.

The bulk of the power is to be transmitted to Atlanta, fifty miles distant, and at this writing the steel tower line has been nearly completed. The entire transmission line is built over a private right of way, twenty-five feet in width, and it is the intention to construct an interurban electric railway line between Gainesville and Atlanta, paralleling the transmission line.

The conception, organization and consummation of this hydroelectric power development which, when completed, will be the longest power transmission in the South, is due to the untiring energy of General A. J. Warner, ex-representative in Congress from Ohio, who is president of the North Georgia company. The design of the entire development is due to W. A. Carlisle, chief engineer, who also superintended the work of construction, being assisted by F. P. Catchings, electrical engineer.

General Electric Stock Issue.

The General Electric directors have voted to increase the capital stock by $20,000,000, making the total amount $80,000,000.

Of this amount $11,000,000 will be offered to stockholders at par. Holders of five shares of the old stock are entitled to one share of the new stock to be issued.

The new stock of the General Electric Company will be used for extensions and increasing the working capital of the corporation. The company will expend next year between $5,000,000 and $6,000,000 for extensions.

Extensions already under way, and which are being met from the proceeds of the stock authorized last year, will give the company an additional floor space of about 1,150,000 square feet, making a total of 5,500,000 square feet. A special meeting of the stockholders will be called on November 20 to authorize the increase in stock proposed by the directors.

Based on the present selling price, 181, the rights are worth $13.50 per share. The issuance of about $11,000,000 additional stock by the company, conferring rights upon stockholders estimated at $13.50, makes a total of $28 in rights which stockholders have received during the past three years, equal to $9 per share yearly, and making the total return per share, including dividends, over $17 yearly for the last three years.

Digitized by Google

Electrical Notes from Europe.

(By Our Special Correspondent.)

A HYDROELECTRIC plant has been recently installed near the town of Rienz, in the Tyrol, in order to secure a large supply of current for lighting and motors in this locality. A dam has been built across the river Rienz and from this point the water is taken by canal 4,000 feet in length to a large settling basin. Three penstocks lead from the basin to the turbine house. The length of the penstocks is 180 feet, with a four-foot diameter. At present there are three turbines installed in the Rienz plant. They are of the Francis type and are designed to give 700 horse-power each. To the turbines are connected alternators which deliver a current of 5,000 volts at fifty cycles, and each of the machines carries an exciter on the end of the shaft. At present an extensive system of feeders runs from the station through the surrounding region and it supplies current for a great number of localities, including the town of Rienz, which takes most of the current. For the public and private lighting the voltage is lowered to 150 by transformers.

A somewhat unusual piece of metallic construction is now being carried out for the Metropolitan underground line in Paris, upon the new section which runs in the tunnel from the Clignancourt to the Orleans gates. It follows a general north and south direction across the city. Where the line crosses the Seine the tunnel construction is formed of a series of caissons which are sunk to a considerable depth below the river bed, where the metallic structure is laid upon the solid rock. The interior of the caisson follows the standard tunnel section of the road for the double track line. Several sections of the cai have already been sunk in the river bed, and this work is now being carried on. Of a much larger size and more complicated construction is the caisson which is to be sunk at the Place St. Michel in order to connect with the tunnel which passes under the river and offer an intermediate portion for joining on to the regular underground line. The metallic structure is now building in a depression below the surface of the street, and when completed, it will be slowly sunk down to the proper depth. Next the river is a short tunnel section, which joins on to an immense cylindrical chamber. The latter is to be used as the underground station of the line. Then the tunnel proceeds in a metallic structure over 200 feet long. Both of the tunnel sections and the cylindrical part form a single metallic structure, and the whole presents a complicated appearance. At present the structure rises some thirty or forty feet above the street level, but when finished it will lie entirely below ground, and passengers will have access to the station by a staircase, as for the standard type of underground stations.

The Italian Government is continuing its experiments with the use of the Stassano electric furnace for the production of iron and steel. According to the most recent data relating to the 150-kilowatt type of furnace, it is operated upon three-phase current, and uses about eighty volts at the terminals. The normal charge of the furnace is 1,000 pounds of material. This is made up of cast iron mixed with lime and iron ore in the proper proportions, also a small quantity of ferro-silicon or ferro-manganese. At present the furnaces are worked for the production of steel which is used in the manufacture of projectiles, and should contain 0.4 per cent carbon, 0.03 phosphorus and 1.5 manganese. According to the most recent figures a furnace of this type will take from 1.1 to 1.3 kilowatt-hours per ton of steel. In a twenty-four-hour run, the furnace gives a yield of 2.6 tons. Three types of furnaces are now in use, having capacities of 750, 150 and 75 kilowatts respectively. As to the wear of the electrodes, this is stated to be twelve pounds per ton of steel. The refractory covering of the furnace needs to be renewed rather frequently, in general at the end of one month.

Some interesting experiments in the use of motors for farming operations have been carried on in Poland in the presence of the Prussian Minister of Agriculture. The trials of the new machines took place on the domains of Kulm, near Birnbaum, using the current from a generating plant which is mounted here. The experiments relate to the use of a new plowing machine operated on the Brutschke system and constructed by the Körting firm, of Berlin. The new plow works very rapidly, and can make three furrows at a time, of twelve inches depth. It is operated on a ten hours' run, in general, and on account of the ease of working, it has proved a favorite among the inhabitants, especially as the cost of running is low. The government committee reported in favor of the new system, and already a company has been formed for promoting it in the region. It is intended to erect a large station which will furnish current for a number of farms, and for this purpose a hydraulic plant will, no doubt, be installed, using the water of the Obra river.

The Swedish Government is taking active measures toward the operation of the state railroads on the electric system. Parliament has recently voted a credit of $1,000,000 for the purchase of a number of falls in order to erect the hydraulic plants which will be needed for supplying the current, as it is proposed to operate the roads entirely by hydraulic power. At present the government has already acquired a number of falls, among which may be mentioned the large falls of Trollhäten and Elfkarleby. The first of the hydraulic plants will be erected upon the Trollhäten fall, and Parliament has already voted the necessary amount for building the station. It is expected to secure about 75,000 horse-power available in this case, a portion of which will be utilized in the first part of the plants. As to the falls which the state controls in the northern part of the country, these will be utilized at a later period.

Among the new mountain-climbing electric roads in Switzerland is the new rack-and-pinion line which runs from Brunnen, on the Four Cantons lake, to the town of Morschach, which lies at 650 feet altitude. The road is laid in narrow-gauge, upon steel ties, and contains many short curves and steep grades. The train is made up of a locomotive and one or two trailers. The locomotives are constructed by the J. J. Rieter firm, of Winterthur, and are mounted on two axles, with the rack-wheel operated by a one to eleven reduction-gear. Two motors of 100 horse-power are used, and the motors work upon 750 volts, three-phase current at fifty cycles. Current is supplied to the road from a station which is located at Altdorf, with an overhead line working at 8,000 volts three-phase current. At Morschach is a transformer station containing three units which deliver 750 volts for the line. The trolley system is used upon the locomotives.

The question of inserting an amendment in the Constitution as regards hy-

Digitized by Google

draulic power has been agitated for some time past in Switzerland. Owing to the popular movement which has been going on recently, a petition containing 90,434 signatures is presented to the government, favoring the insertion of the amendment. The text of the latter is as follows: Article 23, *viz.*, The legislation as to the use of hydraulic power belongs to the Confederation. Nevertheless, the cantons or other authorities designated by the cantonal legislation are exclusively to collect the taxes and other impositions coming from the use of hydraulic power. Following the promulgation of the present article, new concessions will be granted only under reserve of the dispositions taken by the future Federal legislation, and the energy produced by the hydraulic forces can not be transported to foreign countries except by authorization of the Federal Council.

It appears that the long-discussed project of a direct electric railroad from Rome to Naples is now to be definitely executed, provided the Italian Government decides to award the concession for such a line which has been asked for by a leading banking house. This firm has a large capital, and is prepared to execute the project within a reasonable time. The project has been drawn up by the engineer Pivetti. Current for the new road can be secured from different branches of the Voltumo river. It is proposed to award the concession for the line for a period of years, after which the Italian Government will continue to operate it. No subsidy is asked from the state by the projectors of the road, which is a favorable point. The subsequent transfer to the government is to be done without any expense to the latter. As to the operation of the line, it is proposed to run extra-fast through express trains between the two cities, a distance of 122 miles, as well as ordinary express trains and slower trains. The high-speed trains are to cover the distance in one hour and forty minutes. The new road is to be used entirely for passenger trains, and no freight trains will be run upon it.

The Perelli Company has recently brought out a new form of cable for 100,000 volts which is said to hold out very well. It is stated that a section of it was tested to 300,000 volts, and a long portion of cable at 150,000 volts, without showing any defects. A new principle is applied in the construction of the cable, based on a series of concentric layers of insulation having different specific inductive capacities. To carry this out, the stranded copper cable forming the core is first given a coating of lead, so as to provide a smooth surface and give a large diameter. On this is placed the series of layers of insulation. The specific inductive capacity of the material decreases at each layer, going from the centre to the outside. To build up the cable a core is first taken, composed of nineteen copper wires of 3.3-millimeter gauge and having a total section of 162 square millimeters. A lead tube is run over the core having eighteen millimeters outer diameter. On this is placed a layer of rubber insulation 2.5 millimeters thick, whose specific inductive capacity equals 6.1. The second and third layers of insulation have respectively 2.3 and 4.5 millimeters thickness with inductive capacities of 4.7 and 4.2. A 5.2-millimeter layer of treated paper comes over this, with a specific inductive capacity of 4.0. A protecting coat and a lead outer covering completes the cable, which has 14.5 millimeters total thickness of insulation.

According to the terms of the contract passed between the Swiss Government railroads and the Brown-Boveri Company for operating the electric trains on the Simplon Tunnel line, the trains are to be run under the following conditions over the three-phase line. During the passage of the trains from Brigue to Iselle, the electric locomotives are to draw the passenger trains at forty-five miles an hour, and the freight trains at twenty-one miles an hour. When passing the opposite way, the passenger trains will run at only twenty-one miles an hour as far as the station of the tunnel, and from thence to Brigue at forty-five miles an hour. During the passage of the trains over the whole of the line there shall be sufficient current so that a passenger and a freight train can cross in the tunnel and also that the two locomotives can be started at the same time. At the north and south ends of the tunnel are located two separate electric stations for the road, each containing an alternator with its exciter and switchboard. As regards the wiring in the tunnel, the contract stipulates that it shall be laid out so that the line can be run at a later date upon the single-phase system, should it be thought advisable to do so.

C. L. DURAND.

Paris, September 29.

Combination of Independent Telephone Companies.

A dispatch from Pittsburg, Pa., states that a telephone merger has been perfected by the "American Union Telephone Company." One hundred companies, with 40,000 telephones and ten long-distance lines, are combined and capitalized at $25,000,000. Pennsylvania, New York, Ohio, Maryland, Virginia and West Virginia are affected by the consolidation.

SOUND ENGINEERING IN INTERURBAN RAILWAY CONSTRUCTION.[1]

BY GUY MORRISON WALKER.

In the construction of railways there is a constant conflict between two diametrically opposing views. First, there is the view of the engineer whose scientific and technical education leads him to plan and urge the best that money can buy or produce; regarding the proposition as an opportunity to show his engineering skill. He struggles for long tangents, low grades, heavy bridges, wide cuts and fills, and a surplus of motive power, constantly holding up to view the desirability of securing economy of operation and low cost of maintenance. On the other hand stands the promoter or broker, who, ignoring all these physical problems, tries to see how much paper in the shape of bonds and stocks he can issue and float against the least possible real property.

Now, the fact is that neither point of view is the correct one, but that somewhere between these two extremes lies the true economic means of a road good enough to carry the traffic and business in its territory, with enough stocks and bonds issued against it to recoup the bankers and investors for their outlay.

The first engineers on interurban railways came from the city lines, and with their city experience they imposed upon these interurban roads city construction and supplied them with city power, as if for city traffic, burdening them not only with a heavy fixed charge to cover the abnormal capital expenditure, but with the expense of a general organization like that on city lines. It was only the fact that these interurban roads were built in thickly populated communities that enabled most of them to carry this burden and survive the management that they endured. Few of them proved profitable until, as years rolled on, the farms through which they ran were cut up into small plots, the communities filled up with new population, and the traffic developed to the point where it was able to absorb this early waste.

When interurban railways first began to be built, there were many places where the population was already so dense and well distributed as to furnish the traffic necessary to make such roads pay, but the ten short years that have elapsed since interurban electric railways were first proved to be successful, have sufficed to see almost every locality with traffic and population enough to support an interurban railway,

[1] Abstracted from an address delivered before the students of Sibley College, Cornell University, Ithaca, N. Y.

Digitized by Google

already supplied with such a service. Indeed, reckless promoters and ignorant investors have built many such lines in communities not yet sufficiently developed to support them, and now find that they have an investment which not only yields them no income, but that the traffic in many instances does not yield enough to pay even operating expenses, and so they are threatened with the loss of their principal, and the fault in many of these cases has been due to the short-sightedness and stupidity of the engineers in charge of the construction.

There is a strong disposition on the part of most engineers to spend on the construction of a road all the money that they can get their backers or clients to put up. Even at the present time the most serious handicap upon existing roads and the most serious obstacle to the further development of interurban railways is the heavy construction advised by most engineers and the heavy equipment almost universally recommended by manufacturers.

The promoters and owners of these properties have not generally taken the public into their confidence, and so it is only those who are on the inside and to whom come the frequent appeals for financial assistance, who know the old, old story of elaborate construction, built at tremendous cost, and heavy equipment run at enormous expense, in advance of the development of traffic. Many of these roads have struggled along borrowing the money with which to pay fixed charges and striving to keep out of the hands of the receiver for a year or two longer, in the hope that by that time the traffic will have developed enough to enable them to pay their way.

It is impossible to estimate how much the development of interurban railways has been retarded by these false standards of physical perfection, and the time has come when the interest and rights of bankers and investors whose capital has been tied up in unremunerative projects, are entitled to paramount consideration, and I wish to impress upon you that, as engineers, you have no more right to experiment at the expense of your clients in an undertaking which they expect to be remunerative, than has a physician to take liberties with the body of his patient.

Select equipment that you know will do the work. Be neither the first to adopt a new device, nor the last to abandon an old. It is your duty as engineers to consider first the economic feature of the enterprises submitted to you for your decision or direction. It has been said that there are no physical difficulties with which engineering skill can not successfully cope. It is merely a question of money. Practically speaking, this is true, and you will find early in your careers that the real question that you have to answer will not be "can it be done," or "how shall it be done," but a really far more important question as to whether the results to be secured will warrant the cost. You should strive to make money for your clients, for by so doing you will not only secure a satisfied clientage, but by building for them profitable and paying plants you will place it within their power to proceed with the building and development of other properties, and so add to the prosperity of the community while making business for yourselves. On the other hand, if you tie up the capital of your client in an unprofitable proposition, you are guilty of an economic crime against the community in which the nonpaying investment is made, and you commit a wrong against the man whose further activities you have prevented by placing his capital where he is unable to realize upon it, in addition to losing a client and destroying business for yourselves. A large fee will be cheerfully paid from a successful enterprise out of the operation of which all the stockholders are profiting while a pittance will be paid grudgingly out of a wreck.

And so, instead of the old standards that have so long prevailed, I desire to raise a new and practical standard which recognizes not only the rights of the investor, but the economic good of the community in which the investment is made, and so I say to you, "Build not the best, but build the best that will pay."

It is plain that railroads built according to the standards of construction that prevail in communities thickly populated and with a heavy traffic already developed, will not pay for years to come in these thinner populated regions, and because the engineer has not yet been found to construct a road as cheaply as it must needs be constructed for it to pay in such localities. And so further development of interurban railways has largely come to be a question as to whether or not a locality must do without local service because a road costing $10,000 a mile will not pay in that territory, or because it can not support a road costing, say, over $20,000 per mile.

In considering a new proposition you should first determine what investment the territory will support. Be assured that the necessary capital is in sight and then plan a completed and earning plant to come within the limits of the proposed investment. It is one of the most common complaints against engineers that the completion of their plans usually costs fifty per cent more than their estimates. As a rule there is nothing so worthless as the "engineers' reports," which the promoters lay before bankers and financiers, unless it be the franchises of which they talk so glibly and for which they claim to have expended such large sums. After the surveys necessary to locate the line, which should not cost much, the first expenditure of money should be for the securing of all the right of way that can be secured without condemnation proceedings, and then suit should be at once instituted against these. The reason for this is, that if an enterprise has any merit in it whatever, its success is assured from the time that it owns a continuous strip of right of way between the proposed terminals, while if it has no merit there is no expenditure that involves less loss, for the fact is that the importance of transportation is so great that there are few real estate holdings that appreciate in value as do these comparatively worthless small tracts when strung together in a continuous line from city to city.

The right of way secured, the next money expended should be for grading. There are two or three good reasons for advising this as the second step. The first is, that there is nothing in connection with railroad work on which you can make a larger and better showing with such a small expenditure of money than you can in the matter of grading. Then, too, it satisfies your client, for he is able to see results; it satisfies the community, for they realize that work is being done and that a railroad is being built, and nothing goes further than this in establishing credit for the new enterprise; while, most important of all, the possession of a graded right of way is the best insurance of your client against competition or loss, for even if his funds should fail him at this point, it is more than likely that he will be able to turn such an asset into some new company for a profit.

Having gotten thus far, the next step is the purchase of ties and rails, and then, with the least expenditure possible on any other account, hurry the laying of track until you can show a continuous pair of rails between your terminals. So many engineers make the mistake of practically completing their track as they go, expending as much in the completion of ten miles, which leads them only half way to the objective point, as would be necessary to reach the objective point if the

Digitized by Google

wiser course had been pursued. The ten miles of track would take you nowhere, but you can ride over the twenty miles from one town to the next even though the going may be rough and slow.

Up to this point you will have been producing real property with the least possible waste. The difference between the sixty-pound and eighty-pound rail will enable you to save twenty-five per cent on the investment in steel, and I might say that one of the best interurban roads of which I have any knowledge has been running its cars for nearly twelve years over fifty-pound rail that is still without sign of wear or deterioration.

Whatever you use, rail and ties should be the best in quality, for there are no profitable economies in the manner of permanent way, but from this point on you should carefully determine the best that the immediate traffic will support with the least probable loss on account of future replacements, and it will not do to discount the future too much. So many engineers burden a small proposition by attempting to build along with the first mileage a power plant large enough not only for the original proposition, but for all its probable extensions. Now, it is mileage that earns the money, and to burden a small proposition with the capital charge of a heavy power-house for which it has no use, simply means to break it financially.

The proper plan is to instal units, second hand, if possible, no larger than the existing mileage needs for its operation, installing additional units as fast as its growth and extension may make necessary, until the territory has been reasonably covered, and the traffic developed to the point where the mileage can properly use and the earnings carry the cost of a suitable power-house, for when this time comes, the original units are not loss, but may be reinstalled in other places to carry other plants through a similar period of development. There is no other initial economy that pays as this does, for it is rarely possible to anticipate the power demands of a territory, and great loss has frequently been incurred by attempting to do so.

One of the most foolish extravagances is the building of a double-track road where a single track will carry all the traffic that can be developed for years to come, for, with your right of way and grade, it is a simple matter to supply the second track when the traffic becomes too heavy for the first. So, if you really must have fifty miles of track, and the distance is only twenty-five miles, find some other place to build the other twenty-five miles, for it is far better to have two single-track roads paying big dividends than a fine double-track proposition that does not earn its fixed charges.

Probably more important even than the question of power is the question of cars and equipment. Cars of from sixty to seventy feet in length, equipped with four motors of from seventy-five to 100 horse-power each, look very handsome and start up quickly from zero, but they cost about $10,000 apiece, and the amount of power that it takes to move the mere weight of the car is a matter that deserves consideration. One of the best paying properties that I know has for years used a car with fifty-six seats, measuring forty-two feet over all, equipped with only two thirty-five-horse-power motors. These cars are built with firm steel frames, yet are extremely light, and have cost complete but little over $4,000 apiece, yet they take in just as much money as any of the large cars.

It is in this matter of traffic that engineers are more often astray than in anything else, for their desire to make new business too frequently induces them to make estimates not only unsupported by any experience, but in many cases beyond all reason. A recent very glaring instance of this kind has come to my attention where a distinguished firm of engineers, in order to justify the expenditure made necessary by some very heavy construction, and a large amount of difficult bridging, estimated the traffic on a fifty-mile road between two large cities at a higher amount per mile than the street railway mileage in those cities had ever taken in, while the fact was that the gross earnings of the road would hardly have been sufficient to pay the fixed charges on its proposed cost.

Two interurban roads running out of Cleveland, Ohio, have forty and forty-four miles of track, respectively. The forty-mile road serves about 440,000 people, while the forty-four-mile road serves about 420,000 people, or only 20,000 less than the first road. With a population so nearly the same the engineers had estimated that the traffic of the second road would be approximately the same as that of the first, but after several years of operation the traffic receipts of the shorter road are still twice as large as those of the longer road, which has now been in the hands of a receiver for several years. The reason for this difference in earnings was, however, understood when upon investigation it was found that 400,000 of the population estimated to be served by each road was in the city of Cleveland itself, while the population served outside of Cleveland was 40,000 in one case and only 20,000 in the other, and that these proportions bear the same proportion to each other as do the earnings of the respective roads that serve them.

In estimating the traffic from a proposed interurban road, you will find it unsafe to consider the population of your larger terminus. This larger terminus is extremely necessary for the success of such a road, for you must have some place to which the people along the line desire to go, but you will find that the people of the larger cities have little business and no inclination to leave their large city and ride out to the smaller points along the line, so you must begin by ignoring the population in the large city. You will also find that the much-talked-of farmer traffic is so small as to be almost a negligible quantity. The riding population, which must be the source of your earnings, you will find to be the population of the villages and towns that you reach, who seek the large terminal for business or pleasure.

For the proper support of an interurban railroad this urban population, outside of the large terminus, should not be less than 750 per mile, and you will find that such a population will yield about five dollars per capita. Such a population will support an electric railway as ordinarily built, paying ordinary fixed charges on a bonded debt, large enough to cover the cost of its construction, but without profit to the promoters or stockholders. In order to be profitable, such a line should have an interurban population, outside of the larger terminus, of at least ten hundred per mile of track. Should this population, however, be less than 750 per mile of track, the proposition is likely to prove a financial failure unless built with extraordinary economy.

It is hard to discuss the cost of construction of interurban roads, because so few of them are built with real money. There is so much waste in the methods of the ordinary promoter, and his ways of raising capital are not only expensive, but his lack of credit makes the carrying charges during the period of construction extremely high. If built and paid for with real money these roads should vary in cost from $16,000 to $25,000 per mile, according to cost of right of way, weight of rail, and power and equipment used. In no case should they exceed this higher sum unless there exists in the particular place some physical difficulties, such as a large amount of tunneling, rock cuts, or heavy bridging.

On the other hand, I have known one or two very profitable propositions doing good service in small communities that have been built for less than $15,000 per mile, these sums including in all cases the cost of power-house and equipment.

Digitized by Google

American Street and Interurban Railway Association.

Auspicious Opening of the Annual Convention at Columbus.

(Special Telegram to the Electrical Review.)

COLUMBUS, OHIO, OCTOBER 16.—The opening of the annual convention and exhibition of the American Street and Interurban Railway Association was particularly auspicious, the weather conditions being perfect and the attendance reaching well above 2,500 railway men, manufacturers and supply men. Among those long affiliated with the association who were present were Harvey M. Littel, Hon. W. Caryl Ely, E. F. Peck, J. S. Doyle, Paul Winsor, W. B. Potter, Charles Remelius, H. H. Adams, S. L. Rhodes, John R. Graham, John J. Lane, Fred G. Simmons, John I. Beggs and Fred N. Bushnell.

The first session of the convention, that of the American Street and Interurban Railway Engineering Association, was called to order by the president, H. H. Adams, of Baltimore, Md., Monday morning at 11 o'clock. Mr. Adams introduced E. C. Spring, president of the Central Electric Railway Association, who delivered an address of welcome to Columbus. He was followed by James H. McGraw who, as president, addressed the meeting on behalf of the Manufacturers' Association. John I. Beggs also addressed the meeting briefly. Then followed the reading of the president's address and the reports of the executive committee and the secretary and treasurer. After the appointment of a committee on resolutions the meeting adjourned.

The afternoon session was called at 2.10 o'clock, when the Hon. W. Caryl Ely addressed the meeting. He said that the engineering association was one of the most important of the re-organization, appealing most strongly to the largest number of members of the association and made a strong plea for earnest, concentrated work, so that the benefits derived might be permanent.

The report of committee on control apparatus was presented by J. S. Doyle, chairman, and discussed by G. J. Smith, Kansas City; E. W. Olds, Milwaukee; H. H. Adams, F. E. Case, Schenectady; W. H. McAloney, Denver; Paul Winsor, Boston; N. W. Storer and William Cooper, Pittsburg.

A paper entitled "Ties, Poles and Posts," was presented by C. A. Alderman, Cincinnati, and discussed by A. S. Richey, Worcester; F. G. Simmons, G. F. Smith, E. J. Dunn and others.

This paper discusses the increasing cost of wood ties, which is leading to the use of other materials. Specifications for ties in use on certain railroads in the West are quoted, and directions are given for the making of concrete ties, poles and posts. To explain the scarcity of tie timber in the United States it is shown that 82,000,000 ties are required annually for renewals alone, which is equivalent to the timber of half a million acres of forests. Steel cross-ties will be used to a considerable extent when the price for timber has advanced about twenty per cent. When inferior woods are used for ties they must be treated with a preservative, and protecting tie plates should be employed.

A paper on "Ballast," presented by Charles H. Clark, Cleveland, was discussed by N. G. Simmons, C. A. Alderman, J. M. Larned and H. B. Flemingo.

This paper is not confined to a discussion of the material used directly under the ties, but deals as well with the foundation laid for former. Methods of preparing this foundation on different characters of soils are discussed, and estimates given for the cost. The paper is illustrated with a number of photographs and diagrams showing different classes of construction, on which estimates of cost are also given.

The report of the committee on maintenance and inspection of electric equipment was also presented, and after a lengthy discussion the meeting adjourned.

The courtesies afforded by the Western Union Telegraph Company, Postal Telegraph-Cable Company, Bell Telephone Company, and Automatic Telephone Company have been greatly appreciated, and the free service given by the street railway companies has greatly facilitated traveling between hotel headquarters and the convention hall and appliance exhibition. A number of the larger companies have headquarters at the principal hotels. A feature is the lighting of the entire corridor of the Chittenden by Buckeye tantalum lamps.

The manufacturers' exhibition is remarkably complete. The exhibits are of a striking nature and for magnificence and perfect setting far surpass anything heretofore attempted. The large displays of Westinghouse, General Electric, Electric Service Supplies, Electric Storage Battery, Lorain Steel, Carnegie Steel, John A. Roebling's Sons, H. W. Johns-Manville, Allis-Chalmers, National Brake and Electric, Chicago Pneumatic Tool, and Franklin Electric Manufacturing companies, all show apparatus under actual service conditions and attract constant attention. In addition to exhibits in the six buildings, covering 110,000 square feet, there is a splendid showing of high-speed interurban steel and wooden cars on side tracks of the "Big Four" railroad, adjacent to exhibit buildings.

Among the manufacturers the following were present on the opening days: Edwin M. Hamlin, George B. Crane, R. H. Watson, William M. Lawler, Claude M. Matthews, J. R. Kearney, B. S. Klees, G. O. Curtis, F. E. Wilson, E. R. Bliss, F. M. Evans, John C. Dolph, C. N. Leet, Frank C. Randall, Dwight Dean, G. M. Haskell, C. H. Spotts, W. M. W. Easton, W. E. Harrington, Charles C. Pierce, J. V. E. Titus, Max Berg, C. H. Bristol, J. N. Porter, Charles J. Mayer, James Todd, Daniel N. Brady, E. J. Wendell, Joseph R. Ellicott, F. B. Degrass, Julian Roe, Josh Cunningham, W. W. Powers, W. H. Hawlings, Jr., J. W. Perry, B. M. Barr, J. C. McQuiston, J. H. Denton, John H. Thomas, F. V. Green, F. H. Gale, Thomas Bibber, W. S. Hager, James G. Biddle, Walter Chur, F. A. Keys, A. O. Benecke, A. H. Whiteside, C. A. Tupper, C. L. Knight, B. B. Ayers, E. J. Blake, C. C. Blake, Harold P. Brown, C. H. Weeks, V. T. Price, H. Lee Bragg, F. D. Masterson, J. W. Duntley, W. O. Duntley, C. B. Coates, A. W. Lenderoth, T. J. Creaghead, F. F. Skeel, C. M. Crofoot, Robert F. Carr, E. A. Dossert, Charles Blizard, G. H. Atkin, H. A. Gay, W. S. Sisson, C. E. Harmon, W. R. Gaston, Charles Ewing, W. J. Clark, H. N. Ransome, W. G. Carey, John E. Ward, Charles K. Knickerbocker, F. P. Harrison, J. W. Perry, A. D. Newton, E. C. Green, A. E. Ducklose, L. O. Dudas, A. T. Baldwin, Charles C. Pierce, G. H. Miller, L. T. Wailes, W. H. Goble, W. R. Crawford, T. J. Cunningham, J. E. Perry, Bert Aikman, C. K. King, U. M. Garland, R. M. Campbell, E. G. Condit, D. J. Evans, J. S. Speer, G. P. Fryling, E. M. Williams, W. W. Affleck, W. P. Bowman, H. L. Shippy, H. W. Benedict, H. H. Cowherd, J. B. Thomas, L. Robinson, F. A. Elinguist, C. L. Cool, S. C. Schenck, A. S.

Digitized by Google

King, E. G. Chamberlin, C. W. Beaver, H. E. Dickerman, W. C. Guest, A. S. Howlett, F. D. Killion, J. A. Brett, L. M. Cargo, W. L. Conwell, R. W. Beebe, C. S. Cook, C. F. Medbury, John B. Allen, F. S. Smith, F. F. Roher.

The following companies are represented in the manufacturers' exhibit:

Allis-Chalmers Company, Milwaukee, Wis.

American Brake-Shoe and Foundry Company, Mahwah, N. J.

American Instrument Company, Philadelphia, Pa.

American Railway Supply Company, New York, N. Y.

A. & J. M. Anderson Manufacturing Company, Boston, Mass.

Armstrong Oiler Company, Philadelphia, Pa.

Atlas Railway Supply Company, Chicago, Ill.

American Mason Safety Tread Company, Boston, Mass.

American Steel and Wire Company, Chicago, Ill.

Atha Steel Castings Company, Newark, N. J.

Adams & Westlake Company, Chicago, Ill.

Acme Automatic Street Indicator Company.

Bayonet Trolley Harp Company, Springfield, Ohio.

Blake Signal and Manufacturing Company, Boston, Mass.

J. G. Brill Company, Philadelphia, Pa.

Harold P. Brown, New York, N. Y.

Buckeye Engine Company, Salem, Ohio.

Burnham, Williams & Company, Philadelphia, Pa.

Brady Brass Company, New York, N. Y.

S. F. Bowser & Company, South Bend, Ind.

L. M. Booth Company.

Cleveland Frog and Crossing Company, Cleveland, Ohio.

Consolidated Car Fender Company, Providence, R. I.

Consolidated Car Heating Company, New York, N. Y.

Cook's Railway Appliance Company, Kalamazoo, Mich.

Curtain Supply Company, Chicago, Ill.

Creaghead Engineering Company, Cincinnati, Ohio.

Cambria Steel Company, Philadelphia, Pa.

Dearborn Drug and Chemical Works, Chicago, Ill.

D. & W. Fuse Company, Providence, R. I.

Carnegie Steel Company, Pittsburg, Pa.

Duff Manufacturing Company, Pittsburg, Pa.

Dayton Manufacturing Company, Dayton, Ohio.

Joseph Dixon Crucible Company, Jersey City, N. J.

Duplicate Transfer and Rebate Company, Philadelphia, Pa.

DuQuesne Steel Foundry Company, Pittsburg, Pa.

Dossert & Company, New York, N. Y.

Dressel Railway Lamp Works, New York, N. Y.

O. M. Edwards Company, Syracuse, N. Y.

Electric Railway Equipment Company, Cincinnati, Ohio.

Electric Storage Battery Company, Philadelphia, Pa.

Charles I. Earll, New York, N. Y.

Electrical Review, New York, N. Y.

Electric Service Supplies Company, Chicago, Ill.

Eclipse Railway Supply Company, Cleveland, Ohio.

Franklin Car Heating Company, Syracuse, N. Y.

Franklin Electric Manufacturing Company, Hartford, Ct.

Felt & Tarrant Manufacturing Company, Chicago, Ill.

Galena Signal Oil Company, Franklin, Pa.

W. R. Garton Company, Chicago, Ill.

General Electric Company, Schenectady, N. Y.

Gold Car Heating and Lighting Company, New York, N. Y.

Goldschmidt Thermit Company, New York, N. Y.

Globe Ticket Company, Philadelphia, Pa.

Griffin Wheel Company, Chicago, Ill.

General Systems Company, Dayton, Ohio.

Hale & Kilburn Manufacturing Company, Philadelphia, Pa.

F. P. Harrison Electric and Manufacturing Company, Incorporated, New York.

Albert B. Herrick, Ridgewood, N. J.

Heywood Bros. & Wakefield Company, Wakefield, Mass.

George S. Hastings & Company, Cleveland, Ohio.

Helios Manufacturing Company, New York, N. Y.

Indianapolis Switch and Frog Company, Indianapolis, Ind.

Ingersoll Company, Pittsburg, Pa.

International Register Company, Chicago, Ill.

International Sprinkler Company, Philadelphia, Pa.

H. W. Johns-Manville Company, New York, N. Y.

Kalamazoo Railway Supply Company, Kalamazoo, Mich.

Kinnear Manufacturing Company, Columbus, Ohio.

Keystone Brake-Shoe Company, New York, N. Y.

George W. Lord Company, Philadelphia, Pa.

Lagonda Manufacturing Company, Springfield, Ohio.

Lorain Steel Company, Philadelphia, Pa.

Lord Electric Company, Boston, Mass.

Lumen Bearing Company, Buffalo, N. Y.

Massachusetts Chemical Company, Walpole, Mass.

John W. Masury & Son, Brooklyn, N. Y.

Maryland Steel Company, Sparrow's Point, Md.

Miller Anchor Company, Norwalk, Ohio.

McGuire-Cummings Manufacturing Company, Chicago, Ill.

National Brake Company, Buffalo, N. Y.

National Brake and Electric Company, Milwaukee, Wis.

National Lock Washer Company, Newark, N. J.

Niles Car and Manufacturing Company, Niles, Ohio.

R. D. Nuttall Company, Pittsburg, Pa.

National Car Wheel Company, Pittsburg, Pa.

Ohio Brass Company, Mansfield, Ohio.

Ohmer Fare Register Company, Dayton, Ohio.

Pantasote Company, New York, N. Y.

Pressed Steel Car Company, Pittsburg, Pa.

Pennsylvania Steel Company, Philadelphia, Pa.

Pittsburg Insulating Company, Pittsburg, Pa.

Quincy, Manchester, Sargent Company, Chicago, Ill.

Rail Joint Company, New York, N. Y.

Recording Fare Register Company, New Haven, Ct.

Joseph T. Ryerson & Son, Chicago, Ill.

Frank Ridlon Company, Boston, Mass.

Sherwin-Williams Company, Cleveland, Ohio.

Southern Exchange Company, New York, N. Y.

Speer Carbon Company, St. Marys, Pa.

Standard Paint Company, New York, N. Y.

Standard Steel Works, Philadelphia, Pa.

Peter Smith Heater Company, Detroit, Mich.

Security Register and Manufacturing Company, New York, N. Y.

Standard Varnish Works, New York, N. Y.

Sterling Varnish Company, Pittsburg, Pa.

Digitized by Google

Star Brass Works, Kalamazoo, Mich.

The T. H. Symington Company, Baltimore, Md.

Schoen Steel Wheel Company, Philadelphia, Pa.

St. Louis Car Company, St. Louis, Mo.

St. Louis Car Wheel Company, St. Louis Mo.

Sterling-Meaker Company, Newark, N. J.

Taylor Electric Truck Company, Troy, N. Y.

Trolley Supply Company, Canton, Ohio.

United States Metal and Manufacturing Company, New York, N. Y.

United States Engineering Company.

W. T. Van Dorn Company, Chicago, Ill.

Van Dorn & Dutton Company, Cleveland, Ohio.

Wallace Supply Company, Chicago, Ill.

Western Electric Company, Chicago, Ill.

Westinghouse Companies, Pittsburg, Pa.

William Wharton, Jr., & Company, Philadelphia, Pa.

Wheel Truing Brake-Shoe Company, Detroit, Mich.

Wilson Company, Chicago, Ill.

Yale & Towne Manufacturing Company, New York, N. Y.

On Monday evening an assembly meeting and reunion was held at the Southern Hotel. The programme for Tuesday evening includes a reception and dance at Memorial Building. For Wednesday evening the entire seating capacity of the Shubert Theatre, where "Fantana" is being played, has been engaged, and also that of the Southern Theatre, where "She Stoops to Conquer" will be seen. On Thursday afternoon there will be a song recital and tea at the Arlington Country Club, and on Thursday evening the annual banquet will be held. On Friday evening there will be the annual amateur vaudeville show at the Southern Theatre.

A. A. G.

Committee on Public Policy of the National Electric Light Association.

The committee on public policy of the National Electric Light Association held a meeting at the Waldorf-Astoria, New York city, on Thursday, October 11. This committee is one of the most important of the association. It consists of Everett W. Burdett, chairman; Henry L. Doherty, Charles L. Edgar, Samuel Insull, J. W. Lieb, Jr., Joseph P. McCall, Alex Dow and Samuel Scovil. W. H. Gardiner, Jr., has been appointed secretary of the committee.

REUNION OF THE OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION AND THE SOCIETY OF THE UNITED STATES MILITARY TELEGRAPH CORPS.

BY GEORGE C. MAYNARD.

The twenty-sixth annual reunion of the Old Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps was held at the Arlington Hotel, in Washington, D. C., on October 9, 10 and 11.

Separate business meetings of the respective societies were held on the first day, and these were followed by a joint meeting, when business in which both organizations are mutually interested was transacted. The attendance was large and the proceedings of much interest.

The societies were welcomed to the national capital by the president of the Board of Commissioners of the District of Columbia, H. B. F. Macfarland. In his address Mr. Macfarland referred to the fact that Washington was the place where the telegraph business was first started; that many notable events connected with the enterprise occurred here, and that this was the place where telegraphers should always receive a cordial welcome and consider themselves as at home.

A response to this welcoming address was made by William J. Dealy, of New York city, in his customary eloquent and appropriate manner.

In opening the meeting of the Old Timers, the president, William H. Young, of Washington, delivered an address full of references to interesting historical events, and read a paper prepared by Dr. J. J. Clark, giving an account of his work in making telegraph instruments for Professor Morse in 1844-45.

The absence of the secretary of the association, John Brant, who was unable to be present on account of severe illness, was much regretted, and a temporary secretary was designated to make a record of the proceedings. After the reports of officers were presented and other routine business was transacted, the following officers were elected for the ensuing year: president, Harvey D. Reynolds, Buffalo; vice-presidents, George A. Burnett, Buffalo, George F. Macdonald, Ottawa, Canada, I. McMichael, Toronto, Canada; secretary and treasurer, John Brant, New York city.

President William B. Wilson, of the Military Telegraphers, called the meeting of that society to order, delivered a stirring address containing an account of the doings of the society during the past year, and made an earnest plea for greater earnestness and activity on the part of the members in their endeavor to secure congressional action, which will give to the members of the organization the right to apply for pensions, and place them on an equal footing with the soldiers of the army in this respect.

The election of officers resulted as follows: president, William B. Wilson, Holmesburg, Pa.; vice-president, William L. Ives, New York; secretary and treasurer, James E. Pettit, Chicago.

At the joint meeting numerous letters and telegrams from members unable to be present were read, and the following communication was sent to them and placed on the records: "The Old Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps, assembled in their twenty-sixth annual reunion at Washington, D. C., send cordial, fraternal greetings to all absent members, with best wishes for their welfare and prosperity."

The deaths during the past year were reported to the meeting as follows: Old Timers—Charles D. Livermore, Kenneth McKenzie, S. H. Kauffman, Alfred S. Brown, William A. Rudd, W. J. Byrne, Charles A. Elster, Alex M. Mackay, W. B. Clum, M. F. Gaffney, H. S. Larcombe, Rodney Smith, William F. Findley, Henry Holland, J. E. Rainsford and Theo. Sumwalt; Military Telegraphers—Martin Barth, W. S. Logue, J. D. Flynn and D. A. Williams.

The assembly stood in silence while the lists of these names were read, and the following expression of the sense of the meeting was placed on the records and sent to the families of the deceased: We give a kindly thought to our comrades who have severed their earthly circuits and answered their last call beyond the horizon of human ken, leaving some of us to linger here awhile as evening embers turn from red to gray and the dusk is waiting for the night; we recall the times which have been rendered joyous by their genial companionship and friendship; we testify to their faithfulness and usefulness in their varied walks of life; we shall always cherish their memories; to their families we tender our sincere sympathy in their bereavement.

Colonel Wilson delivered a eulogy especially referring to the memory of the late Edward Rosewater, who was one of the operators in the Civil War, and whose death occurred recently at his home in Omaha.

After the close of the business meetings

Digitized by Google

the two societies, with their friends and guests, made an excursion to Arlington in special electric cars, and the evening was spent in attending the performance at Chase's theatre.

Wednesday, the 10th, was devoted to an electric-car excursion which passed through all the most interesting sections in the city, and this was followed by an afternoon reception by President Roosevelt at the White House, where each individual received a cordial greeting. A visit to the Capitol and Congressional library followed. The library being kept open and beautifully lighted until 10 o'clock in the evening, an excellent opportunity to examine the beauties of the building was afforded. The officers of the library paid special attention to the telegraphic visitors and gave them opportunity to examine the intricate workings of the institution.

On the third day the company left the Arlington Hotel for Mount Vernon in special cars to the wharf and took the steamer down the river. Many of the guests had never visited the place before and all were intensely interested. In the afternoon visits were paid to the Corcoran Art Gallery, the National Museum, the Washington Monument and various other public institutions.

The formal exercises were closed on Thursday evening by a banquet at the Arlington Hotel, which was attended by 300 persons, one-half of whom were ladies. The Arlington's finest banquet hall was tastefully decorated with national flags, trailing vines, flowers and electric lights. A string band and a male quartette furnished music. In many of the choruses splendid voices of guests were heard. A new song dedicated to the Military Telegraphers was sung with spirit. The words of this song were written by M. H. Kerner, who also composed the music to which it was sung. The affair was elegant, harmonious and dignified. President Young was the generous host entertaining his personal friends.

P. V. DeGraw, assistant postmaster-general, acted as toastmaster and carried the proceedings through with tact and enthusiastic spirit. William J. Dealy delivered the first address in response to a toast to the ladies. His speech was appropriate, graceful and complimentary and was received with pleasure.

Professor Willis P. Moore, chief of the United States Weather Bureau, gave a brief statement of the history and operation of the service, the success of which, he declared, depends upon the excellent telegraph facilities of the United States. He stated that his bureau is conducting experiments and making plans for utilizing wireless telegraphy in collecting and distributing weather reports and expressed the opinion that it will not be long before all severe storms on the Atlantic ocean will be foretold and reported to vessels at sea.

Commander E. E. Hayden, the superintendent of the government's time service, spoke on this subject. He also acknowledged the country's indebtedness to the telegraph companies for their excellent facilities and great liberality in transmitting time signals over the world.

B. W. Trafford, general manager of the Chesapeake & Potomac Telephone Company, made one of the best addresses of the evening, briefly sketching the history of the development of the telephone business, its close relation to the telegraph, the wonderful extension of both enterprises, which demands the utmost energy and skill, and placed especial emphasis on the necessity of keeping the business on a high plane of integrity and honor.

W. W. Jermane, a prominent Washington journalist, spoke on the relations of the press and the telegraph, paying high tribute to the telegraphic fraternity for its zeal and efficiency in the prompt and rapid transmission of press despatches.

John E. Wilkie, chief of the government secret service, gave an interesting and witty talk without disclosing any secrets. He announced himself as having been a plug operator, but his speech made it clear that he knows a great deal about the business.

Colonel William B. Wilson delivered an eloquent and forcible address on the military telegraph in the Civil War. He recounted many thrilling episodes of that tragic time and paid glowing tribute to the memories of the war operators.

The closing address was by M. J. O'Leary, known as the "Irish orator" of the telegraph fraternity, whose subject was "The Telegraphers' Mutual Benefit Association as a Powerful Auxiliary for the Advancement of the Standing of the Profession." Mr. O'Leary, on behalf of the visitors, expressed thanks to the Washington members for their hospitality.

Among the invited guests at the banquet were Commissioner Macfarland; General D. J. Cragie, U. S. A.; General Dunwoody, representative of the DeForest Wireless Telegraph Company; Major A. E. H. Johnson, one of President Lincoln's private secretaries, and Dr. William Tindall, secretary to the District Commissioners.

The entire business of making and carrying out plans for the reunion was under the immediate and active control of President Young, with the cooperation and assistance of the members of the executive committee and the chairmen of the various working committees, among whom were Charles P. Adams, telegraph superintendent of the Southern Railway; G. W. Ribble, superintendent Postal Telegraph Company; James B. Yeakle, superintendent Fire Alarm Telegraph, Baltimore; P. V. DeGraw, assistant postmaster-general; Henry F. Taff, manager Western Union Telegraph Company; George C. Maynard, National Museum; Ernest W. Emery, Associated Press; Jesse H. Robinson, Weather Bureau; W. H. McKeldin, J. T. Bresnahan, R. G. Callom, P. E. Brown, J. W. Collins and J. J. Mooney, of the Western Union Telegraph Company's Washington staff. The financial affairs were ably managed by J. H. King, cashier of the Western Union office. A ladies' reception committee, under the direction of Mrs. P. V. DeGraw, cordially welcomed the guests and added much to the enjoyment of the reunion.

There was a large attendance at the meeting, including a goodly number of ladies. Among those present may be mentioned the following: William J. Dealy, J. B. Taltavall, publisher of the *Telegraph Age,* New York city; J. P. Altberger, W. T. Westbrook, Philadelphia; Charles A. Tinker, Brooklyn; W. J. Fraser, Boston; Charles Selden, J. B. Yeakle, Baltimore; I. N. Miller, Cincinnati; P. V. DeGraw, assistant postmaster-general; R. B. Dickey, Ernest W. Emery, George C. Maynard, G. W. Ribble, Washington; Henry A. Reed and wife, of Newark, N. J.; George M. Case, wife and daughter, Rochester, N. Y.; John F. Knapp, Los Angeles, Cal.; J. Annand and wife, Portland, Ore.; J. C. Smith, Dallas, Tex.; E. P. Griffith, Passaic, N. J.; R. C. Jones and wife, and G. L. Lang, Chattanooga, Tenn.; L. B. McFarlane and wife, Montreal, Canada; W. F. Williams, Portsmouth, Va.; W. P. Cline, Wilmington, N. C.

BOOK REVIEW.

"Brazing and Soldering." James F. Hobart. New York. The Derry-Collard Company. Paper. 34 pages. 5½ by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

A very practical little book giving excellent instructions for brazing and soldering.

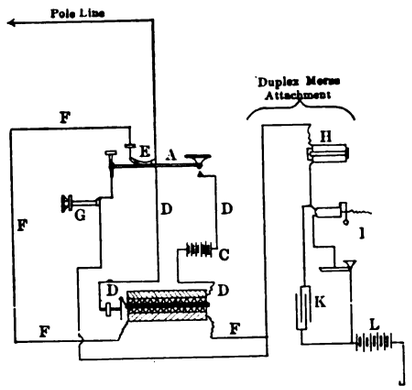
Digitized by Google

SIGNALING ON THE LEHIGH VALLEY RAILROAD.

THE OLD INDUCTION TELEGRAPH AND THE PRESENT BLOCK SYSTEM.

The success which is attending the present-day experiment of transmitting messages through space, and the assertion from time to time that application is to be made of wireless systems of communication between moving trains, calls to mind the utilization for some time of the old induction telegraph of the Consolidated Railway Telegraph Company. On Thursday, October 6, 1887, a notable assemblage of then prominent electricians, a number of them members of the old New York Electric Club, were the guests of Charles A. Cheever, president of the Consolidated company, on a trip made over the lines of the Lehigh Valley Railroad, the special feature being a test of the induction telegraph system, which the Lehigh company was making use of. The accompanying illustrations, which are reproduced from the ELECTRICAL REVIEW of Saturday, October 15, 1887, will be readily understood. The system, in brief, consisted of a single metallic conductor stretched on poles about sixteen feet above the ground, suitably connected with an apparatus for intermittently charging and discharging the line. A similar apparatus was carried upon the car, the roof of which was utilized as the condenser; or, in case the roof was not available, a rod or strip of metal was substituted. A telephone receiver was interpolated in the circuit at both receiving and sending stations, audible signals being given in place of the customary dot and dash of the visual indications of the Morse telegraph. The source of current in each case was a few cells of primary battery. The primary circuit consisted of a double-acting Morse key, a local battery and the primary of an induction coil. The secondary included a connection to the ground through the running gear and track rails, and a connection to the roof or other artificial condenser. Included in the primary circuit also was a vibrator of the now well-known buzzer type, which was utilized to throw a persistent train of electrical impulses onto the line so as to increase the inductive effect and make possible the long or short intervals of sound which would spell out the message. This system apparently worked to the perfect satisfaction of the company's guests upon this memorable occasion. Some 400 messages were sent and received in a run from Jersey City to Easton, Pa. The rapid development, however, of other forms of signaling and the complications introduced by the constantly growing traffic demands in time mitigated the usefulness of this system, and at the present time it is but a memory and an indication of the enterprise of the management of the Lehigh Valley Railroad.

The same spirit which prompted the Lehigh Valley to take advantage of the induction telegraph in 1887 is responsible for the excellent signaling system which is at present in vogue on that company's lines. The block signals on the Lehigh Valley Railroad are automatic in their action. Electricity carried through the rails in such a manner that it is controlled by the action of a pair of wheels on the track is the power that operates the signals. The road is divided into blocks varying from one-half a mile to two miles in length, the distances being determined by the density of traffic and other considerations. For example, on sections of the road where the



INDUCTION TELEGRAPH SYSTEM TRIED ON LEHIGH VALLEY RAILROAD IN 1887.

trains are most frequent the blocks are shortest. Automatic disc and semaphore signals are used. The disc signal consists of a banjo-shaped box with a large glass in the front and one in the back, the latter being painted white on the inside so that a white circular surface may be shown from the front of the signal. Inside this box is placed a red or green movable disc. This disc is either hidden, thus allowing the white glass in the back of the signal head to be seen when the signal is at safety, or exposed to view when the signal is at danger or caution. At night these signals are given by lamps placed at the back of the signal head, the light of which is thrown through a small glass opening above the large one just described. The colors—red, green and white—indicate the same conditions at night as in daytime. The semaphore signal consists of an iron post with a red arm or blade projecting at the top and a green blade with a forked end beneath. Danger or caution and safety are shown by the position of these blades. At night red, green and white lights are used in the signal indications, as in the disc signal.

At the beginning of each block is placed a signal post with a danger signal at the top and a caution signal beneath. The normal position of these signals is at danger or caution, as the case may be. A train entering a block at, say, A, causes the two signals on the post at the beginning of block B to display safety, providing there is no train or other obstruction in blocks B and C. At the same time, a danger and a caution signal are shown at the beginning of block A. As soon as the front trucks of the engine of this train pass into block B the latter also displays a caution and a danger signal. After the entire train passes out of block B the top signal at A will display safety to an approaching train, but the lower one will still be at caution. This lower signal at A will not show safety until the entire train has passed into block C—that is, the second block ahead of A. An engine-man then has an indication of the presence of a train on the same track two blocks ahead of his train, and a double indication—that is, a danger and a caution signal—at the beginning of the block in which the train is located.

These signals do not merely give indications of a train ahead. Should a rail be broken, a switch open or any other impediment which would interfere with the safe passage of the train be in a block, the signals in the rear will display danger and caution, the same as if the train were on the rails at that point.

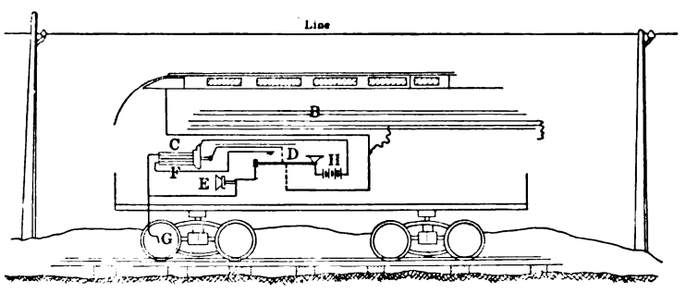
Another important feature of this system is the system of switch indicators. This consists of a small disc placed in an iron box about five feet above the ground in close proximity to each switch leading out of the main tracks. These indicators notify trainmen about to open a switch in the main track of the approach of a train on that track. All the indicators in the block show danger as soon as the train enters the second block in the rear, and until it has passed out of that block in which the indicators are located, so that there is no chance for a trainman to open a switch in the main track after an approaching train has passed the signal at the entrance of the preceding block, without full knowledge of the approach of the train.

In conjunction with this system of automatic signals there are placed at all junction points and grade crossings with other railroads interlocking signal towers

Digitized by Google

from which all the switches in the vicinity are operated mechanically by the man in the tower. Each of these switches is protected by signals, and these signals and switches are so interlocked that it is impossible for a wrong signal or signals governing converging routes to be given.

Backward movements of trains over switches at these interlocking points and movements on sidings are governed by special signals placed on the right-hand side of the track which they govern. In no case does a signal govern more than one track. All the signals at these plants are so interlocked that no signal can be thrown to safety until all the switches on the route which this signal governs are in the correct position, and all the signals governing movements over any portion of this route from other tracks are at danger.



ARRANGEMENT OF INDUCTION TELEGRAPH APPARATUS USED IN THE LEHIGH VALLEY RAILROAD TRIALS.

The Lehigh Valley system operates 1,090 automatic disc and semaphore signals and 1,660 interlocking levers located in eighty towers operating signals and switches.

Each division of the road has a signal inspector whose duties are to oversee maintenance of all the signals on his division and to have them kept in proper working order. This man has as assistants automatic and mechanical repairmen, battery-men, helpers, etc. He reports to the division engineer and to the signal engineer. The signal engineer is the head of the signal system. All matters pertaining to either the maintenance or installation of signals must pass through his office, and receive his approval. In this way all the appliances used, the manner of their installation, and, in fact, every detail, are made standard throughout the road.

TELEPHONE AT AUTOMOBILE RACES.

MOTOR-CARS QUICK, BUT TELEPHONE IS QUICKER.

To those interested in the practical side, the managing of the big automobile race recently held on Long Island, the extent to which the telephone was used in keeping tabs on the big racing cars and in transmitting orders and information is of more than passing interest. To telephone men, also, a description of the special telephone plant installed is of particular interest as an example of efficient telephone work under rather unusual conditions.

It was necessary to install and operate two distinct systems—the first, consisting of timing and checking circuits, in order that the cars entered in the race might be followed from the official stand and grand stand in their trip around the course, so that the officials and spectators might keep in touch with what was going on not only before them, but all around the circuit as well. Second, a system of private and public lines, in order that the newspaper correspondents and the general public might at any time communicate with the city or with other outside points.

TIMING AND CHECKING CIRCUITS.

To keep in touch with what was going on around the course, twelve telephone lines, connecting stations located at each of the twelve turns with telephones located at the official stand, and five timing circuits, connecting telephones in the official stand with telephones connected at the five, ten, fifteen, twenty and twenty-five-mile points respectively, were installed.

The telephones located at the turns and timing stations along the course were nickel desk sets, equipped with head and hand receiver, magneto and dry batteries enclosed within regular wooden cable terminal boxes attached to poles at the designated points. The telephones at the official-stand end of these lines were nickel desk sets, with head and hand receiver, magneto and batteries, placed along a shelf on the second floor of the stand. When bulletins were received a force of clerks indicated the drivers' places on a great map over the stand.

In order to make up the lines connecting the telephones in the pole boxes with the telephones in the stands, four miles of twenty-five-pair lead cable were placed temporarily on poles from the official stand to a point at Albertson, where suburban toll trunks, additional cable facilities to Roslyn, connecting with existing wires on poles toward Great Neck, were available, and could be used to complete the circuit.

NEWSPAPER AND PRIVATE LINES.

The Associated Press and several of the newspapers installed private lines from their offices to the official stand. Several other special circuits also were installed, including one to the private car of President Peters, of the Long Island Railroad, located at a siding just north of the Jericho Turnpike, at Mineola, and several circuits to the headquarters of the various automobile companies located near the course. A telephone line was also established between the official stand and the band stand for the purpose of directing the bandmaster.

To accommodate the general public, and such newspaper correspondents as had not contracted for private lines, a two-position switchboard was installed in a portion of the official stand with trunk-line connections to the Long Island toll-board, the Roslyn central office, the Garden City central office, and tie lines to the switchboard at the Garden City Hotel. From this switchboard extensions were run to the public telephone room at the official stand, the grand stand, and various important points nearby.

The total circuit mileage of the timing and checking system was seventy-eight miles; the total mileage of the newspaper system, 215 miles; the pay-station system, 155 miles, making a total mileage of 448 miles. Of this total mileage 292 miles of existing circuit was used, and 156 miles was placed temporarily. The entire system was efficiently operated, an ample force of uniformed operators, attendants, messengers and supervisors being provided. A special pay-station department inspector was also on hand to look after any irregularities that might arise.

In spite of this ample equipment there were occasional periods when the demand for service taxed the installation to its fullest capacity. There was, however, no delay. The service was efficient and satisfactory in all respects.

This telephone service was installed and maintained by the New York & New Jersey Telephone Company.

Digitized by Google

Vol. 49—No. 16

Illuminating Engineering Society.

THE first fall meeting of the Illuminating Engineering Society was held at the Edison Auditorium, New York city, Friday evening, October 12, with President Louis B. Marks in the chair. At this meeting, following the resolution adopted at the meeting of the council, the New York members were organized as a New York section of the society. This action has been taken in order that the work of all the sections may be given the same weight. The general policy of the society will be governed by the council, but the management of each local section will be left largely to its officers. The following temporary officers were elected for the New York section: Alfred Forstall, consulting gas engineer, chairman; Frank A. Pattison, consulting electrical engineer, first vice-chairman; Dr. F. Schniewind, consulting chemical engineer, second vice-chairman; Preston S. Millar, expert with the Electrical Testing Laboratories, secretary.

A brief report was submitted by Secretary Elliott. It shows that the society has collected $1,802.50 from dues, sales of transactions and advertising, and has expended $1,276.18, leaving a balance of $526.32. The membership is now 750.

Two interesting papers were read and discussed. The first, submitted by Ernest C. White, illuminating engineer, Winnepeg, Manitoba, was entitled "Application of Photometric Data to Indoor Illumination." In the absence of the author it was read in abstract by Dr. Clayton H. Sharp. It calls attention to the somewhat troublesome methods in use for solving problems in illumination. These questions are generally decided by means of candle-power polar diagrams, curves which show the intensity of the light emitted in all directions. What the illuminating engineer wishes to know, however, is not the intensity of light emitted by a certain source, but what amount of illumination a certain source will give at a certain distance and in a certain direction. In order to obtain curves showing this feature, what are called uniform illumination curves are plotted—that is to say, a polar diagram showing the distance away in all directions from the source of light at which an equal illumination is obtained. These diagrams may be plotted for different types of lamps or lamps fitted with different types of reflectors, one diagram of each kind being sufficient for lamps of all candle-powers. By means of a number of scales laid off at the side of the diagram and the concentric circles drawn on the diagram, it is easy to interpolate what distance away from the source of light a given illumination in candle-feet will be obtained in any direction. With a diagram of this kind for a given combination of lamp and reflector it is a simple matter to figure out from any assumed grouping of lamps the illumination in candle-feet which will be obtained at any point. three-fourths foot-candle at sixteen feet distance; two foot-candles at ten feet distance; one-eighth foot-candle at forty feet distance, etc. In order to calculate illumination at an angle of forty-five degrees from the vertical, the radius of intersection is swung around to a line parallel to the scales, the reading then being 0.5 foot-candle at nine feet distance, etc., if the rays are incident to the plane to be illuminated. If the plane in this case were

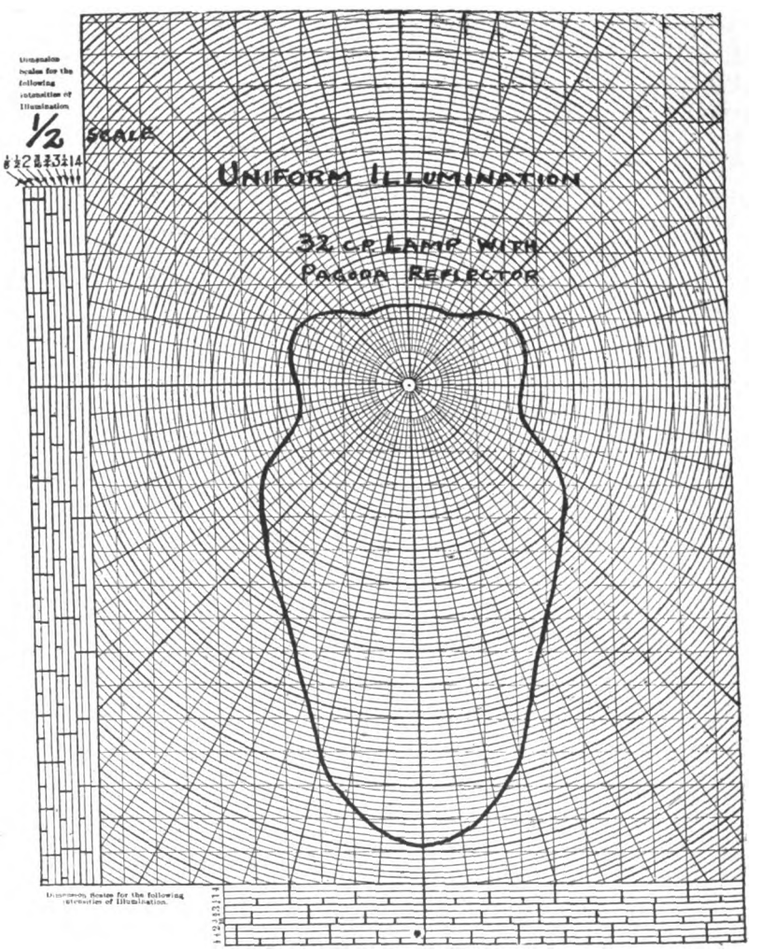


FIG. 1.—POLAR DIAGRAM OF UNIFORM ILLUMINATION FROM AN INCANDESCENT LAMP.

Fig. 1 represents the uniform illumination from a thirty-two-candle-power incandescent lamp with a pagoda reflector.

Each of the various scales is labeled in foot-candles, *i. e.*, each scale applies correctly to the curve for the intensity of illumination marked above it. Thus the illumination directly below the lamp will be one foot-candle at fourteen feet distance (*i. e.*, seven divisions on the one foot-candle scale equals fourteen feet, the curve being plotted to one-half scale); four foot-candles at seven feet distance; horizontal, the horizontal and vertical rulings (provided on the coordinate paper to facilitate reference to the scales) easily permit of swinging a radius proportionate to 0.5 foot-candles illumination through the angle of incidence and thus reading with close approximation the actual illumination, which would be about 0.35 foot-candle at nine feet distance. Attention was called to several advantages that were thought to result from the use of these curves. The shape of the curve represents the effect produced, which is not

Digitized by Google

the case with the ordinary polar distribution curve. The area of the curve is not so largely affected by the character of distribution as in the polar distribution curve. The curves of uniform illumination afford instant reference to the best location for lights—that is, the proportion of distance from ceilings and floors, the best angles for bracket lights, etc. The paper then showed the application of this method to fixture design, and pointed out that it is not extravagant to expend a good deal of careful calculation and thought on the design of a fixture when it costs from $200 to $300.

The second paper was read by J. E. Woodwell, illuminating engineer for the Federal government, the title being "Data on Indoor Illumination." Mr. Woodwell emphasized the fact that the intensity of illumination should be varied according to the character of the work to be done, but that there are no fixed limits in any case, since the eye accommodates itself to considerable variation. He directed attention to the present demand for a simple, practical "illuminometer" which shall be portable, accurate and low-priced. There is need for a large amount of data showing the results of different methods of lighting, for since there is no simple connection between the physiological effect and the amount of light given out, we must depend upon the results of successful plans to guide us in this work. It has been found that in the postal service, for example, for reading addresses of mail in an endless variety of forms, pencil, pen and print, on backgrounds of various color, a local illumination of from two to four foot-candles has been necessary. Two foot-candles is generally sufficient for desk illumination, though if much detail is involved, three and even four foot-candles is not excessive. For corridors, public places and assembly rooms the figures range from one-half to one and one-half foot-candles, while in stores where dark goods are displayed and a brilliant display is desired, five to ten foot-candles is not uncommon. The latter amount of illumination is also required for tracing, drawing and engraving. These intensities relate to the working plane, and, in addition, consideration must be given to the walls and ceiling and whatever objects in the space are to be illuminated. The figures determined upon for this purpose will depend principally upon the color and reflection value of such surfaces. The deceptive character of the candle-power distribution curves as usually plotted was pointed out, and it is shown that the effect produced by reflectors is not always made clear. For instance, a reflector may be used which will take only a small part of the light thrown out in a horizontal direction, yet will give a very intense illumination in a vertical direction. For studying illumination problems the Rousseau diagram is often more valuable than the candle-power diagram, since it shows the total amount of light given out by the illuminant. The author gave the usual method of solving illumination problems, and then passed to a consideration of actual cases. By means of lantern slides the results accomplished in a large number of public buildings where various methods of lighting are in use were shown, such as classrooms, post-office departments, courtrooms, reading rooms and other interiors. In some cases the method illustrated has been found highly successful. The use of Cooper Hewitt lights in the New York post-office has given excellent results. For sorting mail a lamp with a reflector concentrating the light downward on the desk and pigeon-holes is good, but should be supplemented by general illumination in the room. Good results are being accomplished by means of the Welsbach lights. Several examples of lighting large interiors, such as courtrooms, were illustrated, and the systems described somewhat in detail, the method of wiring being explained. Some cases in which the illumination was bad were also shown, the troubles being pointed out and possible remedies suggested.

The discussion was opened by E. L. Elliott, who said that the method proposed by Mr. White for solving illumination problems was of very great value and represented the first important step in advance since that made by Rousseau. He thought, however, that the diagram might be simplified a little bit, stating that it is very easily plotted from the ordinary candle-power curve. Mr. Woodwell's paper was also of very great value, since it gives the results of a large amount of actual work; it is just such results as are being sought by illuminating engineers.

Dr. A. H. Elliott expressed his appreciation of the two papers presented, and said that he was struck by the amount of attention which electrical engineers have been giving to problems in illumination. Gas engineers have been devoting their attention to securing a large amount of light per cubic foot of gas, and to devising gas lamps of great intensity. The gas engineers should realize that the direction in which the light is given out is as important as the amount. Attention was called to the high efficiency of plaster of Paris as a reflector, about eighty per cent of the incident light being reflected. This, he thought, might be employed as a means of diffusion, instead of glass shades.

W. H. Gardiner asked why the general public to-day believes that the gas furnished is poorer than that of ten or twenty years ago. He himself has been led to the conclusion that the introduction of lamps of higher intrinsic brilliancy in public buildings has led to this dissatisfaction, because of the contrast thus created. Gas engineers know that the gas furnished to-day is better than that of ten years ago, but a gas user, in going into his home from a brilliantly lighted building, is struck with a feeling of gloominess and attempts to overcome this by lighting three or four burners.

R. M. Searle thought that the position of the gas burners might have something to do with the trouble. Formerly side lights placed four feet from the floor were much used. To-day they are placed seven feet from the floor even where dependence is not put entirely upon a central chandelier.

H. H. Seabrook pointed out that the intensity of illumination does not determine the visibility. As shown by Helmholtz thirty years ago, a brilliant illumination, particularly one rich in actinic rays, causes a great contraction of the retina and may result in poorer definition.

Dr. C. H. Sharp said that the standard of illumination has been steadily increased, and this is the reason for the dissatisfaction. Buildings lighted by methods satisfactory twenty years ago now, by contrast, seem dismal. Attention was called to the fact that the introduction of more efficient gas lamps such as the Welsbach had not decreased the sale of gas, but had, in fact, increased it. The public, instead of reducing its consumption of gas, is buying more light. He thought that the same result would be found from the introduction of the more efficient types of electric lamp.

Mr. Gardiner agreed with Dr. Sharp, and called attention to a recent discussion of the matter in which it was held that the sixteen-candle-power incandescent lamp is now out of date.

President Marks took issue on this point, saying that although, no doubt, the present dissatisfaction is due to a toning up of our standards of illumination, that we have gone very much too far. He asked whether any one had data regarding the intensity of illumination given by a ground-glass window on a bright day. This he held to be ideal, and, from measurements of his own, thought that it might be as low as one-fiftieth of a foot-candle. This is what we should aim for. At the present time we use too great brilliancy.

The meeting was then adjourned.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

A Study of Starting Hoisting Apparatus when Operated by Continuous-Current Motors.

The usual method employed in determining the resistance of the successive steps in a starting rheostat when used for hoisting motors is well known, and this may be carried out either analytically or graphically. It is usual in such cases to decide upon a limiting current value which bears a certain relation to the full-load current. When this is done the total starting resistance, including that of the armature, is given by dividing the applied electromotive force by the maximum allowable current. Each successive step in the rheostat then bears to the preceding one the ratio of the starting to the normal current. The same method may be employed when it is desired to maintain a constant acceleration during the start. This system does not, however, take into consideration the effect of the self-induction of the armature and of the rheostat, and this phase of the problem is taken up here by G. Hacault. The author considers first the mechanics of the problem of starting a motor when lifting a given load. From this he deduces an equation involving this load and the constants of the apparatus, which shows that the inductance of the starting circuit has a considerable effect upon the performance of the motor. The equation is solved to determine the limiting values, and curves are plotted to enable it to be made use of graphically. The experiments verify the analytical consideration, showing that the inductance of the circuit makes it allowable to reduce considerably the starting resistance, and it was found that, in some cases, it would seem desirable to wind this resistance on an iron core, so as to increase its inductance.—*Translated and abstracted from L'Éclairage Électrique (Paris), September 22.*

Wireless Telegraphy for Railway Signaling.

The idea of applying wireless telegraphy to railway use is not new, if one include under this item the early attempts of Phelps, Smith, Brown and others with the so-called induction systems. So far no actual use is being made of the new system of communication for controlling railway trains, but Dr. E. Nesber describes here some interesting experiments made in this field near Berlin. A station was equipped with apparatus of the Telefunken system, and a horizontal aerial was adopted, about 210 feet long, 190 feet of which was stretched between two telegraph poles twelve inches below the telegraph wires, the remainder of the length being made up of the connections to the sending apparatus. A car attached to a steam-hauled train was fitted up with the receiving aerial, consisting of a horizontal rectangle of wire supported on six short posts. The receiving apparatus was placed in one compartment of this car. Experiments were made to determine the distance to which signals could be sent with certainty, and the influence of overhead wires. It was found that the latter, when directly over the car, interfered somewhat with the clearness of the received message. The experiment is thought to indicate that for railway signaling purposes a system of wireless telegraphy such as that used in this work can be depended upon to transmit messages about seven and one-half miles, and that with more attention to the equipments of both the fixed and moving stations, greater distances can be covered. The operation of the system was found in no way to interfere with that of the ordinary telegraph lines running along the road.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), September 27.*

Applications of Rare Metals to Incandescent Lighting.

As was pointed out by Féry, carbon at the temperature it attains in the incandescent lamp is not an efficient optical radiator. It is exceeded by chromium oxide, platinum, magnesia, zirconia, lime, lanthanite, thoria, and the Auer mixture of thoria and ceria. From Féry's figures it would seem that certain of these substances, at the temperature of 1,400, have an efficiency six times greater than that of carbon. It was this fact that led up to the numerous recent attempts to substitute some other material for carbon in the incandescent lamp. The work which has so far been done is reviewed here by J. Izart, who points out that although the materials mentioned give much better efficiencies, and may even be still further improved by carrying them to higher temperatures, nearly all of them are deficient in mechanical properties. Platinum, in fact, may be employed and give twice the efficiency of carbon, but this does not make a satisfactory lamp. The author then passes to a discussion of the more recent work in this direction. Titanium, which has been proposed, is found in great abundance throughout the surface of the globe. It is as widely distributed as carbon and iron, and may be considered as one of the principal constituents of the terrestrial crust. It is found in nearly all crystalline rocks, bauxites and iron ores, and is much more abundant than tantalum, tungsten, or molybdenum, so that if it can be employed successfully for making a filament, such lamps should not be expensive. On the other hand, tantalum is not so widely distributed. In fact, it is found in small quantities associated with earths and sands, from which it is extracted with difficulty. It is accompanied very often by tungsten and the materials of the tin group, such as niobium yttrium, uranium and the rare earths. For these reasons a metallic tantalum will command a high price. Tungsten, while more abundant than tantalum and molybdenum, still possesses the disadvantages of titanium. Its minerals are wolfram, an oxide of tungsten, and scheelite, calcium tungstate. Kuzel, employing filaments of tungsten, has secured specific consumptions of 0.4 watt per candle. It is pointed out that in the present state of the art, when so many different metals are being suggested for use in incandescent filaments, that the relative luminous efficiencies of the methods should be determined, so that an intelligent idea of their relative values might be secured.—*Translated and abstracted from L'Industrie Électrique (Paris), September 25.*

Electric Traction in the Simplon Tunnel.

The putting into use of the electric railway system of the Simplon tunnel is a noteworthy piece of work carried out by Brown, Boveri & Company. This company offered, during the summer of 1905, to equip the tunnel and its termini for

Digitized by Google

electrical operation and have the system ready for operation the following summer. Due to a delay on the part of the tunnel company to decide finally upon the matter, the electrical company did not receive the contract until late last fall. For this reason it decided to install a three-phase system, simply because it could put such a system into service more quickly, and not because it believed that this system was better suited for the work than other proposed plans. It happened that Brown, Boveri & Company was building at that time two new locomotives for the Valtellina line, and by agreement with the Valtellina company transferred these locomotives to the Simplon company and secured from the former three other electric locomotives which that company had in service. This supplied the five locomotives necessary to keep the system in operation, four being required to haul the trains through the tunnel. Two power-plants were erected, one at Brigue, the Swiss end of the tunnel, equipped with a 1,200-horse-power plant; and the other at Iselle, the Italian end where a 1,500-horse-power plant has been installed. These two plants operate in parallel on the line, and are sufficient for the present tunnel service. The pressure employed is 3,300 volts at sixteen cycles. The tunnel is divided into five sections: from the station at Brigue to the northern end of the tunnel, the northern half of the tunnel, a siding in the middle of the tunnel, the southern half of the tunnel, and from the southern end to the Iselle station. Section switches are provided at the two stations and at the middle of the tunnel, as well as a telephone system. At the northern end of the tunnel the overhead line is carried on steel cross-wires strained between poles of hard-drawn steel, which are placed on each side of the track. Poles consist of two members, and on curves are stiffened by a third member, forming a tripod. At the southern end of the tunnel there is a separate set of poles for each track, making a very solid construction and enabling the work to be carried on on any one track without disturbing the others. In the tunnel the conductors are carried on steel cross-wires stretched between gun metal studs cemented directly into the face of the tunnel. No strain insulators are used, as it is necessary to keep the overhead work in the tunnel as simple and as strong as possible. The cross-wires are insulated at each end of the gun metal studs by strong porcelain insulators, allowing the cross-wires to be drawn as tight as required. The cross-wires are about eighty-three feet apart on straight portions of the line, and forty-two feet on curves. No trouble due to change in temperature is met with in the tunnel. A special type of insulator supports the trolley wire, this being made of a porcelain body carried on an ebonite bolt. The complete insulator is carried on a gun metal fitting. These insulators are tested at 40,000 volts. The section of conductors is 0.15 square inch in the tunnel, and one-half this outside. The double cross-section in the tunnel is obtained by using two wires, and is intended to prevent too great a fall of potential along the line, as well as to give additional surface of contact. The two overhead conductors are zigzagged slightly over the track, so as to equalize the wear on the trolley. The rails are bonded with a plastic joint, so that the ordinary fish-plates only are used to conduct the current from one rail to the other. The locomotive employed, which is also discussed here, was described in the ELECTRICAL REVIEW for July 14.—*Abstracted from the Electrician (London), September 28.*

A Large Steam-Turbine-Driven, Continuous-Current Dynamo.

In an article on the steam turbine department of Richardsons, Westgarth & Sons, Hartlepool, England, is given an interesting description of a large direct-current dynamo direct-connected to a steam turbine. This company builds steam turbines under the Parsons patents, and is the English representative of Brown, Boveri & Company, of Baden, Switzerland. The dynamo was built by the latter company, and is intended for the Lisbon electric tramways. The machine has an output of 1,000 kilowatts, and runs at a speed of 1,260 revolutions per minute. It is stated by the author that at the time he inspected it the machine was carrying a load of 2,100 amperes, corresponding to an overload of fifteen per cent in current, without sparking, although the voltage of the machine was below the normal because of an insufficient steam supply. The normal potential is 550 volts, and the allowable overloads are ten per cent for three hours, twenty per cent for one hour, and fifty per cent momentarily, all at the normal voltage. The rotating armature is of the slotted drum type with ample provision for circulation. The windings are held in the slots by hardwood wedges, while the parts of the windings overhanging the ends are covered and positively held by metallic caps cast from a special alloy of great tensile strength. The commutator is of hard-drawn copper and mica, and is strengthened by four steel rings shrunk on. The four-pole magnet system, which, in appearance, nearly resembles the stator of an induction motor, consists of soft-iron core plates carried on a cast-iron frame and well ventilated. It is provided with two distinct windings—a shunt winding and a compensating winding displaced from the former by an angle of ninety electrical degrees. This compensating winding enables the machine to work with brushes fixed at all loads from zero to fifty per cent overload without injurious sparking. At the same time, as it carries all or a part of the main current, it can be adjusted so as to give the dynamo the characteristic of a level-compounded, over-compounded or under-compounded machine. The dynamo is to run in parallel with existing slow-speed machines in the Lisbon tramways power-station, and was required to have an over-compounded characteristic. Instead of making use of the above-mentioned feature of the compensating winding, the builders have provided a special compound winding, thus making the brush position independent of the compounding. A direct-coupled, six-pole exciter is provided, giving thirty-eight amperes at 100 volts, with the armature mounted on the end of the shaft. "Galvano" metallic brushes are used on the generator with small carbon pilot brushes set slightly in advance. There are twelve copper and six carbon brushes per pole for this machine. Special care was taken in balancing the rotating parts so as to eliminate all vibration. The temperature limit of the hottest part of the commutator or windings was specified to be forty-five degrees above the temperature of the surrounding air after a run of ten hours at normal full load. The insulation of the generator windings was tested to the frame with an alternating pressure of 1,100 volts. Forced ventilation is provided by means of vanes on the end of the armature spider, which draw air from under the bed-plate and discharge it through an opening in the top of the frame after circulating through all parts of the machine. The separate exciter is provided to avoid a tendency to racing which might exist if the machine were self-exciting with the system of compound windings employed. With this exciter the exciting voltage increases with the speed, checking any tendency to race when unloaded.—*Abstracted from the Electrical Review (London), September 28.*

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

The accompanying illustration is a reproduction of an advertising folder recently issued by the Philadelphia Electric Company, Philadelphia, Pa. While the cover design, which is in black and red, contains no direct reference to anything electrical, the idea has force in creating an inquiry as to the logic of the expression "mending fences." If this bulletin, therefore, attract any attention whatever it will hold it until an analysis is made of the argument which adorns the inside. There is a good deal of food for thought in this argument, and it is understood that the folder has been the means of securing a number of direct replies which have resulted in closing business.

THE FRONT VIEW OF THE FOLDER.

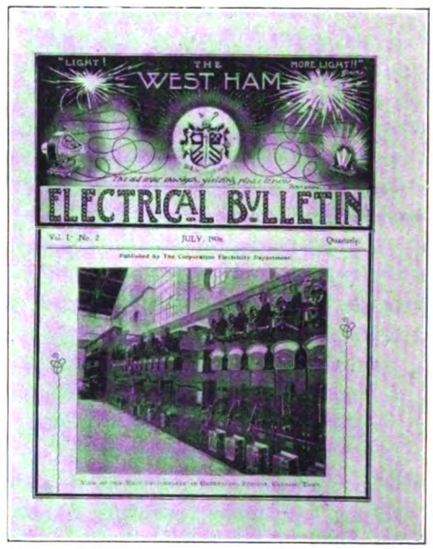
A. Hugh Seabrook, the engineer and manager of the West Ham (England), Corporation Electricity Supply, is one of the most enterprising of the British central-station managers. In some recent correspondence with Mr. Seabrook he has taken exception to various extracts from American journals published in the London technical papers, creating an impression that the managers of electric supply concerns in Great Britain—especially municipal propositions—are not up to date with regard to selling their commodity. Herewith is reproduced the cover page of the *West Ham Electrical Bulletin*. In addition to considerable advertising, the July issue of this bulletin contained an editor's page, some very interesting information concerning the definition of units, prices for various installations, a complete layout for a six-room, eight-room and ten-room house, a list of local electrical wiring contractors, and statements concerning the progress of electricity supply in West Ham, as well as a number of other articles relating to apparatus, notes of scientific interest, and a page of special interest to the tradesman.

MENDING FENCES
FIGURATIVELY speaking, this is the time of year to mend your business fences—to protect your growing business crops from the grazing of the stray animal—COMPETITION!
A store or place of business which is not lighted by Electricity has "let down the bars" to the inroads of its competitors.
No matter how complete and fine your stock is, the improper lighting and worse ventilation of your store will turn away many probable purchasers—A GREAT MANY MORE THAN YOU IMAGINE OR ADMIT!
The fall trade in the majority of cases is that part of the yearly business which is greatest in amount and profit. There is ample time between now and the middle of September to wire for Electric Light or to erect an Electric Sign.
An Electrically-lighted interior and exterior are just as necessary for successful store trade as the right line of goods and clever salespeople. Our rates put the use of Electricity within the reach of every storekeeper, and our data regarding costs and results cannot fail to interest you.
Begin mending fences now by getting an estimate for either Arc, Incandescent or Nernst Lamps, or an Electric Sign. Use the attached card.
The Philadelphia Electric Co.
Tenth and Sansom Streets, PHILADELPHIA
BOTH 'PHONES
POST CARD
The Philadelphia Electric Co.
10th and Sansom Streets
Philadelphia
Commercial Department

ANOTHER EFFECTIVE FOLDER.

We have received from the Dallas (Tex.) Electric Light and Power Company, through M. W. Powers, of the soliciting department, a handsome set of souvenir postal-cards depicting various local scenes of interest.

In a conversation with a central station man connected with one of the largest lighting and traction interests of the country, the matter of courtesy on the part of the company's employés was touched upon. This subject was brought up in commenting upon Arthur Williams' recent address at the Hotel Frontenac before the Association of Edison Illuminating Companies. It was in this direction alone, said Mr. Williams, that the privately owned corporations has an immense advantage over the municipally operated plant. "But," said the other central station man, "in a very great number of cases you will find that somebody's brother or his brother-in-law is at the head of these departments, and is imposing upon this relationship, and in his brusque treatment of consumers is building up a wall of dissatisfaction." We have heard this before. Now, as a matter of fact, if a consumer's bill for light, say in February, was $3.70, in March and April $3.50 each month, and in May $5.25, when the consumer knows, that, if anything, he has burned less light than hitherto, it is barely possible that his meter is running fast (and sometimes meters do run fast), and his complaint should be listened to patiently, the matter explained and assurance given him that full satisfaction will be his.



THE BULLETIN OF THE WEST HAM (ENGLAND), CORPORATION ELECTRICITY SUPPLY.

Digitized by Google

INDUSTRIAL SECTION

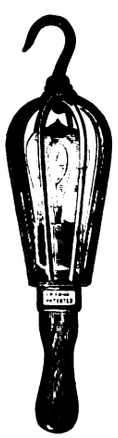
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A Portable Lamp Guard.

The accompanying illustration shows the portable lamp guard placed upon the market by I. P. Frink, 551 Pearl street, New York city. There has long been a demand for a portable lamp guard that could be used by the most careless workman without injury to the lamp.

The ribs of the guard are made of galvanized bessemer steel, and their strength lies in their depth rather than in the thickness of the ribs. This is a desirable point, as there is a minimum obstruction of the light from the protected lamp.

The guard has had a thorough test by electrical and mechanical engineers of leading railroads, and has been widely



PORTABLE LAMP GUARD.

adopted. It is of great utility around lighting plants, car barns, pits, breweries, freight terminals and similar installations.

Owing to the tapered fitting in the handle through which the reenforced cord is drawn and knotted there is no strain on the terminals nor the sockets. This is a feature which appealed strongly to an engineer who recently advised a large order for use in a prominent cotton mill.

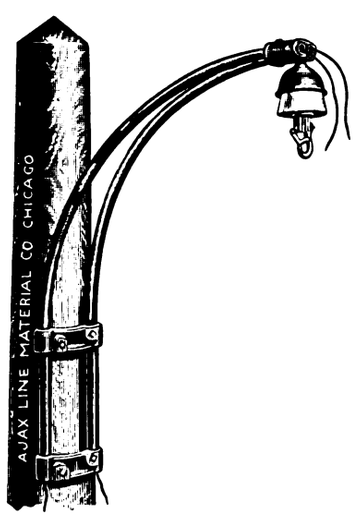
New Pole Fixtures for Arc Lamps.

The use of brackets or some other type of pole suspension for arc lamps which does not necessitate the undesirable span wire and a second pole is becoming more and more popular. At times the lamp may be placed directly over the pole without casting bad shadows, as is the case when there are trees on the street; but, more often, the illumination will be better when the lamp is held a little in front of the pole.

In order to meet these two conditions the three types of fixtures shown in the accompanying illustrations have been brought out by the Ajax Line Material

AJAX UNIVERSAL POLE TOP.

Company, Chicago, Ill. They are designated, respectively, as a universal pole top, forward pole top and front fixture. All of these fixtures are wired through the piping and are fitted with the high-

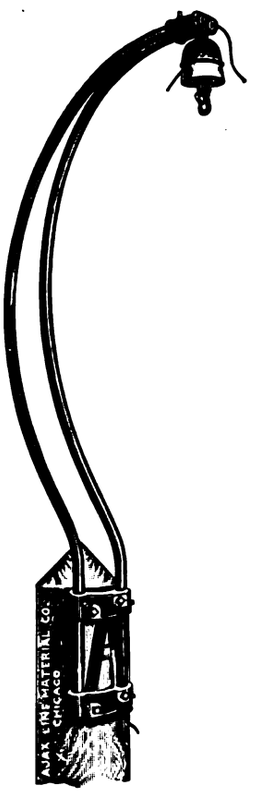


AJAX FRONT POLE TOP.

voltage type Ajax arc lamp insulators. The company's universal pole top is given an extra wide spread of the pipes, leaving ample room for a reflector above the lamp. The forward pole top also allows for such a reflector.

The front fixture may be used at any height on the pole, so as to allow the cross-arms to be placed above it on tall poles. This type is made with either a two-foot or a three-foot reach, and the latter size is supplied with pulleys for lowering the lamp if desired.

All three of the new fixtures can be



AJAX FORWARD POLE TOP.

fastened readily to either round or square poles, while the front fixture may be used on walls as well.

The Rall Joint Company.

The enlargement of the steam rolling mill of the Rail Joint Company, at Troy, N. Y., known as the Albany Iron and Steel Works, has been completed. The rolling mill building is 400 feet long, independent of machine shops and other buildings.

An electric crane with a range of 600 feet carries steel billets from the yard, constantly feeding the furnaces, so as to supply two twenty-one-inch trains that are in operation day and night rolling rail joints for T and girder rail sections for steam and electric railways.

The Troy mill has a capacity to roll

Digitized by Google

over 145 different sections of rail joints and an annual output of 50,000 tons. There are over 350 men employed in its operation. A railroad siding or switch from the New York Central & Hudson River Railroad runs around the property, bringing raw material, coal and steel billets into the yard and removing finished parts.

Special attention is being given to the production and perfection of girder and insulating rail joints of various base-supported types. Over 25,000 miles of track are equipped with the company's base-supported rail joints.

While the Rail Joint Company owns the works at Troy, it has nine other distributing points where its patented machinery is in use to produce rail joints under contract. Deliveries are made from Buffalo and New York city, N. Y.; Newark, N. J.; Newcastle, Del.; Steelton and Pittsburg, Pa.; Chicago and Joliet, Ill., and Milwaukee, Wis.

The company's general offices are at 29 West Thirty-fourth street, New York city, and it also maintains fourteen branch selling agencies.

Fires Not Caused by Electricity in Germany.

Electricity has often been accused of causing fires, but this has not been the experience of Herr von Moltke, who considers that the danger is infinitesimal if the electrical installation has been carried out in accordance with the recognized rules. The total loss through fire in Prussia in the years 1900, 1901, 1902 and 1903 amounted to ninety-seven, ninety-two, seventy-six and ninety million marks respectively, and of this only two, two, one, and one and one-half million marks, respectively, are officially ascribed to electrical causes. Even this small percentage would probably be reduced by careful investigation.

It has often been suggested that the overhead wires of electric tramways, etc., would give trouble in case of fire, and elaborate precautions for disconnecting these in case of need have been insisted on by the police in certain towns. An enquiry addressed to thirty-eight German towns asking whether this disconnection has at any time been necessary has been replied to in the negative in every case except that of Hamburg. The same enquiry sheet elicited the fact that death or serious injury has never been caused to anybody at a fire in these towns through electrical installations, in spite of the fact that a number of personal injuries of various kinds occur at almost every important fire.

With regard to danger of shock to firemen through squirting high-tension mains, experiments have shown that this is a real danger, but at the same time extremely little damage has resulted from this cause, chiefly owing to the careful instruction given to the firemen. This instruction often includes particulars of all the electrical installations in the town as well as notes as to the avoidance of shocks, and as to the first aid to be given to persons suffering from electric shock.—*Journal of Electricity, Power and Gas.*

An Allis-Chalmers Hoisting Engine for the Chapin Mine.

The Chapin mine, in the heart of the city of Iron Mountain, Michigan, and known for many years as one of the largest producers in the Lake Superior region, is to have added to its present equipment a new Allis-Chalmers duplex, single-drum hoisting engine of the first-motion type, built by the Allis-Chalmers Company, of Milwaukee, Wis.

The new hoist, which was recently ordered, will have cylinders thirty-four inches by seventy-two inches and will be fitted with Reynolds Corliss valve gear, with automatic cut-off and governor and with Stephenson link motion. The shaft will carry a composite drum twelve feet in diameter by ten feet on the face, keyed to the shaft and grooved for one and three-eighths-inch ropes. The hoist will have a capacity of 26,400 pounds at a speed of 1,900 feet per minute when supplied with steam at a pressure of 125 pounds.

The valve gear, actuated by a link motion of the Stephenson type, will be reversed by separate steam apparatus.

The engine will be fitted with a device for automatically closing the throttle valves, when the cage reaches the desired position in the shaft. This device is driven by means of gearing from the drum shaft, and connected with the reversing gear so that the throttle valves can not be opened until the engine is reversed. In addition there will be provided a device which will automatically apply the brake when the cage reaches the desired point so as to prevent overwinding.

The drum brake will be of the steel-band pattern, fourteen-inch face, and lined with wood blocks. The brake will be applied by a heavy weight and released by steam.

The engine will be of the horizontal pattern fitted with oil cataract cylinder and controlled by a hand lever on the operating platform. Each cylinder will be fitted with a quick-opening throttle valve. One twelve-inch throttle valve is in the centre of the steam pipe below the platform and controlled from the engineer's platform located between the cylinders and carrying throttle, auxiliary throttle, reverse, and brake levers. The frame used for this engine will conform to the standard Allis-Chalmers heavy-duty type.

The weight of the empty skips carried by this hoist, two in number, is 4,000 pounds each, while the weight of ore in the skips is approximately 14,000 pounds. The maximum depth of the lift is 2,500 feet. The total load, including ore, skips and rope, is 29,500 pounds. The unbalanced load, ore and rope, is 21,500 pounds.

This outfit constitutes the third piece of Allis-Chalmers equipment installed in this mine. The second is the Cornish pump built many years ago and installed in one of the older shafts but lately used to drain the new "C" Ludington shaft. Its capacity is 3,000 gallons per minute from a depth of 1,500 feet. The other equipment is the Allis-Reidler pump, and is one of the largest in use in any mine on the globe. It is located in the Hamilton shaft, where it handles 2,000 gallons per minute, which it lifts over a quarter of a mile to the surface.

A New Steam Relay Plant for the Washington Water Power Company.

W. S. Barstow & Company, of New York and Portland, Ore., have been retained as consulting engineers by the Washington (Oregon) Water Power Company to design its new steam plant. This is a relay plant and is for the purpose of the insurance of good service, particularly in case of any accident to the transmission lines of the various water-power plants of the company. The present installation will be about 8,000 horse-power. Steam turbines will be used for power generation, and the plant will be modern in every respect. The Washington Water Power Company was one of the original pioneers in the long-distance transmission, one of its transmission lines extending into the Coeur D'Alene country, a distance of about 110 miles, and having a potential of 60,000 volts.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

OAXACA SPRINGS (MEXICO) FOR POWER—A despatch from Oaxaca, Mexico, states that Ing. Andres Brandenburg has obtained a concession from the state of Oaxaca for the use of the waters of the spring known as Ojo de Agua for the purpose of using it to generate motor power for the production of electricity to light up the towns of Tehuantepec and Juchitan.

JOHN R. WALSH ROADS FILE TRUST DEED FOR $11,000,000—The Chicago Southern and the Southern Indiana Railway companies, two of the lines owned by John R. Walsh, of Chicago, have filed a trust deed conveying to the Girard Trust Company, of Philadelphia, all of their lines, equipment, and other properties, to the value of $11,000,000, as security for a loan of $5,500,000.

INDIANA TRACTIONS TO CONSOLIDATE—A meeting of capitalists from Pittsburg, Louisville, Indianapolis, Cincinnati and Evansville has been held in Evansville, Ind., and it has been decided to merge the Evansville and Eastern traction line, Evansville and Newburg, Evansville and Boonville and Evansville and Mount Vernon traction lines. It is stated positively that the deal has been consummated and that the new company will organize and incorporate within two weeks, with a capital stock of $3,000,000. One of the plans of the new company will be to extend the Evansville and Mount Vernon line to New Harmony and to build the proposed Evansville and Cannellton line and extend it to Louisville along the Ohio river.

TO TAKE OVER LAKE ERIE & MIAMI CANAL TOWING FRANCHISE—The Lake & River Transportation Company, of Hamilton, Ohio, has been incorporated by the following men from Cleveland: W. B. Whiting, Attorney C. E. Sanders, R. F. Denison, C. C. Owens and A. J. Sperry. The object of the formation of the company is to take over the "electric mule" franchise and the rights to operate the Lake Erie and Miami canal by electric power, a right granted to George B. Cox, of Cincinnati, and others by the state legislature four years ago. The company headed by Cox is known as the Miami & Erie Transportation Company, and it is now in the hands of a receiver, the court having named J. C. Schmidlapp and C. C. Richardson, of Cincinnati, as receivers.

PLAN ELECTRIC PLANT FOR LANE COUNTY, ORE.—W. S. and Leland Spencer, capitalists of Seattle, Ore., have filed with the County Clerk, at Eugene, Ore., a notice of appropriation of 50,000 miners inches under a six-inch pressure of the waters of Triangle Lake, in the Coast Mountains, thirty-five miles west of Eugene, and of a power canal and a site for a power station. The Spencer brothers have given out little information concerning their plans, but it is known that they contemplate erecting a plant at the site filed upon for the purpose of furnishing power and light for Eugene, Junction and other valley cities. An electric railway from the valley to the Siuslaw country is also included in their plans for the future. The power site filed upon is considered one of the best in the state, and thousands of horse-power can be generated.

UNITED STATES TELEPHONE COMPANY TAKES OVER LINES OF THE FEDERAL TELEPHONE COMPANY—It is announced that the United States Telephone Company has taken over the lines of the Federal Telephone Company, controlling many exchanges throughout northern Ohio, and will begin operating them at once. The new issue of United States Telephone preferred and common stock has gone into effect. The preferred consists of $636,800 and the common consists of $1,100,100, which has been issued in exchange for securities carrying the control of the Massillon Telephone Company, the Findlay Home Telephone Company, Citizens' Telephone and Message Company, of Fostoria; Columbiana Telephone Company, Lancaster Telephone Company, Mansfield Telephone Company, Huron County Telephone Company, Stark County Telephone Company, Youngstown Telephone Company and the Zanesville Telephone Company.

NEW INDIANA TRACTION LINE—Indiana is to have another traction line, the Fort Wayne & South Bend Railway Company, which is proposed to extend between those cities. The company is to have a capital stock of $2,500,000, of which $10,000 has already been subscribed. Articles of incorporation have been filed giving the following directors: J. H. Garsamer, G. A. Wulkop, Charles A. Shorb, E. B. Swift, Perry Randall, W. F. Diemen, Charles M. Niezer, Val Brown and F. P. Randall. The proposed line will extend through the counties of Allen, Whitley, Noble, Kosciusko, Elkhart and St. Joseph, touching the following towns: Fort Wayne, Churubusco, Merrian, Wawasee, Syracuse, Mishawaka, South Bend and a number of smaller towns. The new company has asked for a right to construct its lines and to equip power plants in as many of the towns along the route as may be necessary.

BIG BEND WATER POWER COMPANY—The Big Bend Water Power Company, which controls twenty-eight miles of water rights below Spokane, has been reorganized with a capitalization of $2,000,000, and will build an electric line from Spokane to Coeur d'Alene, Ida., thence into the Coeur d'Alene district, connecting all the mining camps, the entire mileage being 154. The new officers are: B. F. O'Neill, Wallace, Ida., president of the State Bank of Commerce and president of the Idaho Northern Railway Company, president; J. W. Douglas, New York, vice-president; E. P. Spalding, vice-president and general manager of the Idaho Northern Railway Company, general manager; A. M. Philips, secretary and treasurer; Mr. Philips and J. H. Tilsloy, of Spokane, are also directors. Thirty thousand horse-power can be developed at the company's plant, for the equipment of which orders will be placed early in November.

NEW PUBLICATIONS.

SUBMARINE SIGNALS—The Submarine Signal Company, 88 Broad street, Boston, Mass., has published a pamphlet entitled "Submarine Signals," which includes the results of tests made by the United States Lighthouse Board during June and July, 1906, of the system of submarine signaling controlled by the company. This report is a very interesting commentary on the remarkable strides which have been made in the methods of communicating to vessels by means of submarine signals.

"THE SOUTH'S AMAZING PROGRESS" AND "ELECTRICITY: THE POWER BEHIND THE SOUTH"—Two important articles dealing with recent progress in the South have been reprinted in pamphlet form by the Southern Power Company, Charlotte, N. C. The first is by Richard H. Edmonds, editor of the *Manufacturers' Record*, Baltimore. It takes up somewhat in detail the progress in all industries which has been made there. The other is a reprint of an address delivered by W. S. Lee, Jr., chief engineer of the Southern Power Company, at the recent meeting of the American Cotton Manufacturers' Association, the theme being "Electricity: The Power Behind the South."

BULLETIN No. 18, ASSOCIATION OF LICENSED AUTOMOBILE MANUFACTURERS—The Association of Licensed Automobile Manufacturers, in bulletin No. 18, gives details and specifications for standard hexagon head screws, castle and plain nuts. This standard is to be known as the "Association of Licensed Automobile Manufacturers' standard for hexagon head screws, castle and plain nuts." During recent years manufacturers of fine machinery have found from experience that for a large portion of their work the United States standards for pitch of threads have been too coarse and the dimensions of heads and nuts too large. In order to secure satisfactory construction, special fine-pitch screw threads and smaller nuts have had to be made. The number and variety of these special threads and nuts have finally become such that great confusion, inconvenience and expense have been caused. To overcome this condition the association has adopted the new screw standard which is set forth in bulletin No. 18.

Digitized by Google

TELEPHONE AND TELEGRAPH.

PLYMOUTH, N. H.—The Baker River Telephone Company has about completed work on its system, and is installing new instruments in town.

BENTON, MICH.—The Michigan State Telephone Company asks to put in an underground system to cost $40,000. It will take nine months to complete the work.

ORANGE, CAL.—The Home Telephone and Telegraph Company has been engaged in extending its lines all over the county. In Orange a large force of men has been at work putting up poles and stretching wires, and the same work is going on at Anaheim, Tustin, Fullerton, Olive, Buena Park and other towns.

CINCINNATI, OHIO—The directors of the Cincinnati & Suburban Bell Telephone Company have authorized the issue of treasury stock to the amount of $325,000, the money realized to be voted to paying for a number of improvements and extensions. The stock will be allotted pro rata to present stockholders at par.

BOSTON, MASS.—President E. B. Field, of the Colorado Telephone Company, says that the increase in subscribers' stations in the territory covered by his company—Colorado and New Mexico—for the present fiscal year, to end December 31, will be close to 10,000, equal to a gain of nearly twenty-five per cent, and giving the company a total of 55,000 stations.

NEW YORK, N. Y.—A bulletin issued by the telephone companies operating in New York city, showing a gain of 7,584 telephones for September, has been issued. This brings the total number of telephones in service and under contract up to 276,000, and is approximately one telephone to every fourteen persons. If the present ratio of growth keeps up, there will be 600,000 telephones in New York city in 1910.

BRUNSWICK, GA.—Work on the new $8,500 building for the Southern Bell Telephone and Telegraph Company will start November 1. The second floor will be used for the exchange with offices on the first floor. Work on the underground conduit system will start shortly after the building is under way. All telephone wires in the business section of the city will be put under ground. New wires will be put in and every part of the old exchange taken away, so that when completed the exchange will be new throughout. It will represent a $100,000 investment.

SCOTTSBORO, ALA.—The local telephone exchange and its lines, which have been operated as an independent system, have been sold by W. L. Moody to local citizens, who propose to incorporate the company with a capital of $25,000 and greatly improve and extend the system. The new owners contemplate putting in a copper circuit from Decatur to Chattanooga in the near future, also the installation of exchanges at Stevenson and Bridgeport. The system has been a paying one. The new officers are: Dr. J. O. Lipscomb, president; J. W. Gay, secretary; L. W. Rorex, treasurer; D. E. Barclal, manager, and the Hon. John F. Proctor, attorney.

OMAHA, NEB.—The Independent Telephone Company has connected its Council Bluffs and Iowa lines with the Nebraska independent systems. Connection is made with the long-distance office of the independent companies in South Omaha, and through that switchboard with the Plattsmouth Telephone Company, the independent organization operating in the South Omaha commercial field. This arrangement will connect up about 100,000 independent telephones in Iowa and Nebraska. The towers carrying the 1,800 feet of aerial line across the river are substantial affairs, of steel construction, 120 feet high. Workmen have been engaged on them all summer. The Council Bluffs independent company's system now covers the western half of the state.

CARLYLE, ILL.—The telephone system in Clinton county is now being operated by the Citizens' Telephone and Telegraph Company, a company which was recently organized by citizens of Clinton county. The new company bought the system from George Johnpeter, of Posey, for $11,000, and it will continue to be operated in connection with the Central Union long-distance lines, although this county will be the exclusive territory of the home company for local business. The system will be extended to Shattuc, Boulder, St. Rose, Bartelso, Jamestown and other parts of the county. Another company, known as the People's Home Company, has applied to the county board for permission to build a system into the county. No action will be taken on the application until the December meeting.

ELECTRIC LIGHTING.

EATON, COL.—The Eaton Water, Light and Power Company's plant has been sold to W. J. Farr.

COOPERSTOWN, N. Y.—Charles H. Scofield has been granted a franchise by the Cherry Valley board of trustees to install an electric light plant in the town.

HOLTON, KAN.—The Holton electric light plant was destroyed by fire on October 2. The property was owned by a private company, and the city was negotiating for its purchase.

PITTSBURG, PA.—The new East End plant of the Duquesne Light Company has been placed in operation and is furnishing light to 1,000 families in the vicinity. The plant cost about $500,000.

NIAGARA FALLS, ONTARIO—The electric light committee of the city council has decided to go ahead with the proposed new construction work and the expenditure for the necessary material was authorized.

MILWAUKEE, WIS.—R. G. Hunt & Company, of Chicago, have been engaged by City Engineer Charles J. Poetsch as the city's experts to prepare plans for and supervise the construction of the municipal lighting plant.

MOREHEAD, KY.—The electric light plant, which suspended operation several months ago, has been purchased by Hiram Bradley and James E. Braden. The franchise was first granted to J. E. Davidson, who was compelled through financial reverses to dispose of it.

LANSING, MICH.—The Michigan Power Company, which is developing power from Grand river, in Lansing, and which has water rights at Diamondale, Grand Ledge and other points on the river, is making extensive improvement under the direction of its new superintendent, Thomas M. Keeley.

CATASAUQUA, PA.—The plant of the Lehigh-Northampton Gas and Electric Company, at Catasauqua, has been sold to Thomas F. Diefenderfer, attorney for a majority of the bondholders, for $100,500, as the result of a suit in equity brought by the People's Bank, of Wilkesbarre, trustee for the bondholders, which will reorganize the concern.

SUPERIOR, WIS.—The work on the Great Northern Power Company's plant is now so far along toward completion that the date for the turning on of the first 10,000 horse-power has been set as December 1. All of the electrical apparatus is on the grounds or has been shipped. The work of erecting the cables is progressing rapidly. After the turning on of the first 10,000 horse-power a month each is figured for the two additional installations of 10,000 horse-power.

NEWARK, N. J.—Without a dissenting vote the plans and specifications of Engineer James M. Seymour, Jr., of Newark, for the proposed municipal lighting plant to be operated by the city of Orange in conjunction with its water and sewerage pumps have been approved by the Orange common council, with the forms for contractors, and a resolution passed providing for advertising for bids for the work, contractors' estimates to be before the council and opened Monday night, October 29.

ALEXANDRIA, VA.—A decree has been entered in the United States District Court at Baltimore confirming the sale of the property of the Osage Manufacturing Company to the Alexandria Electric Light Company, and the deeds to the property ordered transferred to the new owners. The price paid was $19,500. The property has been in litigation for several years past, and although it was purchased by the electric company a few weeks ago, the work of installing the plant had to be postponed until the sale was confirmed by the courts. Edward E. Mandeville, of Philadelphia, to whom the franchise for supplying Alexandria with electricity was awarded by the city council and who organized the Alexandria Electric Company, has inspected the Osage property and has expressed himself as being pleased with it. There are several buildings located on the property which will be remodeled and used for the electric plant. The work of remodeling the buildings and installing the machinery will be commenced in the near future, and it is thought that the plant will be in operation by the end of the present year.

Digitized by Google

ELECTRIC RAILWAYS.

REDLANDS, CAL.—N. Buckmaster has applied for an electric railway franchise. Incorporated in the request is a clause providing for freight business.

GREENVILLE, TEX.—At a special meeting of the city council a franchise was granted to J. Mercer Carter, of Dallas, to build a street railway into the city.

OROVILLE, CAL.—The survey of a street railway system for Oroville has been completed by the Northern Electric Company and the chief engineer states that work will begin shortly.

RICHMOND, IND.—Ground has been broken for the excavation for the new power-house for the Indianapolis, New Castle & Toledo Traction Company, which will build a branch line to this city, at New Castle.

ST. LOUIS, MO.—Frank R. Tobin, a St. Louis capitalist, has been granted a franchise to build an interurban car line from El Paso to Ysleta, a distance of ten miles. He has also secured a concession from the El Paso electric line.

BOSTON, MASS.—The Washington avenue division car house of the Boston & Northern Street Railroad Company on Washington avenue, Chelsea, has been destroyed by fire. The house was filled with rolling stock and the total damage will reach $300,000, covered by insurance.

WALLA WALLA, WASH.—The Walla Walla Valley Traction Company, now building city and interurban electric lines here, announces that separate car service will be maintained to College Place, exclusive of the through line. The road is nearly completed to College Place.

PIERRE, S. D.—At a meeting in Onida, Sully county, to consider the question of assistance to an electric road across that county, township committees were appointed for every township to solicit for subscriptions to stock, the residents of that county being asked to take stock to the amount of $100,000.

CORINTH, MISS.—The Corinth & Shiloh Electric Railway Company has been financed and the bonds successfully floated by W. W. Williams & Company, Nashville, Tenn. The road is standard gauge and will carry freight and passengers, thus making cheap freight rates between St. Louis, Mo., and Corinth.

ROCK ISLAND, ILL.—The Moline, Rock Island & Eastern Traction Company held a business meeting in Rock Island and elected the following officers: president, J. F. Porter; vice-president, James F. Lardner; secretary, F. G. Young; treasurer, H. E. Casteel; attorney Burton F. Peek, Moline. The organization of the company ensures the construction of an interurban for the twin-cities in the near future.

PARIS, KY.—At a meeting of the promoters of the proposed electric line from North Middletown to Lexington, it was decided to raise $100,000 to guarantee the building of the road. Thirty thousand dollars of this amount is to be raised in Bourbon county. The proposed line will be about thirty-five miles in length, extending from Lexington to Sharpsburg, in Bath county, passing through the most populous section of Bourbon county from Clintonville to North Middletown.

SPOKANE, WASH.—Frank MacKean, of Chicago, announces that he has secured a contract to install a $2,000,000 power plant for the Spokane Western Power and Traction Company. It is expected to develop 2,000 horse-power which can be expanded to 40,000 horse-power. The company was incorporated in Washington, for $3,000,000 and Mr. MacKean announces that it is an entirely independent concern, backed by Chicago capitalists. The route of the proposed railway has not yet been determined.

RACINE, WIS.—The Milwaukee Light, Heat and Traction Company will not build its interurban line from Milwaukee to Lake Geneva through the city of Burlington, Racine county, unless the city grants a fifty-year franchise. The residents of the city are willing to give a twenty-five-year franchise, but protest against a longer term. John I. Beggs, of the Milwaukee company, has informed the city officials of Burlington that the road will be built near the outskirts of the city, unless a fifty-year franchise is granted.

DAVENPORT, IOWA.—The American Express company and the Iowa & Illinois Interurban have closed a deal whereby the Interurban will handle all the express company's business out of the tri-cities, transferring it to the Northwestern at Clinton. The contract is for five years and is the first express company contract made with an electric road in the country, so far as is known. This contract includes only the business to and from the tri-cities, the interurban continuing to handle the business of the intermediate towns.

NEGAUNEE, MICH.—On October 23 the properties of the Marquette County Gas Light and Traction Company, which for some time has been operated by a receiver, will be sold at public sale by order of the United States court. The company controls the trolley lines running between Negaunee and Ishpeming and operates gas and electric lighting plants. Its debts amount to about $300,000, including outstanding bonds, and it is expected that, even at a forced sale, the properties will realize more than enough to pay all indebtedness. It is said, however, that should the bids prove unsatisfactory, it is the purpose of Granger Farwell, of Chicago, holder of the bonds, to take over the plants himself, improve them extensively and put them upon a dividend-paying basis.

SPOKANE, WASH.—The Lewiston & Southeastern has under construction 115 miles of electric railway to connect Lewiston, Grangeville, Nez Perce and smaller towns in central Idaho and eastern Washington. The Spokane & Inland will connect Spokane, Waverly, Rosalia, Thornton, Colfax and Palouse early in October. This system covers 106 miles. A branch line from Spokane to Lake Pend d'Oreille, fifty-six miles, is expected to be in operation within a year. A company organized as the Spokane & Big Bend Electric Railway Company, of Spokane, W. H. Plummer, president, to build a road from Spokane to Davenport, 120 miles, has purchased ninety miles of right of way. Surveys have been completed, and the president announces that the road will be completed and in operation before June, 1907.

BALTIMORE, MD.—The Kent Traction Company, of Kent county at Chestertown, has been incorporated, a charter obtained and the enterprise successfully launched by Alva A. Lamkin, of this city. In speaking of the project, Mr. Lamkin said: "The undertaking as planned by the newly organized company will connect Chestertown, Tolchester, Rock Hall, Sandy Bottom, Georgetown and Fairlee, all in Kent county, by trolley. The money to be spent in building these lines will approximate $300,000, and the financial end is in such shape that work will be begun in about thirty days. The contract has been awarded to D. E. Baxter & Company, of New York, for the construction of the line between Tolchester and Chestertown, touching Fairlee and Georgetown. This portion of the line will cost about $200,000, and it is expected to have it in operation before Christmas. This line when completed will afford quick transportation between the Eastern Shore peninsula and Baltimore and will afford the farmers and truckers of Kent county a market for their perishable products the same day they are shipped. This line is expected to divert much of this traffic from Philadelphia to Baltimore. As it is a cross-country line, the mileage will be short, as will the time in making the run. Suitable freight cars will be operated by the company. The officers of the company are: Fred G. Usilton, president; Jefferson D. Bacchus, vice-president and treasurer, and Alva A. Lamkin, secretary and general manager. The directors will be made up of men from Kent and Queen Anne's counties and from Baltimore." It is proposed to issue five per cent mortgage bonds of $1,000 each. This issue will be for $200,000, and a part of it has already been placed.

EDUCATIONAL NOTE.

THE SILLIMAN LECTURES AT YALE UNIVERSITY—The Silliman lectures at Yale University will be delivered this year by Professor Walther Nernst, of the University of Berlin. There will be twelve lectures, delivered daily, the date for the first being October 22. The subject is a general consideration of the subject of thermodynamics and chemistry. The Silliman memorial lectures on subjects connected with the natural and moral world were established by the will of Augustus Ely Silliman, of Brooklyn, N. Y. The previous lecturers have been Professor J. J. Thomson, Professor Sherrington and Professor E. Rutherford.

Digitized by Google

PERSONAL MENTION.

MR. CARL E. CRAIG, who for the past year has been chief operator at the Nashua, N. H., exchange of the New England Telephone and Telegraph Company, has been appointed manager of the company's Laconia exchange.

MR. LOUIS H. FRICK, of Denver, Col., has been appointed general manager of the Cheyenne Light, Fuel and Power Company, which is owned by the Northern Colorado Power Company. Mr. Frick succeeds Mr. N. D. Miner, resigned.

MR. FRANK U. BLISS has resigned as general superintendent of the American Falls Power and Light Company, of Pocatello, Ida., and will probably move to Seattle, Wash., where he will undertake engineering work in the Puget Sound country.

MR. A. M. BARRON has resigned his position as manager of the Consolidated Light Company, of Joplin, Mo., and will move to Carterville, where he has purchased the Carterville Hotel. Mr. C. W. Huff, of Kansas City, will take Mr. Barron's place at Joplin.

MR. NORMAN MINER has become connected with the Bates Advertising Company, New York city, and will represent it in its central station advertising department. Mr. Miner has had considerable experience in this field, and is familiar with the laying out of advertising plans.

MR. EDWIN M. HAMLIN, Boston, Mass., announces his retirement from the Lord Electric Company. This company is about to move its manufacturing plant and headquarters to New York city, and Mr. Hamlin is unable to make this change because of other interests which are involved in New England.

MR. STANLEY GAINES has been appointed superintendent of the Wilson Electric Company, Huntingdon, Pa. The company furnishes light for the following towns: Huntingdon, Petersburg and Alexandria, Huntingdon county. Mr. Gaines resigns as superintendent of the Citizens' Electric Illuminating Company, of Wilkesbarre, Pa.

MR. C. F. BAKER has been engaged by Mr. L. B. Stillwell as superintendent of motive power and construction in connection with the engineering and operating contract which Mr. Stillwell has recently executed with the United Railways and Electric Company, of Baltimore. Mr. Baker is well known to the engineering fraternity and to the street railway world. For many years he was with the West End Street Railway Company, of Boston, and with the Boston Elevated Railway Company in charge of construction and operation of power plants and rolling stock. He is a past-president of the American Street Railway Mechanical and Electrical Association, and also of the New England Steam Railroad Club, and is an active member of the New England Street Railway Club.

MR. JAMES H. BARRY, superintendent of the central division of the New England Telephone and Telegraph Company, with headquarters at Lowell, Mass., has been promoted to the post of division superintendent, with headquarters at Boston. The headquarters of the central division has been moved from Lowell to Boston, the work of this division having been apportioned among five division superintendents, who will report to Mr. Barry at Boston. Mr. Barry entered the service of the company twenty years ago. In 1896 he was appointed superintendent of the northern division, in charge of the state of Vermont. A year later he was transferred to the western division, with headquarters at Springfield, and in 1898 he went to Lowell as superintendent of the central division.

OBITUARY NOTE.

MR. JOHN E. POWELL, president of the Pittsburg (Pa.) Light and Manufacturing Company, and treasurer of the National Cable and Wire Company, Pittsburg, Pa., died at West Middlesex, Mercer county, Pa., on October 6. Mr. Powell was forty years of age, and was elected a member of the Pennsylvania state legislature in 1902.

NEW MANUFACTURING COMPANY.

SPRINGFIELD, ILL.—The Freeman-Sweet Company, of Chicago, has been incorporated to deal in electrical apparatus. The incorporators are: Ernest Freeman, Frank Z. Sweet and J. G. Spurling. The capital of the company is $25,000.

ELECTRICAL SECURITIES.

There was considerable improvement in the tone of the market during the week. The course of prices, while irregular, was generally upward, and there were a number of rallies as compared with the previous week. Dealings, however, were mainly professional, the speculative public evincing small interest. It is not believed that an active campaign will be inaugurated for some little time, probably not until after the November election. One of the main factors in the market's improvement has been the easing monetary situation. While local sentiment was adversely influenced by an increase of over $13,000,000 in loans shown in the bank statement, this was offset by the showing made by the banks of an increase of over $8,000,000 in cash and over $3,000,000 in surplus reserve. A favorable influence was also exerted by the government wheat crop report, which shows a new high record of 2,780,069,000 bushels, as against a previous high record of 2,707,993,000 bushels. A number of railroads issued their annual reports. These indicate the present great prosperity of the transportation industry, showing large increases in both gross and net earnings in all cases.

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 13.

New York:	*Closing.*
Allis-Chalmers common	17¼
Allis-Chalmers preferred	45
Brooklyn Rapid Transit	78⅛
Consolidated Gas	142
General Electric	179½
Interborough-Metropolitan common	37½
Interborough-Metropolitan preferred	77
Kings County Electric	155
Mackay Companies (Postal Telegraph and Cables) common	72
Mackay Companies (Postal Telegraph and Cables) preferred	70½
Manhattan Elevated	146
Metropolitan Street Railway	106
New York & New Jersey Telephone	125
Western Union	86⅛
Westinghouse Manufacturing Company	156

Boston:	*Closing.*
American Telephone and Telegraph	136
Edison Electric Illuminating	235
Massachusetts Electric	71
New England Telephone	130
Western Telephone and Telegraph preferred.	85

The annual report of the Edison Electric Illuminating Company of Boston for the fiscal year ended June 30 last shows an increase in gross and net earnings, while the surplus more than doubled during the twelve months. There was no change in the capital stock of the company in the year, and, although the natural growth was great, all the money necessary for construction was raised by temporary notes. It is expected that in the present fiscal year the stockholders may be called together again to authorize a petition to the Massachusetts board of gas and electric light commissioners for permission to add to the present capital of $11,500,000. Lamps and motors connected on June 30 last are as follows: incandescent lamps 788,560, arc lamps 10,534, motors (horse-power) 30,432. Leaving out of consideration the new business acquired in the purchase of the property of other companies, the regular increase in the current year is greater than in any previous year in the history of the company. Since the close of the last fiscal year a new price list has been put into effect, which favorably affects more than 14,000 of the customers of the company. Although this will materially cut down the income from existing customers, it is confidently expected that it will be more than made up by the new business that will be the natural result.

Philadelphia:	*Closing.*
Electric Company of America	11⅞
Electric Storage Battery common	72
Electric Storage Battery preferred	72
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	28⅜
United Gas Improvement	89¾

Chicago:	*Closing.*
Chicago Telephone	118
Chicago Edison Light	140½
Metropolitan Elevated preferred	66½
National Carbon common	84
National Carbon preferred	118
Union Traction common	4½
Union Traction preferred	16½

Digitized by Google

NEW INCORPORATIONS.

SPRINGFIELD, ILL.—Home Telephone Company, St. Jacobs. $5,000.

SPRINGFIELD, ILL.—Green River Telephone Company, Harmon. $2,000. Incorporators: Elmer Cotton, C. F. Ribordy and G. F. Brooks.

WEBSTER CITY, IOWA—Martin Telephone Company. To do a general telephone business and to establish telegraph and electric light lines. $200,000.

MONTGOMERY, ALA.—Thomasville Manufacturing, Electric Light and Power Company. $11,000. Incorporators: W. A. Scott, Jr., John S. Henson and others.

COLUMBUS, OHIO—The Muskingum River Traction Company, of Marietta. To construct a street railway connecting Marietta and Beverly. $25,000. Incorporators: C. H. Shattuck, W. W. Mills, A. D. Follett, C. C. Tospy and W. H. H. Jett.

CHARLESTON, S. C.—St. Andrew Railway Company. To construct a line from Charleston through St. Andrew's parish to Meggett, for the purpose of facilitating the movement of freight. $5,000, with the privilege of increasing to $1,000,000.

INDIANAPOLIS, IND.—The Winona & Maxinkuckee Railway Company, of South Bend. To build an electric road between Culver, Warsaw and Argos. $10,000. Directors: Edwin P. Taylor, S. I. Perley, Alexis Coquillard, Virginius Miar and T. P. Moredock.

FRESNO, CAL.—Merchants' Independent Electric Company. $200,000. Directors: Fred Dodd, Fresno; Arthur Gore, Los Angeles; W. J. Eilert, Fresno; H. A. Sprague, Fresno; R. J. Woodward, Fresno; J. J. Graves, Fresno; J. B. Lankershim, Los Angeles.

ALBANY, N. Y.—Otselic Valley Railroad Company, South Otselic. To operate an electric or gasolene railroad, twelve miles long, from South Otselic to Georgetown Station, Madison county. $220,000. Directors: B. F. Gladding, E. C. Stack and M. K. Perkins, South Otselic.

COLUMBUS, OHIO—The Ohio & Southern Traction Company, Columbus. To construct an electric road from the south corporation line of Columbus to the farm of S. B. Hartman, four and one-half miles south, over the Columbus and Chillicothe pike. $75,000. Incorporators: S. B. Hartman, F. W. Schumacher, James M. Butler, W. V. Baker and J. A. Hedges.

AUSTIN, TEX.—Texas Traction Company, of Dallas. To construct or acquire an electric line of railway from Dallas to Sherman and to own and operate street railways in those two cities. $3,000,000. Incorporators: Frank H. Proctor, Boston; Walter C. Clark, W. R. Brents, Grayson county; J. S. Heard, Collin county; R. H. Baker, Travis county; W. J. Neale, McLennon county; Fred A. Jones, Harris county; M. B. Templeton, Ellis county; D. A. Templeton, Oscar Goodwin, J. F. Strickland, John N. Simpson, Dallas.

AUGUSTA, ME.—York & Oxford Railway Company. To construct a standard gauge railroad, to be operated by electricity, compressed air or animal power, from the terminus of the Atlantic Shore Line Railway, in the village of Springvale through the towns of Sanford, Shapleigh, Acton, Newfield, Limerick, Parsonfield and Cornish in York county; Porter and Hiram in Oxford county, and from Baldwin to Bridgton Junction in Cumberland county, a total mileage of forty miles. $160,000. Directors: Fred J. Allen, George W. Hanson, Sanford; J. M. Lord, Parsonsfield; Henry E. Eastman, Charles G. Moulton, Limerick; Ira H. Moore, A. P. Towle, Newfield.

ALBANY, N. Y.—The Honk Falls Electric Company, Napanoch, Ulster county. To operate in the towns of Wawarsing, Rochester, Marbletown, Hurley, Ulster, Rosendale, New Paltz, Gardiner and Shawangunk, and the villages of Ellenville, Rosendale and New Paltz and the city of Kingston, Ulster county; in the towns of Crawford, Montgomery, Newburgh and Wallkill, and the villages of Montgomery, Walden and the cities of Middletown and Newburgh, Orange county, the towns of Thompson, Liberty, Fallsburg and Mamakating, and the villages of Monticello, Liberty and Wurtsboro, Sullivan county. $15,000. Directors: Susan C. Dickinson and Milton L. Dickinson, of Fitchburg, Mass., and Thomas Gray, of Ellenville.

INDUSTRIAL ITEMS.

JOSEPH P. DEVINE, Buffalo, N. Y., has ready for distribution a new catalogue describing and illustrating the vacuum drying and impregnating apparatus manufactured under the Passburg patents.

THE ADVANCE ELECTRIC COMPANY, St. Louis, Mo., will be pleased to send a leaflet describing its alternating-current motors. These are single-phase motors of the brush and commutator class.

THE HOLOPHANE GLASS COMPANY, New York city, announces that its sales have so increased that it has been necessary to more than double the size of the stock room and stock. An enlargement has also been made in the company's demonstration rooms.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, has ready for distribution a new catalogue describing and giving prices of "Noark" enclosed fuse devices, National Electrical Code standard. This catalogue will be sent to any one interested upon request.

THE SCHMIDT-WILCKES ELECTRIC COMPANY, 135 William street, New York city, has ready for distribution a new catalogue describing its intercommunicating and private line telephone system. This booklet shows an entirely new line of instruments devised and invented by Lambert Schmidt.

THE LORD ELECTRIC COMPANY, Boston, Mass., announces the removal of its manufacturing plant and headquarters to New York city, where it will have improved facilities for handling its rapidly increasing business. The Boston office will be continued as a branch department. After November 1 the New York headquarters will be at the Fuller Building.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., has ready for distribution price list No. 7, applying to catalogue No. 12, dealing with electric light supplies. Particular attention is called to the changes in prices of entrance-switch boxes, taplets, panel cutouts for rotary switches and cartridge fuse cutouts. This price list will be sent to any one interested upon request.

HARVEY HUBBELL, INCORPORATED, Bridgeport, Ct., is publishing a small catalogue devoted to the Hubbell shade-holder, shade and guard. A unique feature of this catalogue is an illustration showing "the one collar that fits them all." This collar may be used with the regular shade-holder, shade-holder with locking spring, half reflector, enameled steel shade, cone shade, flat shade, parabolic shade and lamp guard.

I. P. FRINK, 551 Pearl street, New York city, designer and manufacturer of the Frink system of reflectors, announces the equipment of the Essex County Court House, Newark, N. J.; the Hall of Records, Brooklyn, N. Y., and the Hall of Records, New York city; with reflectors for unusual conditions. This system has become a recognized solution of many difficult illuminating problems, a careful analysis of which is now engaging the attention of the most prominent architects and engineers.

THE HEANY FIREPROOF WIRE COMPANY, York, Pa., has published an interesting and instructive pamphlet entitled "Cotton *versus* Fireproof Insulation." The insulation manufactured by this company is a white asbestos composition, and is inorganic and chemically neutral. The company is distributing a hanger, upon which are mounted three samples of fireproof insulated magnet wire. It is stated that coils wound with this wire will not be destroyed, even though the wire becomes red hot.

THE H. A. PETERSEN MANUFACTURING COMPANY, Harvey, Ill., is the subject of an extensive article in the Harvey *Herald* of Friday, September 28. This company has recently opened a new factory at Harvey, 75 by 125 feet, located directly on the Chicago Terminal Transfer Belt Line Railway and the Grand Trunk Railway, and has the service of 400 feet of switch track on its grounds. The company manufactures architectural iron work and a complete line of "Harvey-Duct" electrical conduits and fittings.

CROSBY, CRAFT & COMPANY, Cleveland, Ohio, have removed their offices from the Citizens' Building to 723 Williamson Building. This company is the agent in northern Ohio for the Switchboard Equipment Company, the Whitney Electrical Instrument Company, the Northwestern Manufacturing Company, the Fort Wayne Electric Works and the General Storage Battery Company. The com-

Digitized by Google

pany reports that it has closed a contract with the Brown Hoisting Machinery Company, Cleveland, Ohio, for sixty-nine large-capacity circuit-breakers made by the Switchboard Equipment Company. The Brown Hoisting Machinery Company will use these circuit-breakers in connection with an installation which is being furnished for the Carnegie Steel Company.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has ready for distribution a new series of advertising literature. This includes flier No. 3488, giving information on packing and standard package quantities; bulletin No. 4457, describing parts of form B arc headlights; No. 4459, feeder regulators; No. 4460, parts of form 3 luminous constant-current series enclosed arc lamps with stationary upper electrodes; No. 4461 GE-78 railway motor; No. 4462, variable-speed, direct-current motors with commutating poles; No. 4463, carrier bus arc panels for Brush arc generators, and No. 4464, polyphase induction motors. Price list No. 5154 gives quotations on tantalum lamps and tantalum units. There is also a supply catalogue, No. 7602, giving quotations and complete information on parts of direct-current, automatic circuit-breakers, and a handsome catalogue devoted to type H transformers.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., is being awarded an increased number of government contracts. A contract recently closed calls for a large amount of electrical power-generating apparatus, to be installed in the Navy Yard at Norfolk, Va. The contract totals $91,125, and consists of the following apparatus: two 1,000-kilowatt, three-phase, 2,200-volt, 7,200-alternation, 1,800-revolution-per-minute steam-turbine generating units; one 500-kilowatt, three-phase, 2,200-volt, 7,200-alternation, 3,600-revolution-per-minute steam-turbine generating unit; two fifty-kilowatt steam-driven exciter units; five fifty-kilowatt motor-generator sets. The motors comprising these sets are of the CCL type, three-phase, 2,200-volt, 7,200-alternation, 1,120-revolutions-per-minute. The direct-current generators are 95-140-volt machines. An interesting part of the equipment is the switchboard, which will have forty-two panels. A large amount of auxiliary apparatus is included in the contract.

THE YALE & TOWNE MANUFACTURING COMPANY, New York city, is doing some very active advertising of a nature particularly designed to assist the dealer in marketing his goods. In addition to a number of very nicely executed fliers calling attention to various forms of Yale padlocks, there is a booklet entitled "A Book about Padlocks." This enumerates a large number of opportunities for the use of these padlocks, each suggestion being illustrated by some characteristic line drawing. Then there is another booklet, got up in unique form, entitled "The Little Black Box." This is a little story which introduces the utility of the Yale padlock. There is a more ambitious booklet entitled "Suggestions for Selling Yale Padlocks." This booklet outlines the advertising campaign which the company has inaugurated, and is replete with suggestions of a timely and helpful nature. On all the literature which the company supplies to the dealer, space is left in a proper place for the imprinting of the dealer's name and local address.

THE STANDARD ROLLER BEARING COMPANY, Philadelphia, Pa., has purchased the entire plant and real estate of the Pennsylvania Iron Works Company, which adjoins its present property. By this purchase the Standard Roller Bearing Company has secured five factory buildings with a total of over 110,000 square feet of floor space, with real estate 1,600 by 120 feet, all located on the main line of the Pennsylvania Railroad. The total length of the property which the Standard Roller Bearing Company will now occupy is over half a mile, with an average width of 200 feet, covering 500,000 square feet of floor space. The cash paid for the above property was nearly $250,000, and it will be immediately equipped with a full line of machinery at an expense of over $200,000. In addition to this purchase the company is at present erecting a large reenforced concrete building in the vicinity of Philadelphia, five stories high, 100 by 210 feet in ground area. This building will be devoted exclusively to the manufacture of annular ball bearings, automobile axles and the like. Over 1,200 hands are now employed, and as soon as the concrete building is in full operation, which will be in about thirty days, over 1,800 will be employed. When alterations are completed on the Pennsylvania Iron Works property over 3,000 employés will be at work. During the past few months the company has built and equipped a large crucible steel-casting plant, as well as an iron and brass foundry. The company has also completed a drop forge plant, 100 by 150 feet, fully equipped with Billings & Spencer drop hammers, where all the drop forgings used in automobile axles and similar products will be made.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., announces a large number of orders by some of the largest manufacturers in the United States. The majority of the apparatus is to be installed where the company's machines have been tested under actual operation. The following list gives an idea of the very general distribution of the Crocker-Wheeler Company's material: Gilbert Knitting Company, one 300-kilowatt alternating-current generator, 240 volts, 257 revolutions per minute, and one thirteen-kilowatt direct-current generator, 125 volts, 900 revolutions per minute as exciter. Eastman Kodak Company, Rochester, N. Y., one 300-kilowatt direct-current generator, for twenty-five volts, 100 revolutions per minute. Chicago, Indiana & Southern Railway Company, two 100-kilowatt alternating-current generators, 240 volts, 257 revolutions per minute; two six-and-one-half-kilowatt direct-current generators, 125 volts, 1,150 revolutions per minute as exciters. American Smelting and Refining Company, Pueblo plant, Pueblo, Col., one twenty-horse-power direct-current motor, 500 volts, 820 revolutions per minute; one forty-five-horse-power direct-current motor, 500 volts, 1,000 revolutions per minute. Arkansas Valley Plant, Leadville, Col., one forty-five-horse-power direct-current motor, 220 volts, 925 revolutions per minute. Eilers Plant, Pueblo, Col., one forty-five-horse-power, direct-current motor, 230 volts, 925 revolutions per minute. Globe Plant, Denver, Col., two twenty-horse-power direct-current motors, 500 volts, 820 revolutions per minute; one forty-five-horse-power direct-current motor, 500 volts, 1,000 revolutions per minute. Orford Copper Company, Bayonne, N. J., four 300-kilowatt direct-current generators, 125 volts, 150 revolutions per minute. Strouse, Adler & Company, New Haven, Ct., one 100-kilowatt direct-current generator, 250 volts, and seventeen direct-current motors, ranging from one to five horse-power, all of 230 volts. Becker Brothers, Chicago, Ill., 100 one-and-one-quarter-horse-power form L motors for driving bottle-washing machinery. Manufacturers' Contracting Company, Wilmington, Del., one 100-kilowatt direct-current generator, 125 volts, and one seventy-five-kilowatt direct-current, 125-volt generator. Borough of Kutztown, Kutztown, Pa., one seventy-five-kilowatt alternating-current generator, 2,300 volts, 900 revolutions per minute.

Record of Electrical Patents.

Week of October 9.

832,600. SPEED-INDICATOR. Hans Dahl, Berlin, Germany. Filed February 14, 1902. Centrifugally operated contacts indicate successive speeds.

832,610. PERMANENTLY PLIABLE AND ADHESIVE COMPOUND FOR INSULATING AND OTHER PURPOSES. Robert L. Johnstone, Glen Ridge, N. J. Filed May 14, 1903. Renewed March 9, 1906. A compound consisting of gutta-percha, resin and carnauba wax.

832,612. METHOD OF INSTALLING ELECTRIC OUTLETS AND FIRE-PROOF WALLS AND PARTITIONS CONTAINING THE SAME. Louis Kalischer, Brooklyn, N. Y. Filed September 25, 1903. A supporting arm provides a plurality of outlets, around which the wall is built.

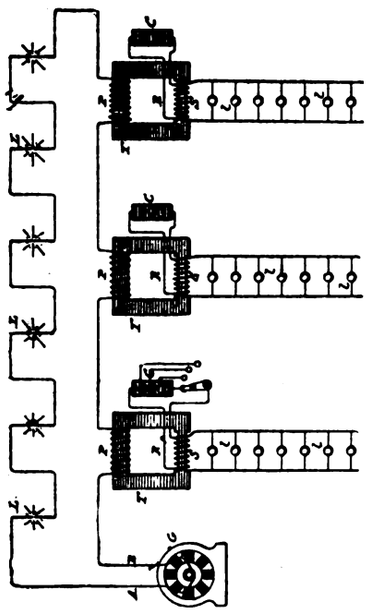
832,622. OPERATION OF SHIPS' PROPELLERS. Cesidio Del Proposto, Nicolaieff, Russia. Filed November 27, 1903. A dynamo and motor are coupled to the shaft of a non-reversible engine.

Digitized by Google

832,632. MULTIPLE CONTACT FOR ELECTRICAL CONDENSERS. John F. Skirrow, East Orange, N. J. Filed March 14, 1905. A block of insulating material contains contact fingers in parallel grooves.

832,642. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago, Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. Utilizes a vertically rotated laminated separator placed between magnetic poles.

832,652. RAILWAY BLOCK-SIGNAL SYSTEM. Abram L. Bower, Boyertown, Pa. Filed October 22, 1902. Actuates signals in the locomotive cab.



832,852. SYSTEM OF DISTRIBUTING ELECTRICITY BY ALTERNATING CURRENTS.

832,653. ELECTRICALLY DRIVEN FLUID MOTOR. Gaston A. Bronder, Brooklyn, N. Y. Filed February 12, 1903. A motor-driven compressor supplies the actuating fluid.

832,705. CIRCUIT-BREAKER. Samuel B. Stewart, Jr., Schenectady, N. Y., assignor to General Electric Company. Filed March 20, 1905. Two contacts are used which engage and disengage in sequence.

832,709. APPARATUS FOR INSURING SAFETY OF TRAFFIC ON SINGLE LINES OF RAILWAY. Edward Tyer, Dalston, England, and James H. Hamilton, Cape Town, Cape Colony. Filed January 5, 1904. Two magnets placed at right angles make possible the step-by-step rotation of this signal.

832,712. TROLLEY. Henry West, Galesburg, Ill. Filed July 20, 1903. A collector ring and contacts are provided within the wheel.

832,713. ALTERNATING-CURRENT MOTOR. John B. Wiard, Lynn, Mass., assignor to General Electric Company. Filed February 23, 1904. Two separate windings are provided for starting and for running.

832,718. ELECTRIC RECEPTACLE. Charles A. Chase, Chicago, Ill. Filed April 29, 1905. A method of construction.

832,720. LIQUID RHEOSTAT. George W. Cravens, Schenectady, N. Y., assignor to General Electric Company. Filed October 21, 1905. Consists of a plurality of conducting elements and a common neutral, and means for varying each of the former independently.

832,724. ALTERNATING-CURRENT MOTOR. Friedrich Eichberg, Berlin, Germany, assignor to General Electric Company. Filed January 12, 1905. A motor of the commutator type having two windings.

832,729. AUTOMATIC UNLOCKING DEVICE FOR SWITCH MECHANISMS. John D. Hilliard, Jr., Glens Falls, N. Y., assignor to General Electric Company. Filed April 20, 1904. Is operated by an electromagnet controlled by alternating currents.

832,730. INCANDESCENT ELECTRIC LAMP. Harry C. Hubbell, Jersey City, N. J. Filed January 26, 1905. A filament supported so that it falls when broken.

832,741. REPULSION-MOTOR CONTROL. Maurice Milch, Schenectady, N. Y., assignor to General Electric Company. Filed April 30, 1904. Renewed February 9, 1906. A method of impressing a variable electromotive force on the secondary of a motor of the repulsion type.

832,742. UNIPOLAR ALTERNATING-CURRENT MACHINE. Jakob E. Noeggerath, Schenectady, N. Y., assignor to General Electric Company. Filed March 17, 1905. The field is excited by an alternating current.

832,745. MOTOR CONTROL. Jesse S. Pevear, Schenectady, N. Y., assignor to General Electric Company. Filed August 10, 1904. A system of controlling motors of the alternating-direct-current type.

832,746. TELEPHONE CIRCUIT. Milton W. Phillips, Ventura, Cal. Filed February 20, 1906. A locking-out party line system.

832,747. ELECTRIC CLOCK-WINDING MECHANISM. George H. Rupley, Schenectady, N. Y. Filed July 14, 1905. The spring is automatically wound by a motor.

832,761. ELECTRIC TIME SWITCH. Charles H. Van Slyck, Philadelphia, Pa., assignor to General Electric Company. Filed October 9, 1899. The main switch is opened by a magnet, itself controlled by a clock mechanism.

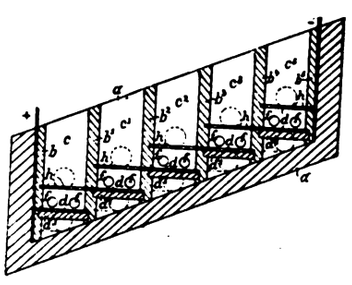
832,765. TROLLEY WHEEL AND SUPPORT. Big G. Young and Charles N. Pickering, Cedar Grove, W. Va. Filed November 13, 1905. A trolley of the swiveling type.

832,767. ELECTRICALLY TREATING AIR OR OTHER GASES. James H. Bridge, Philadelphia, Pa. Filed April 3, 1906. Gas is passed between charged plates, one of which is perforated.

832,768. ELECTRIFIER FOR TREATING AIR OR OTHER GAS. James H. Bridge, Philadelphia, Pa. Filed May 25, 1906. A method of constructing electrodes for the preceding patent.

832,809. MACHINE FOR MAKING BATTERY GRIDS. Willard F. Richards, Buffalo, N. Y., assignor to Gould Coupler Company, New York, N. Y. Filed May 25, 1904. A grid-spinning machine.

832,820. MAGNETIC SEPARATOR. Frederick T. Snyder, Oak Park, Ill., assignor, by mesne assignments, to International Separator Company, Chicago, Ill. Filed December 20, 1902. Renewed June 9, 1906. The magnet, alternately excited and neutral, separates the materials as they move with a reciprocating motion past it.



832,983. ELECTRODE FOR USE IN THE MANUFACTURE OF BLEACHING LIQUOR.

832,821. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago, and Frederick T. Snyder, Oak Park, Ill., assignors to International Separator Company, Chicago, Ill. Filed March 9, 1905. A rotating magnetic cylinder is placed diagonally over a separating table.

832,822. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago, and Frederick T. Snyder, Oak Park, Ill. Filed March 9, 1905. A horizontally toothed armature rotates in a horizontal field.

832,823. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago, Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. The materials to be separated are conducted by a fluid through the magnetic field.

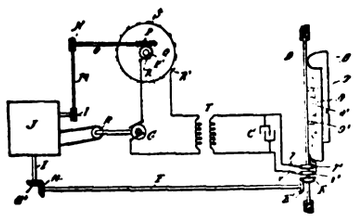
Digitized by Google

832,824. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago, Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. A laminated annular pole-piece rotates between fixed pole-pieces.

832,825. MAGNETIC SEPARATOR. Henry H. Wait, Chicago, Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. A concentrically laminated annular armature rotates over an annular table.

832,826. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago., Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. A revolving tapered magnet rotates in proximity to a tapered fixed magnet.

832,827. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago., Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. Both rotating armature and fixed poles are covered with non-magnetic shields.



833,034. AEROPHORE.

832,828. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago., Ill., assignor to International Separator Company, Chicago, Ill. Filed March 20, 1905. A fixed pole opposing a rotating armature which is shaped to concentrate the magnetic field.

832,829. MAGNETIC SEPARATOR. Henry H.. Wait, Chicago, Ill.. assignor to International Separator Company, Chicago, Ill. Filed April 24, 1905. A magnetic attracting surface provided with pyramidal projections.

832,847. LOCK FOR SIGNALS. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. Filed February 7, 1906. A magnetically controlled locking device.

832,849. ELECTRIC PERFORATING MACHINE. George H. Davis, Brooklyn, N. Y. Filed April 22, 1901. An electrically operated punch-controlling device.

832,852. SYSTEM OF DISTRIBUTING ELECTRICITY BY ALTERNATING CURRENTS. William M. Fairfax, Brooklyn, N. Y. Filed July 18, 1892. A series system provided with means for maintaining constant potential on secondary circuits.

832,862. MEANS FOR INSTALLING ELECTRIC OUTLETS. Louis Kalischer, Brooklyn, N. Y. Filed October 1, 1903. A device for supporting outlets.

832,876. CONNECTOR FOR TELEPHONE AND OTHER WIRES. Charles L. Peirce, Jr., Chicago, Ill., assignor to Peirce Specialty Company, Chicago, Ill. Filed May 31, 1905. The wires are clamped against an interposed conducting plate.

832,880. ART OF PRECIPITATING METALS FROM CYANID SOLUTIONS. William J. Sharwood, Berkeley, Cal., assignor of one-half to Charles W. Merrill, Lead, S. D. Filed February 24, 1904. The solution is brought into contact with a finely divided, more electropositive metal.

832,912. RHEOSTAT. Fred R. Kunkel, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed June 12, 1905. A rheostat for placing in the hollow base of small motors.

832,913. FAN-MOTOR ADAPTER. Fred R. Kunkel, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed August 2, 1905. A slotted hollow elbow.

832,926. MULTIPLE-UNIT SWITCH-CONTROL SYSTEM. Francis H. Shepard, New York, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Filed February 12, 1904. The patent covers the sequence of steps followed in cutting out the starting resistance.

832,934. ELECTRIC GLOW LAMP. John Van Vleck, New York, N. Y., assignor, by mesne assignments, to Nernst Lamp Company, Pittsburg, Pa. Filed May 9, 1899. A lamp of the Nernst type.

832,946. AUTOMATIC RELEASE FOR PARTY-LINE EXCHANGES. Clarence A. Anderson, Salina, and William Hagstrom, Lindsborg, Kan., assignors of one-third to John Anderson, Salina, Kan. Filed February 8, 1905. A prolonged releasing impulse is sent automatically over the line.

832,951. SUSPENSORY DEVICE FOR ELECTRIC LAMPS. Samuel R. Bell, Tuscaloosa, Ala. Filed September 19, 1905. A spring-controlled adjustable suspension.

832,963. INDICATOR. Harrison D. Flegel, Racine, Wis., assignor, by direct and mesne assignments, to Daniel L. Hayward, Chicago Heights, Ill. Filed April 20, 1905. A step-by-step movement is secured through a magnetically actuated rocker-arm.

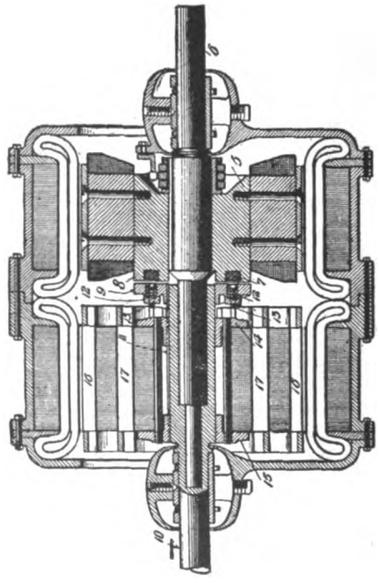
832,983. ELECTRODE FOR USE IN THE MANUFACTURE OF BLEACHING LIQUOR. Richard Kother, Cunewalde, Germany, assignor of one-half to Charles Edward Waithman, Gaddum, Montford, Cheshire, England. Filed November 3, 1905. A step-like arrangement of electrodes in similarly placed cells, whereby one plate acts both as anode and cathode.

833,009. CORD-ADJUSTER. George B. Smith, Indianola, Neb. Filed April 28, 1906. A cord-adjuster of looped wire.

833,017. ELECTRIC RAILWAY. Miles E. Bailey, Washington, D. C. Filed May 27, 1905. A siding normally insulated from the main line, provided with means for connecting it to the latter.

833,034. AEROPHORE. Lee de Forest, New York, N. Y. Filed December 8, 1905. A system for directing electromagnetic wave-signals.

833,051. ELECTROMECHANICAL TRANSMISSION DEVICE. Arthur W. Harrison, Los Angeles, Cal. Filed June 12, 1905. A combined motor and generator with independent shafts which may be coupled magnetically.



833,051. ELECTROMECHANICAL TRANSMISSION DEVICE.

833,080. TROLLEY. Elijah D. McDonald, Los Angeles, Cal. Original application filed August 31, 1905. Divided and this application filed November 28, 1905. A method of construction.

833,125. ELECTRIC SYSTEM FOR OPERATING BULKHEAD DOORS, HATCHES, ETC. William B. Cowles, Cleveland, Ohio, assignor to the "Long Arm" System Company, Cleveland, Ohio. Filed July 11, 1904. A safety spring is interposed in the gear train.

833,135. HIGH-TENSION TERMINAL FOR SPARK-COILS. Edward B. Jacobson, Pittsfield, Mass., assignor to Pittsfield Spark-Coil Company, Pittsfield, Mass. Filed February 7, 1906. A method of construction.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 17. NEW YORK, SATURDAY, OCTOBER 27, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON
NEW ENGLAND OFFICE, M. W. BARBER, Mgr., DELTA BLDG., 10 Post Office Sq.

LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE
TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS
One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING
CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS.

EDITORIAL:
Progress in Engineering Education 663
Seeing Electrically 664
Oil-Electric Boats 665
The Street Railway Convention 665
Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw 666
Electromagnetic Control of Governors 667
Proposed Peruvian Electric Railway 667
The Suppression of Industrial Smoke, with Particular Reference to Steam Boilers, by A. Bement 668
A New Method of Employing Twin Lead-Covered Wire for Electric Light Wiring, by E. L. Berry 669
Electrical Equipment for the Indiana Steel Company, Gary, Indiana 670
The Engineering Building of the University of Pennsylvania 671
Car Brakes, by Henry Mozley 676
New Electric Generating Station at Birmingham, England 679
"Increasing the Standard of Illumination" 679
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 680
Street Railway Week at Columbus, Ohio. Convention of the Railway, Engineering, Accountants' and Claim Agents' Association, and the Manufacturers' Exhibition, October 15-19 682
METHODS OF GETTING NEW BUSINESS 696
INDUSTRIAL SECTION:
New Types of Interior Telephones 697
Monthly Dinner of the Boston Edison Company 697
A New Separable Switch Attachment Plug 698
"Wotton" Single-Coil Ringers 698
Electrical Engineering Department, Columbia University 698
A Correction 698
Special Announcement 698
CURRENT ELECTRICAL NEWS 699

Copyright, 1906, by Electrical Review Publishing Co.

PROGRESS IN ENGINEERING EDUCATION.

The dedication, on October 19, of a magnificent new engineering building at the University of Pennsylvania is an important event in the educational world. This building provides excellent facilities for instruction in all branches of engineering, and in its arrangement particular attention has been paid to the various laboratories, for without satisfactory equipment in these departments it is difficult, if not impossible, to give adequate instruction to the students. The engineering departments of the University of Pennsylvania are to be congratulated on acquiring such an excellent educational equipment, and one befitting the dignity of the university. Fortunately, such dedications have not been rare during the last few years, as nearly all the large universities have come to see the importance of providing thorough training in all branches of engineering, and a goodly number of them have already dedicated magnificent halls to training young men for the engineering profession, including its various branches.

The increasing attention which is being given to technical and scientific instruction is not without significance. It shows that the faculties of our universities now realize that it is their duty to provide instruction for that ever-increasing class of students who desire to acquire useful information at the same time they are training their minds. The demand for technical education shows that many of these men enter college with a definite purpose; yet there are others who have not finally decided to take up engineering as a profession, and who take instruction in some branch of it as a matter of preference. And it is also true that some of those who expect to become practising engineers drift into other lines of work, and experience has shown that this kind of training is well adapted to fitting men for walks in life, entrance to which is gained usually through other gates.

The last century was noteworthy on account of the remarkable development of the school systems and the general spread of education. It is not unlikely that the present century will be as remarkable on account of a similar spread of higher education, and in this it seems certain that the so-called technical courses will play a most important part. The young man who formerly could not afford to go to college because of the time it required will find means to do so, because the work he does there will be directly useful to him in his after life; and many others who to-day believe that they can not spare the time will then think that this time is well spent. The condition to-day marks the passing of the old idea that the best mental training a man could get was by wrestling with subjects that

Digitized by Google

had no interest for him and were of no practical value. To-day the opinion which is gaining rapidly is that while all mental exercise is good, and so far as developing the mind only is concerned equally good, the fact that the subject studied may be directly useful does not detract from its educational value. The present century will undoubtedly be marked by a spread of technical training and, as a result, a general advance in all our standards of education.

SEEING ELECTRICALLY.

Some little discussion has taken place recently regarding the possibilities of "seeing electrically." The idea of transmitting pictures is probably as old as the telephone, but a new interest in the matter has been aroused, apparently because two inventors have almost simultaneously claimed to have solved the problem. As yet no proofs have been submitted to show the validity of these claims, and until this has been done no one should be criticized for doubting.

The expression "seeing electrically" must be distinguished from another and simpler problem in the same field—that of transmitting pictures over a wire. The latter problem has been solved in various ways; in fact one solution is offered by the Gray telautograph, while Korn, in Austria, as well as others, have devised means for transmitting over a telegraph wire a passable reproduction of a photograph or drawing. These systems can not, however, be designated as means for seeing electrically, as the reproduction requires time for producing, and is built up painfully step by step.

To reproduce a visual image by electrical means is a problem more nearly resembling the transmission of speech than any other, but there is this great difference: in the transmission of speech a great variety of sensations is produced, but they occur one at a time, although they may follow one another with great rapidity. But to see electrically one must produce a large number of sensations simultaneously. This feature would make the solution seem hopeless were it not for the persistence of vision, on account of which, if the sensations succeed one another with sufficient rapidity, they seem to be simultaneous. If, therefore, the whole series of sensations can be caused to take place and the series start afresh before the first one of the series has died away, the image will appear permanent.

Another necessity for visual reproduction is some apparatus or material which will respond to light. Such a material is available. Selenium, an element of the sulphur group, when carefully prepared and cooled so as to crystallize in a certain way, becomes an electrical conductor whose resistance is affected by incident light. This material then might be used to vary an electrical current or a series of electrical currents sent out over a wire, so as to correspond to different intensities of light; and these currents might be caused to vary the illumination at the receiving end of the wire so as to reproduce there a similar effect. Suppose the object to be reproduced were a photographic positive plate and light were allowed to fall through this upon a sensitive selenium surface, reproducing there a picture of the object in lights and shades. If the selenium surface were divided into a large number of small squares, each of these would represent a small portion of the object, just as do the small squares of a half-tone. If, from each one of these squares, a wire be led out and equal sources of electromotive force be introduced into them, the currents flowing will correspond in a way, to the average intensity of the light on the corresponding squares, on account of the effect of the light upon the selenium. These various currents could then be caused to reproduce the original image by determining the amount of illumination which should fall upon the corresponding squares of the receiving surface, but there would be this difference: the illumination of each little square on the receiving surface would be uniform, so that the final picture would be built up of a large number of small squares all differing from one another, but each one uniform in itself. The image would resemble very closely a half-tone reproduction.

For any satisfactory reproduction these little squares should be small—that is to say, there should be a large number of them; but this introduces a difficulty, for assuming each one to be one-fiftieth of an inch on a side, which would correspond to a very coarse half-tone screen, there would be 2,500 squares to each square inch of picture, and it is, of course, out of the question to carry any such number of wires as this arrangement would require any considerable distance to reproduce a picture. To get around this difficulty the impressions might be produced successively with sufficient speed. To do this requires that two different mechanisms, one at the transmitting station and one at the receiving station, run in almost absolute synchronism; but that may not be impossible. Assuming, however, that the same degree of subdivision be adhered to, and the image produced is about four inches square, it will be necessary to transmit 100,000 impressions per second, if each impression persists for only one-tenth of a second. To do this is certainly not easy, for it requires apparatus at the receiving end which will respond to this rapid change. Given such a device, and supposing that the selenium itself would respond to the action of the light with sufficient rapidity, a small spot of light might be caused to travel rapidly over the selenium screen, and the changes in the resistance thus caused be made to vary the intensity of a second spot of light which is following exactly on the receiving surface the motions of the transmitting spot. If this could be done satisfactorily the result would be a picture on the receiving surface resembling a half-tone reproduction. At the present time we seem to be a long way from accomplishing this result. We have developed part of the necessary equipment, but little or no progress has been shown to have been made in constructing a practical apparatus; and although the plan outlined was suggested some time ago, we seem to be no nearer to the solution than we were before.

The problem is thus seen to be a very difficult one. It is much more difficult than transmitting speech, because of the large number of simultaneous sensations which must be reproduced, and this applies to the reproduction of only a simple black and white picture. To reproduce an image of the original object in its original colors seems to be as difficult again, as this

Digitized by Google

introduces a new factor. Not only must we cause a variation in the intensity of illumination, but in the character of the sensation produced, and as yet we have discovered nothing which will respond in different ways to different colors of light. When it is realized that even the so-called systems of photographing in colors do not actually do this, and that the colors of the reproduction are added, and not reproduced, the probability that any one has to-day succeeded in transmitting electrically a picture in its natural color would seem to be very remote.

OIL-ELECTRIC BOATS.

The advantages of interposing a dynamo and a motor between the prime mover and the driven wheels have led to the adaptation of this system for vehicle propulsion. A number of automobiles have been equipped in this way which undoubtedly possesses some virtues, and a similar arrangement is now being tried both in this country and in Europe for propelling cars on railways. A further extension of this principle has been taken by the application of it to ship propulsion, for which purpose it possesses features of considerable importance. Economy of fuel, of space and of weight is an essential to success in marine engineering, so that the oil engine which does away with boilers and which gives a remarkably high thermal efficiency offers a possibility of making an important development in marine engineering if it can be applied satisfactorily. Unfortunately, these engines are generally irreversible, and they do not submit readily to speed control. Moreover, they can not be started under load. These features are, however, essential in marine work, so that to apply the oil engine to propelling boats requires the introduction of some system of transmission between the engine and propeller which will make up for the deficiencies of the engine; and here electrical transmission has stepped in, for by attaching a generator to the engine and a motor to the propeller shaft, the desired flexibility is obtained.

This plan is, of course, not perfect, for the introduction of the two new mechanisms offsets, in part at least, the displacing of the boilers. But the high efficiency of the oil engine still remains, and even when coupled with the necessary electrical losses may give a resultant efficiency still above that obtainable with the steam engine. And the system brings with it other advantages not obtainable in any other way. The engine may run at a constant speed, for which it is best suited, while the speed of the propeller may be changed at will. Moreover, the control of the propeller speed may be transferred from the engine room to the pilot house, and thus valuable seconds saved when navigating difficult waters. There is probably also some gain resulting from the elimination of one human link in the chain from pilot to propeller.

The system just referred to has been tried in a small way abroad, where it is giving some degree of satisfaction; but a recent modification of it has been made which partially eliminates the defects of the other. The new system was patented recently in this country by C. Del Proporto, but it has been undergoing trial for a year past on Lake Geneva, in Switzerland, and at St. Petersburg. The principal changes made are the reduction of the size of the generator and motor and the providing of a mechanical coupling between engine and propeller shafts. Since the flexibility of the electrical system is of most service when maneuvering, which is usually done at a decreased speed, the full output of the generator and motor are not then required. This work may therefore be done by a generator and motor of reduced size. In the new system they are rated at one-half the output of the engine, which will be found ample for such purposes. For proceeding at full speed, however, the electrical system possesses no particular advantage, and may, in fact, be cut out and the propeller directly attached to the engine shaft. This is accomplished by means of a mechanical coupling, as the engine is placed so as to allow this to be done. Under these conditions the generator and motor are cut out, their armatures acting merely as flywheels, and all electrical losses are avoided. The arrangement has the further advantage of reducing the weight of the electrical apparatus. The two vessels which are now being tried have apparently given good accounts of themselves. Although these equipments are small, it is not impossible to install large engine-power on shipboard by coupling two or more engines to one shaft, and, if necessary, by using two or three propeller shafts.

Developments in this direction will be watched with interest by marine engineers, for if an oil engine may be used for ship propulsion important advantages will be gained in other ways. Oil is not only a more concentrated fuel than coal, but is more easily handled, and its adoption would do away with the large corps of firemen now found necessary as all the fuel could be handled by means of pumps. Further, the increased thermal efficiency of the engine, together with the more concentrated type of fuel, would increase considerably the useful range of the vessel.

THE STREET RAILWAY CONVENTION.

The street railway convention, held at Columbus, Ohio, October 15 to 19, was impressive in many ways. First of all, it apparently developed the fact that under the scheme of reorganization the affiliated associations would do well, and that in conforming to the ideas espoused by the parent organization a sturdy growth would be assured and success eventually crown the efforts of all concerned.

President Ely, who has labored so long and so faithfully for the success of the organization, was the recipient of a handsome tribute from the officers and executive committees of the affiliated associations. In accepting this tribute, and, in fact, in all his remarks, there was the frank expression that work had been done and there was work to do, and that no one but a strong man could hope to carry out successfully the plans which had been outlined for future effort.

The choice of the nominating committee, there is no reason to doubt, is fortunate. John I. Beggs has impressed his personality upon the minds of men and indicated the ability to carry forward successfully large undertakings. It is to be hoped that he will be as successful as his predecessor, who has set for him a very lively pace.

Digitized by Google

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW, F. I. C.

VII—The Practical Application of the Test Results.

1. Frequency of Sampling and Testing—The feed-water from whatever source used for the boilers ought to be sampled regularly, at shorter or longer intervals, according to the nature of the supply, and the samples should be tested in accordance with the instructions given in Article VI.

In the case of surface and river water, the amount of impurities present in the water will be high during the dry season, and also after the first heavy rains at the end of such a season. At such times, therefore, the sampling and testing of the water should occur at least once weekly, or oftener if this be possible with the laboratory staff available for the work. During the winter and spring after the dry accumulations of the summer have been washed away, surface and river waters do not show such large amounts of dissolved and suspended matter, and at these periods of the year, a monthly examination of the feed-water will suffice.

Well waters, and waters drawn from large catchment areas in mountain districts and stored in artificial lakes, do not, on the other hand, show such marked variation in the amount of impurity at the various seasons of the year; and in the case of such waters, a monthly or quarterly examination of the water is sufficient.

2. Oil—If any portion of the boiler feed be drawn from the condenser water, this ought to be specially sampled daily, and tested for oil in the manner already described. In skilled hands the test will not require more than twenty minutes to carry out, and the results obtained may save very heavy expenditure upon boiler repairs at some later date. If oil be discovered in appreciable quantities, the water should be rejected for making up the feed, or should be put through a softening plant. In this case the calcium carbonate which is formed in the softening plant will enclose and carry down the oil particles; and the softening plant will in fact act as a chemical oil-purifying plant, and save the cost of the latter.

Even when specially erected oil-separating plants are in use it will be found advisable to pass the effluent from these through the ordinary softening plant as well in order to remove the last traces of oil. The water as it enters the boilers should also be examined daily for oil, and every effort should be made to keep the feed entirely free from this most destructive impurity.

3. Alkalinity and Acidity—All waters containing carbonates of lime or magnesia in solution give an alkaline reaction with litmus paper and methyl orange, and as already stated the alkalinity test is a measure of the temporary hardness of the water. Waters showing more than five English degrees (5 parts $CaCO_3$ per 70,000 of water) of temporary hardness ought to be submitted to the action of softening chemicals before admission to the boiler, otherwise these carbonates will separate inside the boiler in the form of scale and mud. Lime-water is the chemical solution employed for removing temporary hardness. The chemistry and practice of the lime-softening process will be dealt with in the next article.

Acidity in feed-waters generally arises from the presence of organic acids, and waters of this kind should not be used if any other source of supply be available. Should it be necessary to use such waters, the acidity must be neutralized with lime or with sodium carbonate, before the water is permitted to enter the boiler. The calculation of the amount of alkali required is easily made from the results of the test with standard alkali solution. The following is an example:

Two hundred and fifty cubic centimetres of the water took 1.4 cubic centimetres of the standard alkali solution (100 cubic centimetres = 1.937 grammes Na_2CO_3.)

$$\frac{1.4 \times .01937 \times 100.000}{250} = 10.847 \text{ grammes } Na_2CO_3.$$

Each 100,000 parts of water will require, therefore, 10.847 parts of sodium carbonate, that is, every 1,000 cubic feet will require

$$\frac{10.847 \times 10 \times 100}{16 \times 98} = 6.9 \text{ pounds of ninety-eight per cent alkali.}$$

4. Suspended Solid Matter—Water which contains more than five parts of suspended matter per 100,000 of water should be filtered or allowed to settle in large tanks before admitting to the boilers.

Sand-filters with an upward flow are the most suitable for removing suspended impurities; since these can be quickly cleansed by washing out in the reverse direction, with clean water. When softening plant is in use, special filtration is unnecessary, for the suspended matter in the untreated water is carried down with the carbonate of lime; and the only danger in such cases is that this lime is not allowed time to settle. The water from the softening plant may therefore at times contain suspended carbonate of lime; the remedy for which is a larger softening plant. As a rule, the precipitation of lime and other insoluble matter in a water-softening plant occurs more quickly with hot feed-water; and it is advisable, wherever possible, to use heated water in the softening plant, and to take the necessary steps to avoid loss of heat during the settling process. Water in a vessel exposed to the outside air will necessarily lose much heat by radiation, and the convection currents set up by this loss will interfere with the settling of the insoluble matter.

5. Total Solids—The total solids in feed-water should not exceed twenty parts per 100,000, and, where this limit is exceeded the water must be submitted to the action of softening chemicals.

The principal salts found in feed-water are the carbonates and sulphates of lime and magnesia; while the chlorides and sulphates of these elements and of sodium occur seldom and in smaller amount. The danger of large amounts of sodium chloride being present at times of flood tide, in water drawn from tidal rivers, has already been referred to; and for boiler plants located in such positions it is necessary to have some means for quickly noting the change in the character of the water supply.

The chemist in charge in such cases either should test the water daily at full tide, for chlorides, or should provide the firemen in charge of the boilers with a salinometer of a reliable type. A test based on the use of capsules of silver nitrate containing a weighed quantity of this salt with potassium chromates as indicator may also be devised, for showing when the feed contains more than ten parts per 100,000 of sodium chloride.

As regards the treatment by chemicals for removal of the total solids, this subject will be dealt with at length in the next chapter; and it is only necessary to state here that carbonate of soda is the chemical usually employed, in conjunction with lime.

6. Temporary and Permanent Hardness—Waters testing above fifteen English degrees of temporary and permanent hardness ought not to be used without chemical treatment in steam boilers.

The heat losses and disadvantages resulting from the formation of scale are so

[1]All rights of translation and reproduction reserved. Copyright, 1906, by John B. C. Kershaw.

Digitized by Google

great that in nearly all cases in large works a positive saving results from the installation of softening apparatus.[1] Permanent hardness, *i. e.*, that due to sulphates of lime and magnesia, is the more dangerous, since these salts form a more compact and adherent scale than the corresponding carbonates. The renewal of hardness by chemicals will be dealt with in Chapter VIII, but it may be remarked here that the removal of permanent hardness is only effected by substitution, and that an equivalent amount of another salt remains in solution in the water. The lime and magnesia sulphates are converted into the insoluble carbonates, while the sulphuric acid radical remains in the water, in the form of sodium sulphate, a very soluble salt.

Where waters with a high permanent hardness test are employed for boiler-feed purposes, the total dissolved salts will therefore always remain high, even when a softening plant is in use, owing to the presence of this sodium sulphate. In such cases it is advisable to blow off the boilers oftener than would otherwise be required, since a concentrated solution of sodium sulphate is corrosive in its action upon the gun-metal and brass fittings of the boiler.

In all cases it is in fact advisable to test the water remaining in the boiler at weekly intervals, and to blow off the boiler when the total dissolved matter exceeds 250 parts per 100,000 of water.

The following are some typical analyses of feed-water from various sources, carried out by the methods described in Article VI:

TESTS OF WATER FROM VARIOUS SOURCES.

RESULTS EXPRESSED IN PARTS PER 100,000.

Description.	Total Solids.	Temporary Hardness.	Permanent Hardness.	Total Hardness.
Liverpool Corporation Water.				
1. Lake Vyrnwy	4.46	..	..	1.7
2. Rivington	10.36	..	..	3.9
3. Dudlow Lane	19.2	..	..	8.8
4. Green Lane	33.1	..	..	20.8
5. Windsor	41.7	..	..	28.5
6. Waterloo district	6.8	1.5	4.1	5.6
Various Districts.				
7. Spring water	17.6	5.6	7.2	12.8
8. Surface water	56.8	34.9	3.8	38.7
9. Surface water	47.0	..	..	..
10. From a boiler in need of washing out	687.2	..	..	..

NOTES—Lake Vyrnwy is in North Wales; Rivington is a catchment area near Bolton.

Samples Nos. 3, 4 and 5 were from the old pumping stations of the Liverpool Corporation, and are samples of well waters. Sample No. 6 is the combination of pure Vyrnwy, Rivington and well water supplied to Liverpool and District for domestic use. It is an exceptionally pure water. Sample No. 9 contained 8.8 parts of organic matter per 100,000, and gave an acid reaction with phenol-phthalein. The acidity required 10.847 parts Na_2CO_3 per 100,000 of water, to neutralize it.

Sample No. 10 contained 43.2 parts of organic matter per 100,000 of water, and showed the danger of running boilers too long without blowing off. In this case the fittings were always leaking.

[1] A scale $\frac{1}{16}$-inch in thickness is the maximum allowable in steam boilers.

Electromagnetic Control of Governors.

The use of storage batteries to assist in maintaining a constant potential on an electrical supply system by absorbing sudden variations in load, while an advantage in many ways, involves the expense of first cost and maintenance of the batteries. The same result may in part be accomplished, says H. R. Speyer, without the batteries by adding an electromagnetic control to the engine governor. An apparatus which is being used for this purpose, and which is described here, consists of an electromagnet placed on the side of the engine with its movable plunger core attached to an extended arm on the governor lever. This coil carries the whole or a proportional part of the generator current, and thus exerts on the governor lever a force which varies with the load on the generator. When properly set this action may be made to vary the speed of the engine so as to maintain a constant potential independently of the load, or even to overcompound the generator by increasing the engine speed. The coil may be provided with a shunt, enabling any desired proportion of the generator current to pass through it, thus giving control over the variations caused in the engine speed. This method is used at the Weisbaden, Germany, central station, in which instance only one-seventh of the total generator current is shunted through the controlling coil. Although this method possesses a distinct advantage in doing away with a battery, it does not enable the engine to run and the boilers to work at their most economical and constant load; therefore there may be a greater coal consumption than if the battery were adopted. On the other hand, the expense of the battery is avoided. A feature of this arrangement is that it acts before the influence of the growing load is felt on the engine, and therefore before the voltage has had time to fluctuate due to a change in engine speed. By means of this it is said that the Weisbaden station now supplies both power and lighting from the same generator. Before its adoption it was necessary to run separate machines for this purpose—*Electrical Review (London), October 5.*

Proposed Pernvian Electric Railway.

M. Emile Guarini, writing from Peru, states that there is a warm discussion going on over the question of the construction of new railways. Among the most important of those to be constructed is that running easterly, and planned to unite the western slope of the rich, fertile and virgin regions of the Amazon. The government of Peru favors a central route for strategic reasons, but this route involves two disadvantages. The new line will depend upon the Oroya road, which is being exploited by a private company, and will be less remunerative than a more northerly route. M. Guarini, who has been acting in an advisory capacity for the government, favors the northern route, since it makes possible the utilization of enormous hydroelectric powers. This road would have a length of 525 miles, and would cost $30,000,000. It could be exploited economically, and would develop a remunerative traffic if it were judiciously constructed and low rates were adopted. This road would open a quick and economical outlet for mining and agricultural products of the region crossed, particularly the fertile, but distant, sections in the east. It could be constructed entirely independently of any other projected lines, and it would be advantageous to operate it electrically, because the route offers many opportunities for utilizing electric power in mines and on farms, and many industries would sooner or later spring up along the route.

To finance the road it is proposed that the Peruvian government guarantee an interest of four per cent on the sum invested, which would amount to an annual charge of $1,200,000 as a maximum. M. Guarini suggests that an electric telpherage system offers an economical and simple solution of the problem, particularly when the local conditions are borne in mind.

Digitized by Google

THE SUPPRESSION OF INDUSTRIAL SMOKE, WITH PARTICULAR REFERENCE TO STEAM BOILERS.[1]

BY A. BEMENT.

The problem of burning bituminous coal without producing smoke can be divided into two distinct features, one referring to legislation and its enforcement, the other to the technical or engineering phase of the matter, and it is more particularly the latter feature that is considered in this paper. It is the author's wish to emphasize certain fundamental principles upon which the complicated and difficult problem of smoke production and suppression rests, rather than attempt the detailed treatment of any individual condition or set of conditions.

It is a recognized fact that bituminous coal can be burned without smoke; also that the consumption of the volatile gases results in increased economy and while great improvement has been made, there is very much still to be accomplished, and the great and foremost requirement is a technical one, demanding not only a recognition of the principles involved in smokeless combustion, but better engineering practice as affecting design of plants and furnace apparatus. In the author's opinion, the people who are to blame for present conditions, may be divided into three classes in the order of their responsibility.

First—Manufacturers of furnace apparatus.

Second — Consulting engineers and architects.

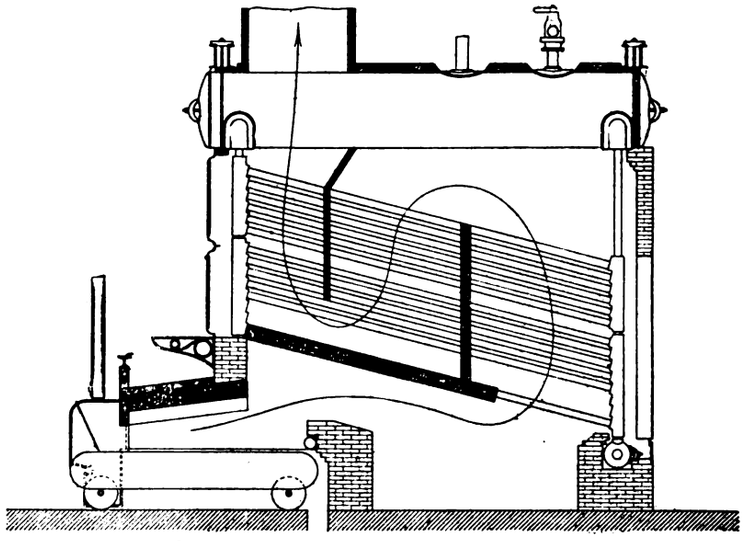
Third—Purchasers who operate the apparatus.

In considering the matter from the standpoint of manufacture, the important fact should be emphasized, that with one possible exception there are, strictly speaking, no smokeless apparatus made. This single exception will be mentioned later, but it is first desirable to outline the requirements governing smokeless combustion. They are:

First—Uniform evolution of the volatile gas, which requires with a stoker a positively uniform feed of the coal.

Second—The location of a chamber of sufficient length or capacity between the fire grate and exit to the boiler, to ensure that the volatile gases shall become thoroughly mixed with the air which enters with them.

Such chamber, which the author has called a furnace to distinguish it from the grate must of course, be made of refractory material to enable it to withstand the heat and its walls necessarily become red hot; this has caused many people to believe that the high temperature in itself was the cause of the volatile gases being burned, failing to take into consideration the fact that the most important requirement is a thorough mixing of the gases with the air in the chamber. Failure to realize this fact has resulted in disappointment with many brick arches, "Dutch ovens," etc. The chain grate, owing to its feed of coal being on a horizontal line, ensures a positively uniform rate in the feed, and consequently there is a steady evolution of the volatile gas, which will be burned if there is such furnace located between it and the boiler, and this apparatus may properly be called smoke-proof, because it is impossible for the operator to either cause, or allow the coal to be fed in other than a steady and uniform manner.



Smokeless Furnace for Steam Boilers.

Even when a very large furnace chamber is used with any form of stoker (other than a chain grate) or a hand-fired grate, a smokeless condition is dependent upon careful manipulation. For example, with a hand fire, if too much coal is added at one time, the evolution of gas will be greater than the mixing capacity of the chamber; or, with sloping grate stokers, when a large quantity of coal is poked or slides down the grate, the result is the same as when a large charge of coal is added to a hand fire. Thus the fuel feeding apparatus or method of manipulation, must not overtax the mixing capacity of the furnace chamber, if a smokeless result is to be secured.

The accompanying illustration shows the latest and best type of smoke-proof steam generator, its furnace chamber being formed by tiles covering the lower row of the tubes of the boiler. It is not a patented apparatus and may be adopted by any one who wishes to do so. In fact, many boiler plants now installed, may at small expense be altered so as to conform to all of its essential requirements. While this particular improved apparatus has already been built when demanded by purchasers, no manufacturer is willing to erect it unless required to do so. The nearest approach to a smoke-proof apparatus in the form of a complete steam generator, offered by any maker, consists of a brick arch as an essential adjunct for the direction of the gases against the tubes of the boiler, and when this manufacturer installs a chain grate under this arch, it becomes the above-mentioned exception to the rule. This does not mean, however, that a purchaser may not buy a boiler from one maker, a stoker from another and with a little engineering produce an apparatus which is strictly smokeless.

For a clearer understanding, it is essential that furnace apparatus be considered in two classes, one which is smoke-proof, the other depending upon careful manipulation for good results. This latter class may also be separated into two divisions, those which by reasonably careful working will be smokeless, and others, which it is very difficult to operate without smoke. Thus there are three grades of apparatus, the perfect, the moderately good and the bad.

The effort of health departments and smoke inspection bureaus should be to enforce the adoption of the perfect apparatus, proper manipulation of the moderately good and the abandonment of the bad. Unfortunately, however, the

[1] Paper presented before the Western Society of Engineers, October 17.

Digitized by Google

most serious offenders—the manufacturers, consulting engineers and the architects—are not affected by the smoke laws, therefore can only be reached indirectly through the purchaser who bears all of the burden. Thus the only alternative is to enforce the laws in such manner as to be most effective.

The position of the smoke inspector from the engineering standpoint is a difficult one. As a general rule he is an administrative official, appointed or elected for the purpose of enforcing laws, and his time and efforts are taken up in such work, and the character of the requirements largely determine the training of the man selected. It necessarily follows that often he is not an engineer; at all events to that extent necessary for the solution of the difficult engineering problems encountered; the conditions under which he must necessarily work, prevent to a very great extent his becoming technically proficient, because the tendency would then be for certain apparatus to be recommended in preference to others; this immediately results in trouble, caused by the influence of manufacturers who would not be favored. As it is, if a prospective purchaser applies to a smoke inspector for information as to the most desirable apparatus to be procured, he may be referred to a number of plants which are examples of good practice, in which he may find a variety of apparatus, and selecting one of these, often finds, after it is in service, that under his conditions it is not satisfactory; upon further investigation, he discovers that others labor under as much difficulty as he, and thus often feels that he is an innocent victim of circumstances.

There are many plans where conditions render it difficult to correct the apparatus except at great expense. Such cases present a real problem to the smoke inspector. On the other hand there are many owners who do not try to improve conditions, in fact, make no effort to discover whether or not they can correct their practice or the apparatus, and make promises they do not intend to fulfil. One of the most common excuses is, that their boilers are "overloaded" and for this reason they can do nothing, and unless the inspector is an engineer and familiar with this phase of the matter, he often encounters a seemingly insurmountable difficulty, when in reality these same owners, for reasons of economy, would not work their boilers at a lesser capacity. As a matter of fact, the practice which ensures a smokeless condition, also results, as a general thing, in the production of a larger capacity. The remedy with such owners is a drastic enforcement of the law.

In view of the fact that the greatest trouble is one that may be overcome by better engineering practice, and that there is no accepted or recognized independent source of information for the guidance of well-intending purchasers, it is recommended that the Engineering Experiment Station of the University of Illinois and the State Geological Survey, present information to the people of this state, which, coming from such sources, may be accepted with confidence and used to advantage.

A NEW METHOD OF EMPLOYING TWIN LEAD-COVERED WIRE FOR ELECTRIC LIGHT WIRING.[1]

BY E. L. BERRY.

At the present time there are practically only two modes of running wires for house lighting; namely, wood casing or metal tubing. Wood casing, although no doubt answering its purpose in dry situations, utterly fails in damp places. Metal tubing, if welded, brazed or seamless, thoroughly well screwed at all fittings, undoubtedly affords perfect protection from damp from without, but unfortunately its use is attended by a trouble peculiarly its own, that is to say, "condensation," so that in cases where metal tubing is employed to overcome possible defects arising from a damp situation, it is done at the expense of introducing another and equally fruitful source of trouble.

When metal tubing is employed it is undoubtedly very desirable, and in some cases even compulsory, that it should be "earthed."

Of course, in theory this is quite a simple matter, more particularly with screwed tube, yet few of the tube installations in use at the present time would stand a continuity test of the tubing from each switch and light point to the mains.

Having pointed out a very few of the defects which are possessed by tube and wood casing I suggest a substitute which in itself is by no means new, but the mode of employing it has, I think, some claim to novelty. I refer to vulcanized rubber twin lead-covered wires. I think we shall all agree that from the electrician's point of view twin lead-covered wires are ideal, in so far as there can be no damp troubles from without or condensation troubles from within, and the only reason I can assign for its not having been more popular are, firstly, the difficulty of satisfactorily jointing the wires, or of looping, if joints are to be dispensed with, in which case one wire would be wasted at each switch and light run; and secondly, the difficulty of making the lead covering electrically continuous throughout for the purpose of earthing.

Both these difficulties have, I think, been satisfactorily overcome by means of a porcelain joint box. It consists of two blocks of porcelain, the base and the cover; on three sides of the rebated edge of the base is an "earth plate," to which are screwed, opposite the points at which the wires enter, four saddles, by means of which the lead sheathing of the twin wire is securely clamped to the earth plate, thus insuring metallic continuity of the lead sheathing of the four lengths of wire which enter the box. In the centre of the base, and entirely embedded in porcelain when the cover is in position, are four contact plates fitted with the requisite number of pillar terminals for connecting the four pairs of wires. Two of these contact plates are permanently connected together in a recess at the back of the base.

That every length of wire where it enters the joint box has its lead sheathing clamped to a plate which is common to all the wires entering the box. It only remains, therefore, at each distribution board to connect the circuit wires by means of a metal strip fitted with the requisite number of saddles as fitted to the earth plate of the joint boxes, the said metal strip being connected to the lead sheathing of the mains where they enter the distribution board with a metal clip and copper wire, so as to insure the whole of the lead sheathing of all the wires of the installation being metallically continuous throughout. If the lead sheathing of the mains at the supply end is connected to a water pipe by means of clips and copper wire, we shall have, I think, a more reliable system of "earthing" than is the case with any iron or steel tubing in use at the present time.

To avoid damaging the insulation when removing the lead sheathing at the end a special form of lead cutter has been devised which, while removing the sheathing in a fraction of the time it would take to do so with a knife, effectually prevents any injury to the insulation.

Where the wiring is done on the surface the wires are fixed by means of metal saddles, either nailed or screwed, as is most suitable to walls and ceilings, the joint boxes fixed on the walls close to ceilings and in such positions as will be most convenient to the run of the wires. In

[1] Abstract of a paper read before the London section of the Electrical Contractors' Association, September 25, 1906.

Digitized by Google

cases where the wires are fixed to brickwork or plaster in damp situations, as a precaution against possible trouble arising from the local action of dissimilar metals in contact, it would be advisable either to interpose some substance such as damp-proofed tape or paper between the saddle and the lead sheathing or use lead saddles.

In the case of sunk work the joint box is fixed by means of an angle plate which is nailed to the side of the joists midway between ceiling and floor boards; the wires running with the joists are fixed by saddles nailed to the centre of the joists, and wires running across the joists are threaded through half-inch holes made in the centre of the joists with an auger bit, no further fixing being necessary. Where wires run down walls a chase is made in the brickwork wide and deep enough to take the wire; the wire is laid in and covered over with hoop steel two inches wide, which is secured by means of clout nails, driven into the joints of the brickwork close up to the edge of the steel. Where wires pass through brick or stone walls they should be drawn through bitumen tubing.

In new buildings it may be desirable to interpose water-proof tape or paper or something of a like nature between the wire and the hoop steel covering the wire chase, to obviate any local action between the lead sheathing and the steel, as in the case of metal saddles in damp places just referred to. In surface work the lead sheathing should afford ample protection against anything short of deliberate or wanton injury. Under floors the wires in all cases being run midway between ceiling and floor are out of the reach of all nails or screws. Under plaster, the covering of hoop steel will protect the lead sheathing from stray picture nails, etc., and also keep the wet plaster from contact with it.

With regard to the handling of lead-covered wire the most convenient way would be to have the 3/20 and 3/22 supplied by the makers in 220-yard lengths on small drums about twenty-four inches diameter by fourteen inches and weighing with the wire about one and one-half hundredweight. This can be readily carried about and when in use the drum should be mounted on a small stand leaving it free to revolve.

In addition to the absolute freedom from all troubles arising from the action of damp and condensation upon the insulation of the wires, and the good protection given to the wires, the system has one or two other advantages. Alterations, additions, the fixing and connecting of fittings, and the removal of faults in installations thus wired, will be as easy to a strange electrician as to the man who did the work originally. The locating of faults is a very simple matter, as the removal of the joint box cover gives access to both ends of every unbroken length of wire throughout the installation.

Less skilled labor is required, the only part of the work requiring electrical knowledge being the connecting of the joint boxes, fittings, switches and distributing boards. The cost of a mile of 3/20 twin lead-covered wire, as compared with a mile of five-eighths-inch slip socket tube with the average number of bends, tees, etc., enclosing two miles of 3/20 ordinary vulcanized wire of the same class, shows a saving of anything from twelve to twenty per cent, the difference being due to the varying proportion of tube fittings to tube on different installations.

To put this method of wiring from its economic point of view in the worst light, and assuming that there is no saving in either labor or material, it will still effect a very considerable reduction in the work entailed in office, stores, and in the value of the contractor's stock.

Electrical Equipment for the Indiana Steel Company, Gary, Indiana.

At Gary, Indiana, there is being constructed by the United States Steel Corporation a plant for the manufacture of steel. The new plant when completed will make use of substantially 5,000,000 tons of ore per year and will produce annually nearly 2,500,000 tons of steel. Along with the completion of the various buildings of the new plant an entirely new city is going up, with parks, theatres, streets and water and sewage systems all planned.

Quite in keeping with the immensity of this project are the plans for the detailed equipment. Practically all the machinery in the steel plant will be driven electrically, the gases from the blast-furnaces being, as far as possible, used for the generation of the necessary power. One of the first buildings to be equipped will be the rail mill, and the induction motors which will be used are not only of interest because of their size, but because of the special method of control. Moreover, this will be the first steel mill in this country to operate its rolls by induction motors. Six General Electric three-phase induction motors, ranging in capacity from 2,000 to 6,000 horse-power, will be used to drive the main rolls. These motors are reversible and are specially controlled. Due to the heavy overloads to which these machines are necessarily subjected, each motor is provided with a heavy flywheel, which, with the system of control, stores up energy when running normally and returns it to the rolls when subjected to a heavy overload. In addition to the heavy flywheels, each induction motor has an overload capacity of fifty per cent for one hour. Thus, three of the motors having a normal rating of 6,000 horse-power can each deliver 9,000 horse-power for one hour when called upon to do so. Mechanically, these motors are of unusually sturdy construction, being built heavy and rigid to withstand the shocks to which they will be necessarily subjected. At the same time the construction is as simple as is consistent with reliability. The heavy bearings and general massive appearance of these motors is quite in keeping with the powerful rolls which they drive.

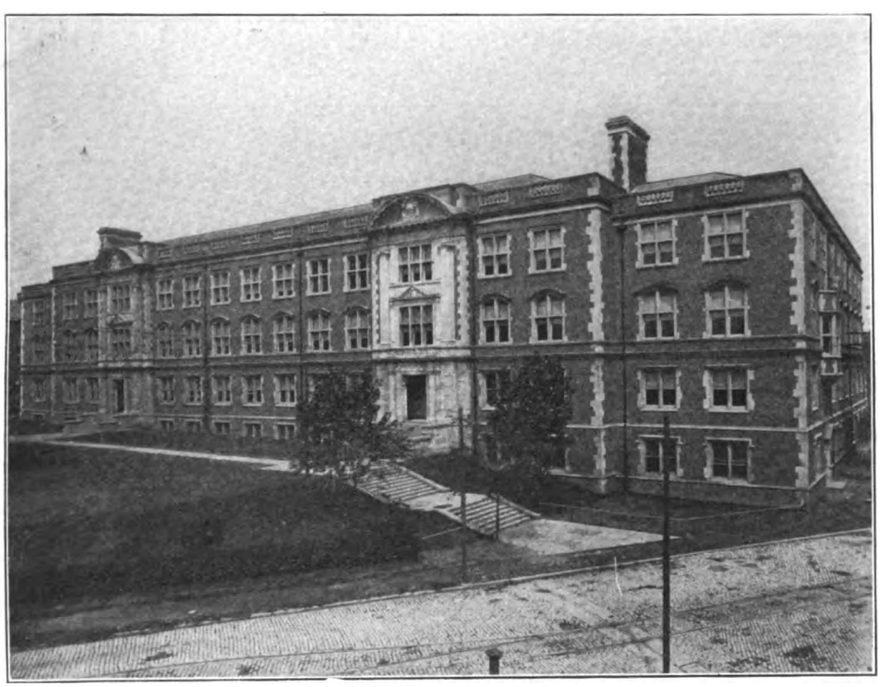
The method of controlling these motors was specially designed by the General Electric Company for this service and is very interesting. A master controller is used from which the main line oil switch can be opened or closed, the reversing switch thrown in either position, or the resistance cut in and out of the rotor circuit in successive steps by means of electrically operated switches or contactors. The main line switch is a triple-pole, single-throw electrically operated oil switch, and the current passing through this is led through the reversing switch, a double-pole, double-throw, electrically operated oil switch. Special precautions have been taken to insure the automatic protection of the control system. It is impossible to operate the reversing switch unless the main line switch has been previously opened, and if the main line switch has been opened by the overload trip, it can not be closed without first bringing the controller to the off position.

As has been stated, a special arrangement is used to assist the flywheel in restoring energy to the motor. So-called "slip relays" are provided in which the actuating coil carries the current of the motor. Whenever the motors are subjected to overloads, the slip relays operate, cutting a small portion of the resistance into each phase of the rotor circuit, causing the motor to slow down gradually and the flywheel to give up a portion of its energy. When the load is taken off the motor, the reverse operation takes place and the motor speeds up, returning the energy to the flywheel.

Digitized by Google

The Engineering Building of the University of Pennsylvania.

A LARGE assemblage of distinguished educators and engineers took part in the exercises dedicating the new engineering building of the University of Pennsylvania. A number of foreign governments, various branches of the Federal government and more than a hundred scientific societies and educational institutions sent delegates to represent them at the opening ceremonies, which took place on October 19. The principal addresses were delivered by Frederick W. Taylor, president of the American Society of Mechanical Engineers, and by Dr. Alexander C. Humphreys, president of Stevens Institute of Technology. They were introduced, respectively, by Professor Henry W. Spangler, head of the mechanical engineering department of the university, and Professor Edgar Marburg, head of the civil engineering department. Provost Harrison conferred a number of honorary degrees on distinguished engineers. In the evening the guests of the university were entertained at a dinner given by the alumni of both departments.



NEW ENGINEERING BUILDING, UNIVERSITY OF PENNSYLVANIA.

The new building is the largest of the university group of seventy buildings, having a frontage of 300 feet and depth of 210 feet at one end, and 160 feet at the other. The approximate cost including equipment was nearly a million dollars. It is of fireproof construction, and the equipment is of the most modern and approved type. The exterior is of dark brick, with limestone trimmings, and the general architectural treatment is in the English Georgian style. There are three stories, with basement covering about a third of the entire building, the total floor area being 128,000 square feet. The heating is by direct steam, each room being heated by steam coils supplied by low-pressure steam from the central station, after having been used in the engines. The ventilation is by electrically driven fans, located in the attic and the basement. The system is divided into sections, each with a separate fan and tempering coils, so that only that portion of the building in use has fresh air pumped into it. The fans may be controlled from any room in the building. The building is lighted by electricity.

The basement contains locker rooms, lavatories, machinery for heating and ventilating, storage battery rooms, laboratories for geodetic and hydraulic work, and for the testing of the materials of construction.

On the first floor, adjacent to the main entrance, are the offices of the heads of departments, the east end of the building being devoted entirely to the civil engineering department, and the west end to the mechanical engineering department. There are two principal entrances leading to the main hallway, which extend east and west the entire length of the building, with staircases at both extremities. Two large light wells terminate in skylights over the ground floor.

The Lesley cement laboratory for the testing of cements, mortars and concrete occupies the southeast corner. This room contains testing machines of various types for tensile, compressive and bending tests, a briquette-making machine, immersion tanks, damp-closets, etc., and a number of individual work tables, each completely equipped with an outfit of minor apparatus. Special provision is made for investigating the properties of plain and reenforced concrete.

The eastern side of this floor is otherwise occupied by the main physical testing and hydraulic laboratories, both extending partly into the basement, as previously stated. The former contains universal testing machines of various types, ranging in capacity from 30,000 to 60,000 pounds; machines for torsion, bending and impact tests, besides a complete outfit of extensometers, deflectometers, micrometers, etc.

The hydraulic laboratory contains a pressure tank five and one-half feet in diameter and thirty-seven feet high, having a total capacity of 5,800 gallons, for experiments on the discharge through orifices and tubes, and two calibrated weir-tanks, five by five and one-half feet in cross-section and thirty-four feet long. These tanks are provided with partially removable ends to permit also of observations of flow over submerged weirs and dams. Two weighing tanks, having each a capacity of 1,800 gallons, have been mounted on scales at the discharge ends of the weir tanks, and will themselves empty by quick-discharge valves into the main supply tank directly underneath. This tank has a capacity of 23,000 gallons, and is connected with the city water mains, and, by overflow and drain pipes, with the sewer. It is below the basement floor level, so that it receives the discharge from any piece of apparatus either on the basement or first floor level. An eight-inch tubular well, 100 feet deep, passes through the floor of this tank and will be utilized in connection with experiments on the efficiency of various forms of deep-well pumps and air-lifts. The pumping plant consists of three units independently driven by variable-speed motors, so that

Digitized by Google

they may be operated either separately or combined and at various speeds, thus ensuring a wide range in the rate of supply.

Various pipe circuits are provided and connected with a twelve-inch standpipe, extending from the basement to a height of about sixty-five feet, or somewhat above the main roof. From numerous connections along these pipe lines water is supplied to various forms of minor apparatus.

On the west end, opening out of the main hall, is an instrument-testing room for the calibration of indicators, thermometers, calorimetric work with fuels, etc., and beyond that an electrical-standard room for the comparison and correction of electrical testing apparatus of every variety. The remaining mechanical and electrical laboratories are situated on a floor four feet below the entrance hall.

The central space under the skylights, about 200 by 50 feet, is utilized entirely for workshops. In the western end is a foundry equipped with a small cupola, brass furnaces and light crane for handling flanks and ladles. A moderate-sized sand floor in the centre, and a small core-oven and benches around the outside, complete the equipment.

The wood-working and pattern shop extends to the middle of the building, and is divided into two parts, the one intended for beginners and the other for students engaged on pattern work.

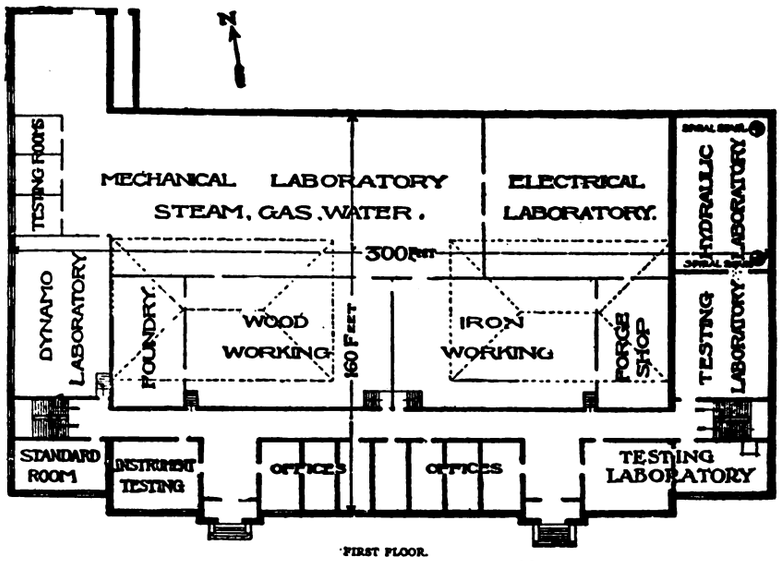
The tool room supplying the wood and iron shops has been placed directly at the centre of the building. To the east of this is an iron-working shop divided into two departments, one for beginners, the other for more advanced students.

The various forms of lathes, planers, drill presses, etc., required in a modern shop, have been installed, besides a number of electrically driven tools.

The eastern end of the shop space is devoted to the forge shop, with accommodations for fifteen men working simultaneously. Collectively, the shops accommodate about ninety men working at the same time.

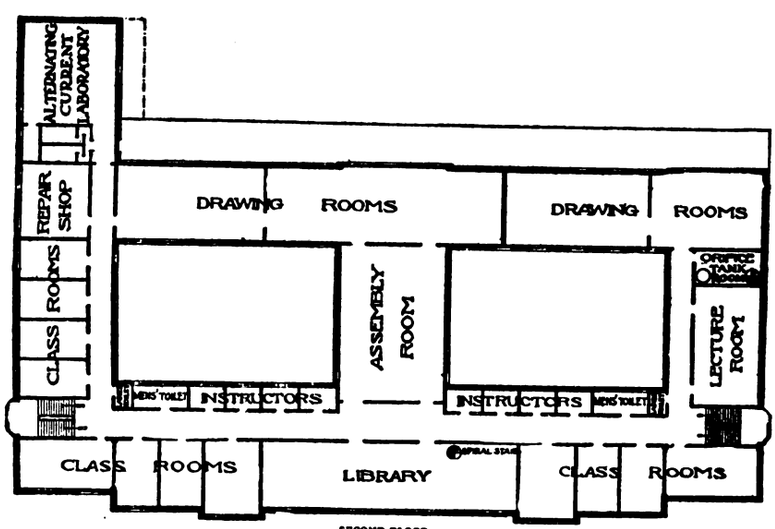
To the west and north of the shops are the mechanical laboratory and a part of the electrical laboratories. At the western entrance is a dynamo and motor room in which direct-current work will be carried on. Provision for high-voltage and railway work has been made in the adjacent laboratory.

In the mechanical laboratory steam and gas engines have been installed, each installation being complete with its apparatus for doing the special kind of testing for which it is to be used. Certain engines are used for valve settings, others for determining mechanical efficiency and others for determining the entire heat efficiency of the installation. A condensing apparatus and a small cooling tower for the steam engines and moderate-sized suction producer in connection with the gas engines makes a complete working installation. A high-pressure water service with accumulators and belted and steam-driven air-compressors make it possible to carry on any experiments with hydraulic and compressed-air transmission. A boiler of 100 horse-power to supply saturated or superheated steam for experimental purposes has been installed near a small erecting floor, on which any kind of machine may be mounted and quickly connected up. Special testing rooms have been provided for refrigerating work, for experiments on heat transmission through pipes and radiators, and for experimental work on fans. There are also apparatus for measuring power transmitted in various ways and for testing the materials used by the mechanical engineer. A large water-supply tank located above the third floor, and cisterns beneath the first floor will receive the discharge from the various machines. A number of water-wheels, steel flumes for handling the water, and weirs and meters for measuring it, afford facilities for laboratory work in this line.



PLAN OF LABORATORIES—NEW ENGINEERING BUILDING, UNIVERSITY OF PENNSYLVANIA.

Adjacent to the mechanical laboratory is the electrical laboratory, in which all measurements and testing to be made



PLAN OF DRAWING ROOMS AND CLASS ROOMS—NEW ENGINEERING BUILDING, UNIVERSITY OF PENNSYLVANIA.

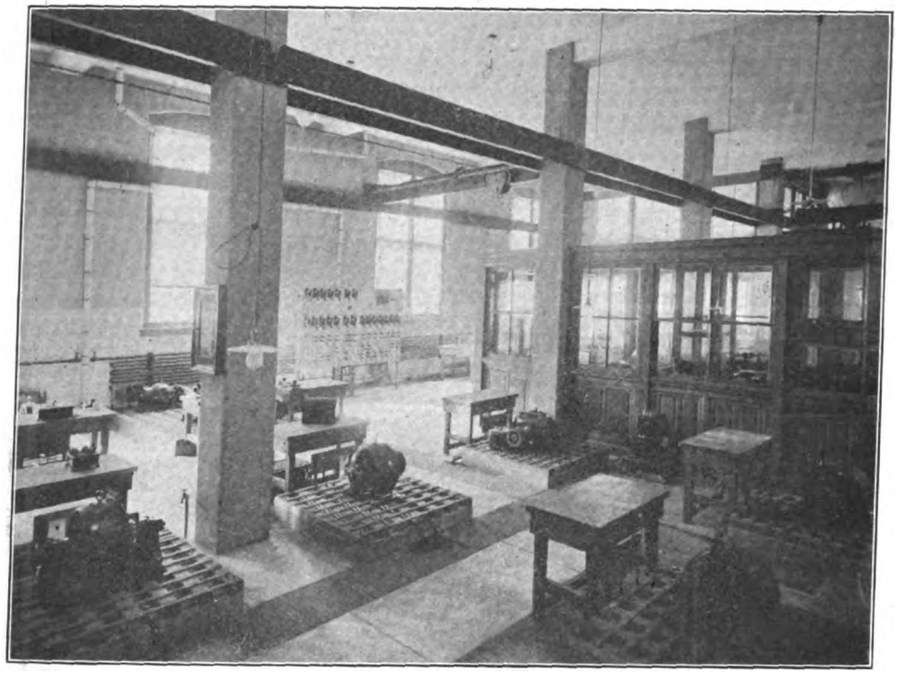
away from the machines will be carried on.

There are in all five rooms in the new engineering building which are used for practical work in electricity. Each of them is amply lighted and all have concrete floors. In every case provisions are

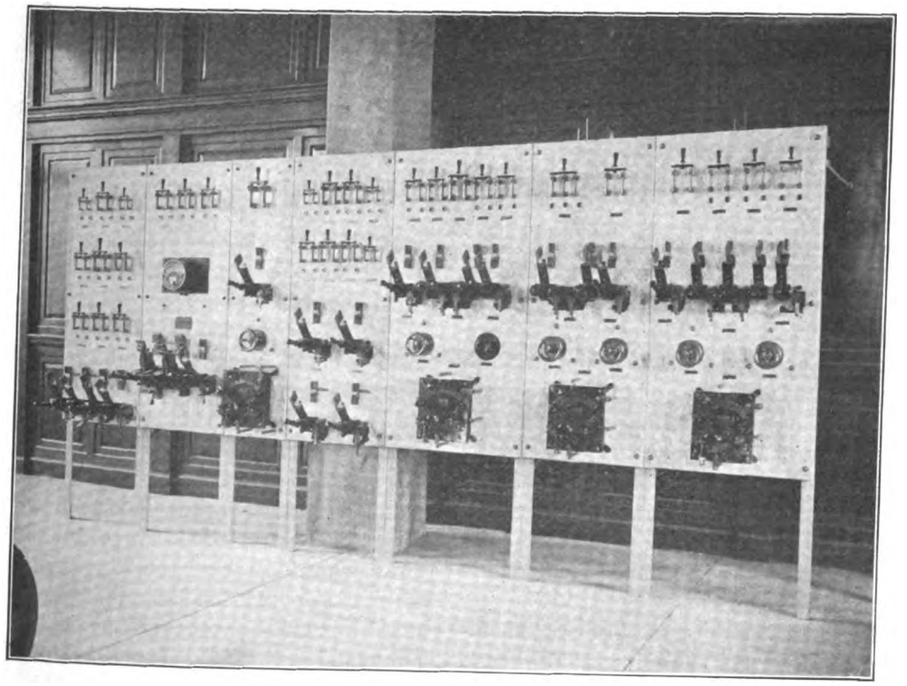
Digitized by Google

made so that any one experiment may be carried on entirely independent of every other one.

The instrumental laboratory, where the men meet with their first practical work is for experiments in the measurement of electromotive force, current, resistance, temperature coefficient, thermoelectric effect, inductance, capacity and permeability. The calibration of voltmeters, ammeters and wattmeters (indicating and integrating) and the determination of galvanometer constants is also done here by the student. This laboratory has a floor space of over 4,500 square feet (seventy-two feet by sixty-three feet), part of which is enclosed for an apparatus room. It is on the ground floor and nearly all under skylight. There are also three instructors' offices and a room for the storage batteries for the use of the laboratory. These offices and the instrument room are located in the middle of the laboratory, forming a division of the large room into two parts of approximately equal size. One of these parts is used for senior students and one for juniors. The divisions are each completely equipped for two laboratory sections, which may work simultaneously or at different times.



DIRECT-CURRENT DYNAMO LABORATORY.



ALTERNATING-CURRENT DYNAMO LABORATORY—DISTRIBUTING SWITCHBOARD.

There is a table and a galvanometer pedestal for each student, there being accommodations for twenty-four men (twelve in each section) on the junior side and eighteen men (nine in each section) on the senior side. These tables consist of two concrete pillars each about two feet high, which carry a slab of slate twenty-six inches by forty-four inches and one and one-half inches thick. The pedestals, which are located immediately in front of the tables, are built of one large concrete pillar, each being capped with a slate slab fifteen inches by forty-four inches by one and one-half inches thick. They are the same height as the tables.

Each of the two groups on both junior and senior side is provided with its own switchboard and its own storage-battery installation, which adds to the individual completeness of each group.

Each of these four switchboards is built of white Italian marble, as are all the switchboards in the electrical laboratories. They are supplied by the Walker Electric Company.

Every table in the room is provided with a slate terminal board upon which are mounted four binding posts, each of which is connected to its plug socket located on the switchboard feeding that part of the laboratory. By this means, any source of supply on the board can be connected to any table in the section the board feeds.

To secure the best insulation, all wiring used in this laboratory is rubber covered. It is run below the floor level in concrete drains which are covered with rolled-steel floor plates.

Each of these four switchboards is fed by a battery of eighty storage cells. These have a normal eight-hour discharge rate of three amperes on a one-hour rate of twelve amperes. They are provided chiefly for purposes requiring high potential and small current.

Each battery of eighty cells is divided into four groups of twenty cells each. The two end groups are arranged as end cells. Two twenty-one-point, button contact dial switches are connected in multiple with each group of end cells, and each of these switches is accompanied by a five-point switch similarly constructed which connects with the points where the large groups of twenty are joined. This makes a total of four twenty-one-point and four five-point dial switches per board, *i. e.*, four sources of storage-battery electromotive force, which can be independently

Digitized by Google

varied, and whose ranges are from two to 160 volts. By means of a single switch the entire eighty cells may be thrown into an arrangement of forty cells in series and two in multiple for charging.

An additional storage battery of six cells for each junior and twelve cells for each senior laboratory is installed. These cells have each a normal discharge rate of fifteen amperes for eight hours or sixty amperes for one hour. Many different combinations of series and multiple arrangement may be got with them, and on the senior board several hundred amperes are available at any part of the laboratory.

All switchboards in this laboratory are also supplied with 110 volts from the dynamos which supply the current for the building, and each circuit on all the boards is protected by a circuit-breaker.

The boards on the senior side have also alternating current which comes from a special generator used for this purpose alone.

By the arrangement of plugs that is employed, the establishment of any desired circuit can be accomplished as quickly as on the modern telephone.

As sources of energy for some of the more elementary work, twenty-five primary batteries are provided.

The floor space in the direct-current dynamo laboratory is over 2,000 square feet (thirty-three feet by sixty-two feet), and it has an instrument room and an instructor's office.

Like the instrumental laboratory, it is on the ground floor. The wiring also is installed in a manner similar to that in the above room. The wire used is fire and waterproof and not rubber-covered.

The dynamos and the motors driving them, as well as the motors for test, are all placed upon raised concrete foundations of sizes varying from four feet square to eight feet square. These are approximately six inches in height, and on top of them are placed wooden runners of three inches by four inches yellow pine at a distance of about six inches apart. On top of these wooden pieces are iron straps laid at right angles to them. The irons are screwed to the wood which is bolted to the concrete. The machines rest immediately upon the iron strips and may be clamped in any desired position.

All vibration produced by the machines is taken up in the wood. The machines are set up in position for the respective tests upon which they are to be used. There are twelve tests, and each is provided with a testing table. These are made of heavy oak and are attached to the foundations by means of bolts imbedded in the concrete. Switches for short-circuiting the ammeters, and line switches, as well as field rheostats, are all permanently attached to the tables. All test machines are, however, connected up each time by the student who is running the test.

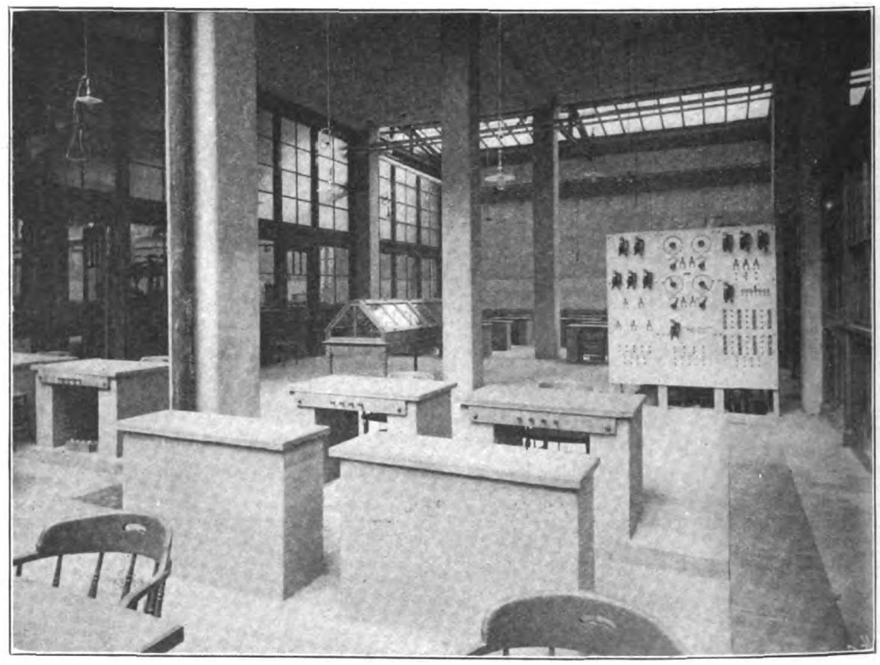
A slate terminal board is placed at each test, and there are four binding posts mounted on each which are wired to plug sockets located on the bottom of the switchboard. One panel of this board is devoted to the storage-battery installation that is provided for this room. These batteries are located in the regular storage-battery room in the basement, and are arranged so that current can be got at six, twenty, 110 and 150 volts. At the lowest voltage they will supply forty-five amperes for eight hours or 180 amperes for one hour. While at twenty volts they will give fifteen amperes for eight hours or sixty amperes for one hour. At each of the higher voltages the current available is four and one-half amperes for eight hours or eighteen amperes for one hour. This is used for such purposes as measuring armature and field resistance, also for any other purpose where a steady source of current is required.

The main power supply for this laboratory is from the building power-house. Five hundred amperes are available at 110 volts. The main circuit is protected by a circuit-breaker of that size, while each motor and all test circuits are equipped with circuit-breakers of proper size.

The machines found here, together with the tests upon which they are used, are a General Electric five-horse-power shunt motor, a Westinghouse five-horse-power shunt motor, a General Electric five-horse-power series motor, a Crocker-Wheeler five-horse-power series motor, a Dallett five-horse-power differential compound motor, and a Westinghouse five-horse-power differential compound motor.

These motors have a special form of pulley to allow a circulation of water. There is a water supply located at each test and a drain to carry off the water.

Two exactly similar five-horse-power shunt motors of Westinghouse make are provided for use in the investigation and location of losses by Hopkinson's method.



Senior Instrumental Testing Laboratory.

These have the losses supplied electrically and can be belted together or direct-connected by coupling.

The generator equipment consists of a two-kilowatt Edison shunt generator belted to a three-horse-power Wagner motor, a three and one-half-kilowatt Holtzer-Cabot compound generator belted to a five-horse-power Crocker-Wheeler shunt motor, a three-kilowatt Crocker-Wheeler compound generator belted to a five-horse-power shunt motor of the same make, a one-kilowatt Weston shunt generator belted to a two-horse-power Lundell shunt motor and a five-light Thomson-Houston arc dynamo belted to a five-horse-power Crocker-Wheeler shunt motor.

The alternating-current laboratory is located on the second floor. Its total floor space is over 2,100 square feet (thirty-eight feet by fifty-six feet), and with-

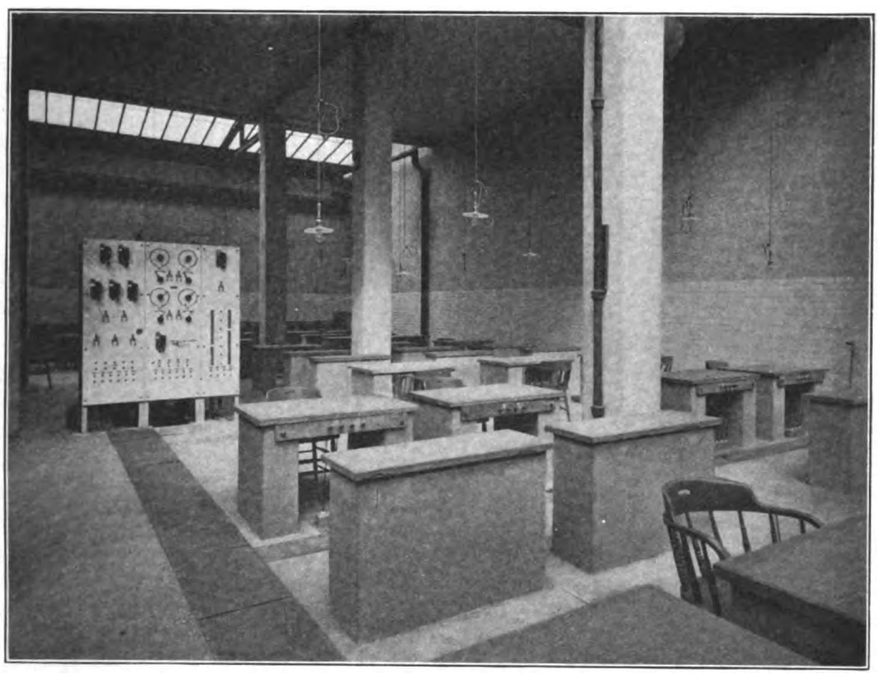
Digitized by Google

in it are an instrument room, an instructor's office and the photometer rooms.

All test machines are mounted on raised foundations in the same manner as that found in the dynamo laboratory, previously described.

In the same manner, also, each test is provided with its own table, to which are attached all switches for the work. A slate terminal board is provided which carries four, six or eight binding posts as the case may require. For example, in case of a six-phase rotary converter there are eight binding posts, two for the direct current and six for the alternating side.

All wire used in this room is fire and weatherproof and is run open, attached by



JUNIOR INSTRUMENTAL LABORATORY.

cleats to wooden runners imbedded into the plaster of the ceiling for this purpose.

Each test is provided with its own generator and is independent and complete in itself. These generators are motor-driven, all being direct-connected sets, and both motors and generators, as well as the circuits from the latter to their tests, are controlled from the switchboard.

This switchboard is the largest board in the building for laboratory use and consists of seven panels. It is somewhat over fourteen feet in length, and all circuits are protected by circuit-breakers.

The direct-current motors in this laboratory, which are used to drive the generators, also the direct-current field excitation, are supplied from the power-house in the building, at 110 volts. Five hundred amperes are available.

The following generating apparatus is placed in the alternating-current laboratory:

A Wagner four-kilowatt, sixty-cycle, 104-volt generator, belt-driven by a seven-and-one-half-horse-power General Electric motor.

A Westinghouse two-kilowatt, sixty-cycle, 104-volt generator, belt-driven by a three-horse-power Robbins & Myers motor.

A 125-cycle, fifty-two-volt Holtzer-Cabot motor which starts as a repulsion motor. This is supplied with power from a small Westinghouse generator which is driven by a two-horse-power General Electric shunt motor.

A group of four four-kilowatt generators, direct-connected to a fifteen-horse-power differential compound motor supplied by the Fort Wayne Electric Works. These generators supply power at different frequencies and voltages to a number of transformers, synchronous and induction motors, arc lamps and other apparatus.

Among the motors in the laboratories are:

A General Electric three-horse-power, sixty-cycle, single-phase synchronous motor, provided with a one-half-horse-power direct-current Westinghouse motor for starting.

A five-horse-power, two-phase, 110-volt, sixty-cycle, variable speed induction motor of General Electric make, which draws power from a five-kilowatt generator direct-connected to a seven-and-one-half-horse-power motor supplied by the Westinghouse Electric and Manufacturing Company.

A General Electric ten-horse-power, three-phase, 110-volt induction motor supplied with power from a Fort Wayne direct-connected set consisting of a seven-and-one-half-kilowatt generator and a ten-horse-power motor.

A multiphase rotary converter, 110 volts on the direct-current side, supplied by the General Electric Company. This machine draws power from the direct-connected Fort Wayne set when converting from alternating to direct current.

All the laboratories are amply equipped with the best makes of measuring instruments, so that no student's work is hampered in this regard. There are also generous supplies of other accessories, such as rheostats, resistances, condensers, lamps and other devices.

On the second floor of the building a reference library and reading room occupy the central space on the front of the building. The library and stack at one end will hold about 20,000 volumes. The library is flanked on either side by a series of recitation and lecture rooms, which are continued along both ends of this floor. Between the light-wells at the centre of the building is a students' assembly room with about 2,500 feet of floor space. There are also a number of rooms for instructors along the south side of the light-wells.

The rear portion of this floor for nearly the entire length of the building is assigned to drawing rooms. A separate room will be allotted to each class and an individual desk to each student, so that he may have free access to the same at all hours.

On the third floor is a large room for the use of the engineering societies, a general supply store and the library stack extends through the middle of the front of the building; the space along the front being otherwise assigned to class rooms and to instructors' rooms along the south of the light-wells.

In the east and west wings, spacious rooms have been set aside for engineering museums. The rear of this floor is also devoted to drawing rooms which, like the drawing rooms on the second floor, will have the full advantage of north light through windows of ample dimensions.

The engineering department of the university was established in 1874, but the constant increase of numbers in the classes of the departments has necessitated their moving into more spacious quarters three times since their founding. The departments this year have a total enrollment of nearly 600 students, and a teaching force of forty.

Digitized by Google

CAR BRAKES.[1]

BY HENRY MOZLEY (GENERAL MANAGER, BURNLEY CORPORATION TRAMWAYS.)

In view of the large number of accidents on tramways recently owing to failure of brakes, and the anxiety of the executive committee to have the question considered in all its bearings, I had no hesitation in complying with the request to give the Association the benefit of our experience with brakes at Burnley, and my committee instructed me to furnish you with any information you required. Municipal authorities, having only one interest to serve, can approach the subject without suspicion of bias, and makers of brakes may be assured that it is the public interest and safety alone which the Association has in view; moreover, this very disinterestedness enables local authorities to freely communicate to each other their common experiences and information without let or hindrance.

The Burnley Corporation Tramways consist of a trunk line seven miles twelve chains in length, and three branch lines a little more than one mile each. The trunk line was worked with steam power for twenty years, the locomotives weighing ten tons ten hundredweight in working order; bogie cars weighing four tons, and having a seating capacity of sixty-four passengers, so that loads of twenty tons were frequent. The brakes were actuated by steam power upon all the twelve wheels simultaneously, and on no occasion during the period did an accident occur caused by a failure of brakes.

Fig. 1 shows the nature of the route. The Padiham section is three miles nineteen chains in length, having very little level in it, the characteristic of the route being a steady rise to Park-lane from both directions—the exact rise Padiham to Park-lane being 257 feet, and the distance two miles three chains; and Calder Vale to Park-lane 155 feet, the distance seventy-five chains; thus showing that we had long been accustomed to controlling heavy weights on severe gradients, and made us very much alive to the importance of brakes when the time came for the introduction of electric traction A section of this portion of the line is given in Fig. 2.

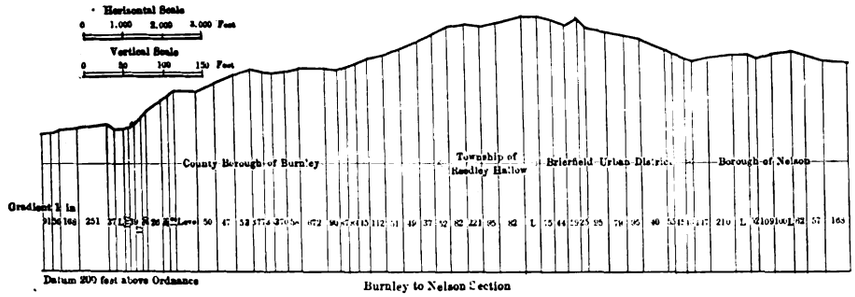


FIG. 1.—GRADIENT LINE, BURNLEY CORPORATION TRAMWAYS.

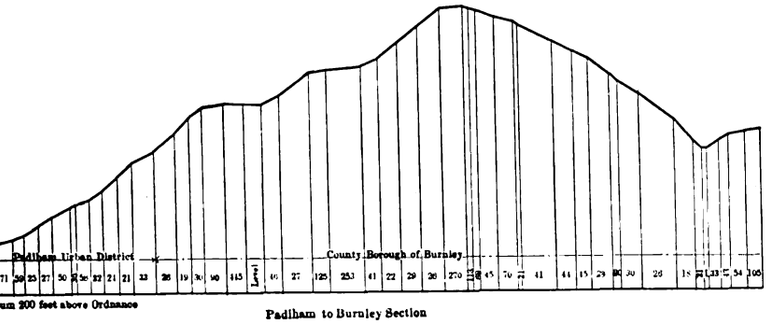


FIG. 2.—GRADIENT LINE, BURNLEY CORPORATION TRAMWAYS.

The trunk line has been worked electrically from March, 1902. The cars are double-decked bogies, equipped with Brill maximum traction trucks and British Thomson-Houston motors, their weight being twelve tons ten hundredweight and seating capacity seventy, the weight, fully loaded, seventeen tons ten hundredweight, with occasional heavier loads. There have been no accidents connected with the brakes, which are the simple hand-brake improved by ourselves, and the rheostatic brake. Track brakes are not required or used on this route.

After the trunk line had been in operation twelve months and the result being satisfactory, my committee began the construction of the three branch lines. One of these, the Manchester-road branch, is of an exceptionally dangerous character, having a continuous gradient averaging 1 in 18 for the full distance and 1 in 9.8, 11 and 12 in parts near the junction with the trunk line, the actual rise being 340 feet in one mile, thirteen chains.

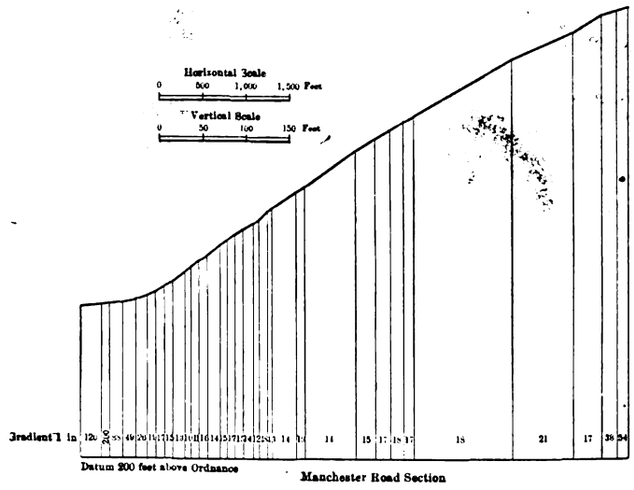


FIG. 3.—GRADIENT, MANCHESTER SECTION.

Fig. 3 will illustrate the nature of the gradient very clearly.

The car for this and the Towneley route (worked as one line, horse-shoe shaped, and touching the trunk line in Burnley center) is of special design, having a large inside seating capacity forty-four, the Towneley branch having a low culvert under the Leeds and Liverpool Canal. This necessitated four motors, thus bringing up the weight of the car to fourteen tons, twelve hundredweight, fifty-four pounds, empty, and seventeen tons, ten hundredweight, 110 pounds, fully loaded.

You will readily understand that to control this weight on such heavy gradients the best brakes obtainable were necessary, and my committee appointed a special subcommittee to deal with the question, and it is from this point the subject will

[1] Paper read before the Leeds meeting of the Municipal Tramways Association on September 19. (Slightly abstracted.

Digitized by Google

be the most interesting and instructive. We had come to the conclusion that only mechanical track brakes were suitable, and made full inquiries into all types of track brakes known to tramway men, including the Hewitt & Rhodes' air brake erected on cars at Oldham (this brake was used for emergencies only and appeared to be too unreliable in the matter of maintenance), and found not one would answer our requirements. We were, therefore, driven to the necessity of designing one.

This brake was erected on a locomotive we were building at the time, and its performances were so satisfactory that it was resolved to adopt it for the Manchester road cars, and here I may say that during the trials it was found that it would be unsafe to use wood for the slippers, and that soft grey cast iron was the only suitable and safe material. Before this point was reached we had obtained some reliable information and experience of magnetic brakes, which, by this time, had begun to interest tramway men. I propose to go into a little more detail to make clear to you the causes which proved to us the unsuitableness of the magnetic and the adoption of the mechanical track brakes with cast-iron slippers in place of wood —the general practice where mechanical track brakes are used. We had been accustomed for twenty years to the use of the mechanical brakes, and it was a considerable shock to go back to hand brakes when electricity was put into operation, and we naturally kept a lookout for a remedy for this backward step, and the magnetic brake appeared to fulfil the requirements. We, therefore, obtained permission to try two rival magnetic brakes for the purpose of ascertaining their suitability for service brakes, and at the same time ascertain whether the brake could be used on the Manchester road cars.

By this time we had gained considerable experience of the rheostatic brake, and found that it was highly destructive to the motors and could only be used for emergencies. The magnetic brake being actuated by the same means, we took the precaution of requiring the makers to satisfy us by actual measurements as to the voltage and amperes generated by the motors. Both makers entered into an agreement to do this, and the brakes were erected on Nos. 6 and 7 cars, the cars being precisely alike.

The Newell brake was fixed to No. 6 car, but we could not use it as a service brake owing to the high current generated causing the resistances to overheat, its tendency to skid the wheels and other causes, and it was removed and returned to the makers.

The British Thomson-Houston Company's brake was kept in service five months, and during that time three armatures were burnt out, and the brake had to be abandoned. After the second armature failed the makers made important alterations in the magnets, which lessened the pressure on the motors, but notwithstanding this improvement one more armature burnt out, and we were then convinced the magnetic brake was unsuitable for service purposes.

The makers took measurements as required by the agreement, and Table I gives the statement supplied by the British Thomson-Houston Company's engineer.

The Westinghouse company's representative failed to supply the readings which were taken by them, but I append, in Table II, readings taken by ourselves at a later date, and after the British Thomson-Houston Company had altered the magnets of its brake.

The data are placed side by side for convenience.

TABLE I—TESTS OF BRITISH THOMSON-HOUSTON MAGNETIC BRAKES—JULY 22, 1903.

From Pole No.	To Pole No.	Distance, Feet.	Time, Seconds.	Speed.	Reading in Amperes.	Volts.
101	84	1,856	102	12.4	35 to 17	400 to 200*a*
73	65	857	43	13.6	35 to 15	400 to 200*b*
49	46	328	14	16.0	47 to 34	550 to 300*c*
..	..	...	..	....	90 to 25	800 to 250*d*
37	34	351	15	16.0	48 to 28	590 to 350*e*
..	..	...	21	11.4	90 to 25	800 to 300*d*
49	46	328	20	11.2	29 to 24	250 to 210*f*
..	..	...	20	11.2	32 to 29	300 to 200*g*
					Momen- Contin- tarily. uously.	Momen- Contin- tarily. uously.
37	34	351	..	....	50 25	400 to 220*h*
..	..	...	21	11.4	25	250*i*

a 1st notch—Grades 1 in 26, 1 in 28, 1 in 22, 1 in 40, 1 in 253. No flashing or sparking of motors.
b 1st notch—Grade 1 in 26. No flashing or sparking of motors.
c 1st notch—Grade 1 in 18.
d 1st notch—High ampere and volt readings due to high initial speed of car, which had not come to an even speed when readings taken. No flashing or sparking of motors.
e 1st notch—Grade 1 in 21.
f 2d notch—Grade in in 18.
g 2d notch—Speed of car fairly constant when readings taken. No flashing or sparking of motors.
h 2d notch—Grade 1 in 21.
i 2d notch—Car had come to even speed when readings taken. No flashing or sparking of motors.

The tests were carried out on certain down grades on the tramway route, as indicated by pole numbers in Table II.

During the tests these grades were approached at a fairly high rate of speed, and shortly before reaching the first pole marking the prescribed course the track brakes were applied. The time required to cover the distance was noted, and concurrent readings were taken of amperes and volts at intervals of four or five seconds. From these observations was determined the average speed of car when descending the grade under the action of the brake, also the average total amperes generated by motors and the voltage across

TABLE II—TESTS MADE DECEMBER 22, 1903.

Pole No.	Distance, Feet.	Grade.	Brake.	Time, M. S.	Speed.	Average Amperes.	Average Volts.
101–84	1,856	1 in 26	B.T.-H.	1 47.5	11.75	13.4	135[1]
..	..	1 in 28	..	..	..	..	..
..	..	1 in 22	..	..	..	..	..
..	..	1 in 40	W.	1 47.0	11.80	19.2	198
..	..	1 in 253	..	..	..	..	..
73–65	857	1 in 26	B.T.-H.	0 46.4	12.6	16.0	204[2]
..	..	..	W.	0 4.90	11.9	16.0	146
49–46	328	1 in 18	B.T.-H.	0 17.0	13.1	28.0	326[3]
..	..	..	B.T.-H.	0 12.8	17.4	47.0	584
..	..	..	W.	0 11.8	18.9	51.5	710
37–34	351	1 in 21	B.T.-H.	0 15.5	15.45	35.0	453[4]
..	..	..	B.T.-H.	0 16.6	14.4	30.0	386
..	..	..	W.	0 16.0	14.95	40.0	532

[1] Car brought to a stop with British Thomson-Houston brake, eighty-two amperes maximum current.
[2] Dead stop made with eighty-five amperes maximum British Thomson-Houston brake and 100 amperes + Westinghouse.
[3] Westinghouse resistance smoking, stop made with 100 amperes + British Thomson-Houston brake and 100 amperes + Westinghouse brake. Westinghouse wheels skid; British Thomson-Houston very slightly.
[4] Dead stop, no skid; 100 amperes British Thomson-Houston and Westinghouse.

Digitized by Google

the motor armature. The results are shown in Table II. Rails were very greasy.

In the above Table II the average values of amperes and volts are computed from the readings taken when running between poles indicated in first column. The momentary high values observed when bringing the car to a stop have not been considered in computing the average.

Several emergency stops were made on slight down grade with the following results:

Whose Brake.	Distance to Stop.	Time.	Volts.	Remarks.
B.T.-H.	67	5	640	With Westinghouse brake motors flash and wheels skidded slightly. No flashing or skidding with British Thomson-Houston brake.
B.T.-H.	54	4	320	
W.	130	7	1,160	

The second emergency stop with the British Thomson-Houston brake was an entirely satisfactory stop, the retardation being practically constant, and at a very high rate. The above figures show the rate to have been 4.6 miles per hour per second, and the initial speed about 18.5 miles per hour.

A further series of tests was made with the same cars on the Manchester road route. The cars were allowed to descend the grade with the track brakes in operation. Five stops were made during the run, using track brakes only, and the time from start to finish of test was noted in each case, as well as approximate speeds and total amperes taken by the brakes:

	B.-T.-B. Brake.	Westinghouse Brake.
Average speed, approximate	7½ m.p.h.	7½ m.p.h.
Total time, including stops	14 min.	12 min. 7 sec.
Total time, exclusive of stops	11 min.	10 min. 42 sec.
Average current, exclusive of momentary stopping currents over 50 amperes	16.68 amps.	19.29 amps.
Average current, inclusive of stopping currents	23.22 amps.	29.28 amps.

Although the British Thomson-Houston readings were more favorable than in the first test, the voltage and amperes were still high.

Now compare the ordinary braking currents with the driving currents on the same hills:

Brakes .....10 to 68 amperes.

Driving .....51 to 90 amperes.

Remembering that motors are designed for driving only it is no mystery why armatures burnt out with the almost double work put upon them. But this is not the only reason why magnetic brakes could not be used for service purposes—they are uncertain in their action, and the tendency to skid a source of danger. With every desire to obtain a service brake, we were obliged to give up the magnetic brake, and we are still on the look-out for a suitable form of mechanical brake to relieve the driver from hand-braking.

The magnetic brake had not been used anywhere under the circumstances of the Manchester road tramway, and with our experience of it on the trunk line it was quite clear an unsuitable brake for the conditions obtaining there. A simple matter of figures will show you how this is. By experiment it has been found that at saturation point the Newell brake magnet can be lifted from the rails at fifteen hundredweight. Now compare this with the weight required to hold eighteen tons on 1 in 9.8—the car must run away if nothing else to depend on.

I now proceed to describe the mechanical track brake, and the way it operates upon the cars which have been working the Manchester road route for a period of two and one-half years with an entire absence of accident.

The hand wheel of the track brake has a diameter of sixteen inches—reckoning fifteen inches centre of rim gives a circumference of forty-seven inches. This wheel operates a screw of one-half-inch pitch (which is provided with a ball thrust to reduce friction), which is connected by pull rods direct to the swing lever in the centre of the car. The gear ratio between the hand wheel and the nut on the screw is 94 to 1. The floating lever in the centre of the car has a leverage of 5 to 3. The connection between this lever and the levers on the trucks is by rod and chain, and is not affected by the radial movements of the trucks on curves. The power is imparted to the track shoes by means of levers having a ratio of 3 to 1. Total leverage, 468 to 1.

The brackets (which are of cast steel) carrying the track shoes and the fulcrums of the levers are attached to the truck frames by means of steel angle and tee bars, which are bolted to the truck frames. The wearing parts of the shoes are of cast iron, and are easily renewed.

The brake is used as follows: on leaving the terminus at the summit the brake is screwed down sufficiently to allow the car to run the proper speed with the hand brakes off; the car is then controlled by the hand brake, which has about the same leverage as the track brake. When the car is stopped the track brake is eased off to allow the car to start, and then screwed down again as before.

For an emergency stop the rheostatic brake is used, and its effect is very efficient and will stop the car at six miles per hour on 1 in 9.8 in three yards or four yards.

Each shoe and lever to the shoe is independent, therefore the failure of one shoe or lever does not affect the remainder. Two shoes only will safely control the car. The track brake alone will bring the car down safely and make service stops, thus being a perfectly independent brake and additional to the ordinary equipment of the car. The shoes are easily changed, and last from ten to twenty-one days according to the weather. The dimensions of the shoes are fifteen inches long by three inches wide, and the wearing depth is one and three-eighths inches. When cast-iron slippers were adopted there were no data available as to the wearing effect upon the rail, but the accompanying section of the rails on the heaviest portion of the gradient clearly show that the wear on

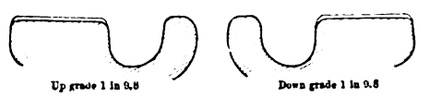


FIG. 4.—WEAR ON RAILS.

the down or braking side is less than the up or driving side.

Fig. 4 illustrates the wear on the rail after two and one-half years' service, and the passage of 81,655 cars.

Practically no sand is used on the down rail, even in greasy weather, and I may here state the meteorological conditions of Burnley are bad, the rainfall being greater than any other part of Lancashire except the lake district; moreover, the subsoil is clay, which accounts for Burnley being such a favorable district for weaving. The brake has recently been adapted to maximum traction trucks under the double-deck cars with equally satisfactory results.

Finally, I submit the following conclusions from our experience: Bogie cars are easier to control on steep inclines than four-wheel cars, whatever the character of the brakes. Magnetic brakes, particularly those which affect the wheel brakes, are unsuitable for tramways either for service or safety purposes. That they can only be considered as auxiliary to the rheostatic brake, and not as independent track brakes. That they are highly destructive to the motors. They are treacherous and uncertain in their action.

The only form of brakes which will safely control a car on gradients greater than 1 in 14 or 15 are: (*a*) hand brake with adequate leverage actuating cast-iron blocks on the wheels; (*b*) mechanical track brakes with adequate leverage provided with cast-iron slippers; (*c*) rheostatic brake for emergencies only.

Digitized by Google

New Electric Generating Station at Birmingham, England.

The new generating station erected at Summer lane, Birmingham, in connection with the electricity supply of that city was formally opened on October 10. It constitutes the third power-house belonging to the corporation, the others being situated at Dale End and Water street respectively. Both these latter stations are equipped with small units; in fact, although they contain no less than eleven generating sets each, their maximum combined output only amounts to less than 5,000 kilowatts. Such plant was manifestly inadequate for the supply for Birmingham, and the acquisition and electrification of the tramways by the corporation made it urgently necessary to provide a new and modern power-house.

A site was consequently acquired, bounded on one side by Summer lane and on the other by the Birmingham and Fazeley canal, and a power-house erected to the general designs of R. A. Chattock, the corporation electrical engineer. The main building comprises three bays—the engine house, of 100-foot span; the boiler house, of eighty-nine-foot span; and the economizer house, of forty-seven-foot span. Each bay runs the full length of the building, 275 feet. The switch gear is placed at one end of the engine room, and is consequently a considerable distance from some of the machines to be controlled.

The plant in the station has been put down to deal with four classes of supply: (1) A direct-current supply to consumers near the station at 220 or 440 volts, the distribution being on the three-wire system, with 440 volts across the outers; (2) A direct-current supply at 440 volts sent through trunk mains to Dale End and Water street generating stations, for distribution from thence; (3) A direct-current supply at 550 volts for the tramways in the vicinity; (4) A high-tension three-phase supply at 5,000 volts to the substations in the city. Altogether, the first equipment of the Summer lane station will consist of 7,000 kilowatts of direct-current plant, and 4,500 kilowatts of alternating-current plant, though the ultimate capacity of the station will be 13,000 kilowatts of direct-current plant and 13,500 kilowatts of alternating-current plant.

The generating plant now installed, or in course of erection, consists of four Belliss-Dick Kerr 1,500-kilowatt direct-current sets, two Belliss-Westinghouse 1,500-kilowatt alternating sets, three Belliss-Westinghouse 500-kilowatt alternating sets, and two 500-kilowatt direct-current turbo machines, built by C. A. Parsons & Company. The six large Belliss engines are exactly similar, and have cylinders twenty-five inches, 36.5 inches and fifty-five inches in diameter, with thirty-three-inch stroke. The direct-current sets run at 160 revolutions per minute, and the alternating-current sets at one hundred and sixty-six and two-thirds revolutions, the latter speed being required for a frequency of twenty-five to be obtained from the alternators. Steam is supplied at 180 pounds, superheated by 100 degrees to 150 degrees Fahrenheit. The engines are fitted with large fly-wheels, the total amount of stored energy being 3,400 foot-tons for the direct-current sets and 4,600 foot-tons for the alternating-current sets. The governors are capable of keeping the speed within two per cent of normal over a load ranging from *nil* to 1,875 kilowatts, or twenty-five per cent overload. As it is intended to supply power, lighting and traction current from the same three-phase bus-bars, the importance of close governing will be obvious.

The four 1,500-kilowatt direct-current generators built by Dick Kerr & Company, Limited, are compound-wound sixteen-pole machines, having their armature spiders extended and bolted directly to the fly-wheels of their respective engines. They will be run as shunt machines when on the lighting load; but the compound winding can be put into circuit from the switchboard when they are required for traction purposes. The two Westinghouse 1,500-kilowatt three-phase alternators generate at 5,000 volts twenty-five periods. They are of the standard Westinghouse engine-type design, with rotating fields bolted to the engine fly-wheels and excited by two 100-kilowatt General Electric exciters. The minor plant includes two motor-driven balancers of 100 kilowatts capacity for dealing with the out-of-balance current on the local lighting network; and two twenty-five kilowatt three-wire boosters to increase the pressure on the trunk mains to Dale End and Water street. These machines are capable of giving a boost of ten volts in either sense, and of dealing with a current of 2,500 amperes. Each set consists of a motor and two boosters for dealing separately with each side of the three-wire system. Besides these there is a 200-kilowatt motor generator which, together with the balancing and boosting machinery, has been constructed by the Phœnix Dynamo and Manufacturing Company, Limited. This motor generator has been installed for the purpose of supplying the tramway load from the lighting bars during the night, when the traffic is very small. It is intended to install a large battery with a reversible booster to equalize the load on the traction generators.

There are four switchboards allocated respectively to the control of the main generators, the tramway feeders, the trunk mains and the lighting feeders. These boards have been constructed by the British Thomson-Houston Company, and the switch gear is of this company's well-known type.

The boiler house contains ten Babcock and Wilcox water-tube boilers of the "land" pattern, each with a heating surface of 6,182 square feet, and fitted with a superheater of 898 square feet surface. The working pressure is 180 pounds. Each boiler has a chain-grate stoker giving a grate area of 100 square feet, and is estimated to evaporate 24,000 pounds of water per hour with a natural draught of three-quarters inch of water. Coal is received from the private canal basin, where it is thrown from the barges on to a twenty-four-inch band-conveyer. This delivers it into an Ingrey weighing and recording machine. After weighing it is elevated by one of the two bucket-conveyers, and delivered into hoppers in the boiler-house roof.—*Engineering*, October 12.

"Increasing the Standard of Illumination."

To the Editor of the Electrical Review:

Permit me to express my appreciation of your editorial on "Increasing the Standard of Illumination" in your issue of October 20.

In my opinion the present tendency of increasing the intrinsic brilliancy of light sources is one which should be deprecated. I am glad to note that you take the same view of the matter.

In your report of the discussion which took place on this subject at the October meeting of the New York Section of the Illuminating Engineering Society there is an obvious error. Referring to the intensity of illumination given by a ground-glass window on a bright day, you quote me as saying that this might be as low as one-fiftieth of a foot-candle. Obviously, the intensity of illumination in foot-candles would vary according to the distance of the point at which the measurement was made to the window.

What I said was, the intrinsic illumination in the case cited was less than one-fiftieth of a candle-power per square inch, which is far less than that of any of the light sources referred to in the paper under discussion.

L. B. Marks.

New York, October 20, 1906.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Piston Action of the Electrical Air Drill.

The more effective action of the electric air drill as compared with the simple compressed-air drill is explained here by Frank Richards. In the first place it is pointed out that the electric air drill has no valves—that its piston is actuated by the alternate supply of compressed air on each side directly from a small two-piston, motor-driven compressor. This arrangement is a simplification over the usual air-operated arrangement, as all the parts of the drill which usually give trouble and cost so much for repairs are eliminated. The compressors, the author suggests, should more properly be called pulsators, as they have no valves and no water jackets. The more effective blow of the electric air drill is due to the fact that the compressor piston follows up the drill piston and maintains an increasing air pressure throughout nearly the whole stroke, while with the compressed-air drill the pressure is a maximum at the start and dies out throughout the stroke. For this reason the blow delivered by the electric drill is more penetrating. Another advantage of the combination drill is its small liability to sticking. When a compresser-air drill catches, the bit must be loosened by hammering or by means of a wrench. The electric air drill, however, when it catches, is subjected to a rapidly alternating series of pulls and thrusts which nearly always loosen the bit before the operator can get a tool on it. This effect saves a great deal of time by not wasting it—*Abstracted from the Engineering and Mining Journal* (*New York*), *October* 13.

Chemical and Electrical Changes Induced by Light.

For some time past H. S. Allen has been engaged in an investigation of the fatigue shown by metals for the photo-electric effect. He has made a careful examination of the rate at which the photo-electric current decays in the case of a zinc plate polished or amalgamated. A large Nernst lamp supplied with current from storage cells is used to give a steady source of light. The decay immediately after exposure to the light was very rapid, but after about twenty minutes became much slower. For a change taking place according to the "compound interest law," as in the case of a mono-molecular chemical reaction or a purely surface effect, it is known that the curve can be represented by an exponential term involving the time. In the case of zinc the author found that the activity at any instant can be represented with considerable accuracy by the sum of two exponential terms. It is possible to interpret this result somewhat on the lines followed by Rutherford in explaining the decay of the excited activity of radium or thorium by supposing that a succession of changes takes place. Similar results have been obtained in the case of aluminum and also with specimens of colored fluorspar. It is interesting to note that the longer waves of light tend to produce a change in the opposite sense, so that the rapid decay at first observed on exposure to light may be followed by a small increase in activity, unless the long waves are absorbed by a solution of alum. —*Abstracted from Nature* (*London*), *October* 4.

An Electrical Anemometer.

An interesting method of constructing an electrical anemometer is described here by R. Goldschmidt. This device depends for its action upon the cooling effect of a moving current of air. A fine platinum wire is exposed to the wind, and through it is sent a small electric current. The latter heats the wire, thus increasing its resistance, and the final point reached will, if the electric current be constant depend upon the cooling action of the wind. The greater the velocity of the wind the greater this cooling action; and therefore the higher the wind velocity, the lower the resistance. To counteract the effect of changes in air temperature a similar strip of wire is placed in proximity to the other and exposed to the air, but protected from the wind. This strip then takes a temperature depending only upon the temperature of the surrounding air. These two wires form two arms of a Wheatstone bridge, and their relative resistances determine the deflections of a galvanometer connected in the bridge, which thus indicates directly the velocity of the wind. To calibrate the apparatus the exposed wire is supported by a vertical rod carried on a disc revolving about a vertical axis, the rod being placed somewhat eccentrically. By revolving the disc at various speeds it is possible to produce the effect of any wind velocity, and thus to calibrate the apparatus. The practical type of instrument is mounted on the weather vane, the one wire exposed to the air and the other protected from it. Both are protected from rain. The same device, as it turns, varies the position of a small brush on a horizontal circular wire resistance. This variation of position, by changing the resistance connected in a suitable circuit, indicates the exact direction from which the wind is blowing.—*Translated and abstracted from the Bulletin of the Société Belge d'Électriciens* (*Brussels*), *September*.

Determination of the Points of Transformation of Certain Steels by Means of the Electrical Resistance.

A brief summary is given here of an experimental research by P. Fournel into the relation between the electrical resistance of steel and the modifications of structure caused by a change in temperature. The resistivity of a steel submitted to an increasing temperature shows sudden changes at those temperatures which produce modifications in the constitution of the steel. This seems to offer a means of watching closely the behavior of steel due to temperature changes. In this particular investigation eight samples of steel were studied. These were in the shape of wire about 0.3 millimetre in diameter and thirty centimetres long. The wires were wound on a double tube of mica and heated within an electric resistance furnace. The resistance was measured by placing each sample in series with a standard ohm and passing through it a current of a few hundredths of an ampere. The fall of potential was measured by means of a potentiometer. The temperature was determined by means of a Le Chatelier thermocouple inserted between the two layers of mica. The temperature resistance curves plotted in this way showed discontinuities which enabled the author to identify the temperature at which the cementite is dissociated, and the transformation from the α state to the β, and

Digitized by Google

from the β to the γ. The temperatures at which these transformations occurred were different for the different samples, due to the different constituents which they contained. Cementite is dissociated at from 670 to 695 degrees centigrade. The change from the α to the β state took place at temperatures varying from 740 to 780 degrees. The presence of manganese influences this point greatly. The final transformation from the β state to the γ takes place at temperatures from 790 degrees to 880 degrees.—*Translated and abstracted from La Revue Électrique (Paris), September* 15.

The Value and Design of Water-Power Plants as Influenced by Load-Factor.

The effect of the load-factor is of great importance in determining the value and design of water-power plants. This is true also of steam plants, for it is difficult, says Dr. F. A. C. Perrine, to reduce the coal consumption to less than five pounds per kilowatt-hour, even with the most economical equipment, if the load-factor on the station be only thirty per cent. But this matter of load-factor often affects the hydraulic plant more seriously than the steam plant, though it is true that the adaptation of plan to load-factor is more often controllable in the design of the hydroelectric plant than in the design of the steam plant. When the load-factor is less than unity and a stream providing no storage is furnishing the energy, energy is wasted whenever the load is less than the maximum capacity of the stream. With sufficient storage a load-factor of less than unity may be served without waste of hydraulic energy, but sufficient storage to care for a load-factor of less than sixty per cent is rarely obtainable in large plants where the head is less than about 100 feet, because the quantity of water becomes too great to be stored in available basins. A correlative solution of this problem of design is found in the selection of the load itself. The problem of design then becomes one in determining rates, and is one which concerns indirectly the engineer as much as the design of the power-plant itself. After all has been done that is possible in obtaining the best possible storage it is often the case that there remains a residuum in the problem which may be economically handled only by steam or gas auxiliaries. The legitimate field for these expedients is now well recognized, and no hydraulic plant should be studied without giving them due consideration. In many cases of plants which have been installed the revenue is based upon an assumed load-factor of unity, and a charge for current made on the basis of the maximum customer's demand. This method of charging requires a rate lower than might be obtained by a different method of charging, since only those customers who can control their load-factor to a value close to unity can afford to enter into such a contract, and it is only justifiable where no means can be provided for handling a variable load-factor in the plant and where sufficient customers for utilizing all the power furnished by the plant can be obtained. An unsuitable load-factor is not necessarily one of low load-factor, but is one in which the curve of the load is different from the possible curve of output. Where the engineering of both plant and load can make the load curves correspond exactly the greatest possible output and revenue can be obtained from the plant. The common method of evaluating a water-power plant is to state its cost or value in terms of dollars per unit of capacity. This method of rating is only suitable where the supply possible from the plant is at a constant rate and the load-factor of the customers is unity. It is, in general, very false to reckon the value of a plant upon any other basis than that of its maximum output in kilowatt-hours, which is the true method of reckoning cost and determining the relative value of water power and other sources for obtaining power. A considerable number of plants already installed are valued solely on a basis of capacity, and they are charging their customers upon a maximum-demand rate. In a number of these cases an increase might be made in the revenue if a rate somewhat dependent upon the customer's load curve were adopted. The maximum-demand rate for charging is a low rate for charging and, in consequence, the valuation of a plant upon the basis of its capacity alone results in an undervaluation of a large proportion of hydroelectric opportunities. The true method of evaluating a hydroelectric plant is dependent upon its competitive value in the territory, and this requires that it be done upon the basis of the total number of kilowatt-hours which may be generated and sold. It is not reasonable to develop a hydroelectric station when a steam or gas station could be built which would supply the same territory at a less amount of cost, but it is also unwise to condemn a hydroelectric development because the cost per unit of capacity is high, when, at the same time, it can develop cheaper power than can be done in any other manner.—*Abstracted from the Journal of the Franklin Institute (Philadelphia), October.*

The Power Plant for the Simplon Tunnel.

In this description of the electrical equipment of the Simplon tunnel railway some particulars are given regarding the two power-houses for supplying power to the railway. The station at Brigue contains two Escher-Wyss hydraulic turbines fed by water from the river Rhone, the water being conducted to the power-house by means of canals 5,000 feet long. Each turbine is rated at 500 horse-power and rotates at a speed of 160 turns per minute, the effective height of the fall being about 140 feet. Both turbines are mounted on one shaft, to which is coupled a 1,200-horse-power, three-phase alternator. This machine delivers current at 3,300 volts, 160 cycles per minute, and is of the revolving-field type. The two turbines are not equipped with any regulating device, and it is necessary, in the absence of a governor, to adopt a special arrangement in order to avoid dangerous rises in speed when the load goes off the generator. The plan adopted is to maintain constant full load on the alternator, which is accomplished by means of a liquid resistance which regulates automatically the output of the machine. This regulator consists of a tank of concrete, in which are plunged two iron electrodes. An automatic device controls the position of these electrodes in the liquid and in this way maintains the load constant. The switchboard at this station is very simple, and consists of three panels, one of which contains the regulating and measuring apparatus; one, the generator appliances, and the other the light and power for the station. A circuit-breaker is placed in the main generator line. The Iselle station utilizes the water of the Diveria river, and is very differently planned from the other station. The effective head of water is about 450 feet. Two centrifugal turbines, each rated at 750 horse-power and revolving at a speed of 960 revolutions per minute, are installed. These two turbines are coupled to the two ends of the shaft of a high-speed alternator. The construction of the latter resembles that adopted for the steam-turbine drive. The whole group is carried on two bearings and is lubricated by oil circulated under pressure. The speed of the turbines is controlled by a very sensitive governor which actuates the regulating mechanisms by means of oil under pressure. Each station supplies one section of the tunnel, but the two lines may be coupled together at the centre if this becomes desirable.—*Translated and abstracted from L'Éclairage Électrique (Paris), September* 29.

Digitized by Google

Street Railway Week at Columbus, Ohio. Convention of the Railway, Engineering, Accountants and Claim Agents' Association, and the Manufacturers' Exhibition, October 15-19.

American Street and Interurban Railway Engineering Association.

MONDAY MORNING SESSION.

THE first session of the American Street and Interurban Railway Engineering Association was called to order Monday morning, October 15, at 11:15 o'clock. The meeting was held in the central convention hall, which forms building No. 5 of the exhibition buildings at the State Fair grounds.

President H. H. Adams, of Baltimore, Md., introduced E. C. Spring, president of the Central Electric Railway Association, one of the principal offsprings of the American Street Railway Association, which was started in 1882. Mr. Spring addressed the meeting briefly in behalf of the street railway men of the middle western states.

The next speaker was James H. McGraw, president of the Manufacturers' Association. Mr. McGraw, in behalf of the manufacturers, outlined the work which had been done with a view to completing the details for the immense exhibit, and pledge the support of the manufacturers in the work of the reorganized association.

John I. Beggs, first vice-president of the American Street and Interurban Railway Association, then addressed the convention. Mr. Beggs stated that, in his opinion, the engineering association was the one upon which depended, in great measure, the success of the affiliated associations. The men who, all along the line, are doing the work—the masters of way and the engineers—are those upon whom the managers must depend.

President Adams then delivered his annual address. He called attention to the work of the executive committee of the parent association, and outlined the steps which have been taken toward reforming and reorganizing the affiliated associations. He called particular attention to the work that had been accomplished through the standing committees, and asked for concentration on the subjects of standardization and insurance. The standardization committee, he said, has been doing a vast amount of work, but it is not the intention of this committee to solve the problem in one jump, but to attack each problem in a systematic manner, in order to lay a firm foundation upon which to work. The committee has met with a liberal response from the various roads, but it is hoped in the future that the response will be even greater. At the present time it has under consideration the brake shoe, wheel tread, flange, journal, journal box and rail section.

W. B. Brockway, president of the Accountants' Association, then addressed the convention briefly, after which the report of the executive committee and the reports of the secretary and treasurer were read.

A committee on resolutions, to consist of G. J. Smith, Kansas City; Charles Hewitt, Philadelphia, and E. W. Olds, Milwaukee, was appointed.

The meeting was then adjourned.

MONDAY AFTERNOON SESSION.

The Monday afternoon session was called to order by President Adams at 2.10 o'clock. The Hon. W. Caryl Ely, president of the parent association, was introduced. Mr. Ely made an earnest plea for concentration along the lines of reorganization. He pledged the entire support of the operating companies, and expressed his appreciation of the manly way in which the engineers had taken hold of every problem which had confronted them. He counseled moderation in all things, and emphasized the importance of each of the representatives of the companies taking back to their home places the evidence that attendance at the meetings was a source of instruction, and that in no direction could the expenditure entailed be considered wasteful.

President Adams thanked Mr. Ely in the name of the association for his remarks, and then called for the report of the committee on control apparatus. This was presented by J. S. Doyle, superintendent of car equipment, Interborough Rapid Transit Company, New York city, as chairman of the committee. This report was devoted mainly to notes on the use of multiple-control. Both the General Electric and the Westinghouse companies have continued to develop this type of apparatus in respect to the reduction of weight and the number of parts. The pressure allowable between the contact points of the switches has also been materially increased. This latter development may be said to be the greatest improvement accomplished. Progress has been made by each of the manufacturing companies on control apparatus for heavy railway locomotive work. Single switches having a capacity of from 1,000 to 2,000 amperes have been developed, but inasmuch as these locomotives have not as yet been placed in regular service, this subject will have to be deferred until the next meeting.

G. J. Smith, Kansas City, stated that the Metropolitan Street Railway of Kansas City has in service and has had for three months past, thirty cars, thirty feet seven inches over corner posts, with type M multiple-unit control operating as a single unit. From present indications the results will be so far superior to the platform controller, that the management is considering installing the type M control on 120 of the same type of equipment, and doing away with the platform control; that is, from the standpoint of panics created by controllers operated on platforms.

At times the motors are taking 800 amperes at 575 volts, and the average amperage on the Troost avenue division is 153, on ten seconds' reading. That current is too heavy to handle on the platform without danger of having not only the automatic openings, but the controller short-circuiting and causing a panic on the car.

E. W. Olds, Milwaukee, stated that the Milwaukee Railway and Light Company last year put into service fifty cars with the contactor in series. The contactor itself, in throwing off the current, opens a little ahead of the controller. The cars first equipped with the controllers caused a little trouble on account of mechanical defects in the construction of the control circuit-breaker but this has been remedied. Should a short-circuit occur in operation on any platform controller, the motorman can at once throw his handle to a position which stops the fireworks. The work that has been done by the manufacturers to reduce the size of the type M and pneumatic control has been very satisfactory.

His company is also placing individual fuses for each motor; should a short-circuit occur on any one of the motors, the fuse protecting that motor would blow. With the old type, very often, should a short-circuit occur, the arc would start, which, on account of the resistance, would cut down the current so that the circuit-

Digitized by Google

breaker main fuse would not blow, but the fireworks would continue.

H. H. Adams added a word in connection with the same type of control. The first part of the year his company put in service forty four-motor equipments on cars that are thirty feet eight inches over corner posts, weighing about 49,000 pounds, with four sixty-five-horse-power motors. At the same time they put in service 160 equipments of four-motor cars, weighing about 45,000 pounds with four forty-horse-power motors. These equipments had the K 28-b control, the first having type K 28-f control. They have had excellent results with the K 28-f, or the contactor combination. The cars have been in fairly heavy service during the past summer.

F. E. Case, of the General Electric Company, Schenectady, N. Y., said he believed the so-called multiple-unit control is well adapted to cars say of 200 horse-power or thereabouts; above this size the ordinary cylinder control becomes somewhat bulky. The chief claim for the control is that it is located under the car. It not only provides a greater factor of safety so far as not arcing, or anything of that sort, causing actual damage, but it also removes the arc to a point where the passengers will not notice it, should any such arc occur. In connection with the type K 28-f controller in which contactors are used under the car some cars have been equipped in addition with an automatic switch or circuit-breaker located in the vestibule, which will open the control circuit when an excessive current flows. This will permit the contactors to drop and operate as a circuit-breaker. At the same time, these contactors operate each time the controller is turned to the first point. In many of the equipments which have been furnished, not only does the control open on the first point, but also during the transition from series to parallel in the multiple-unit control both for single cars and for trains. His company has been working along the line of securing more efficient apparatus and has succeeded in increasing the pressure at the contacts.

Paul Winsor, Boston, Mass., stated that the Boston Elevated is experimenting with two cars coupled together, using an extra set of contacts, extra contact plates in the reversed circuit on the off position. The two cars are coupled together permanently with a slide draw-bar, which does away with the scrapers and platform controllers between the cars; and with the extra set of plates on the off position of the controller, they are enabled to control from the front platform two motors on each car with three wires between the cars. The multiple controllers are giving very good satisfaction.

President Adams asked Mr. Case if he had been able to get the multiple-unit control reduced in size and weight for the single car equipment.

In reply Mr. Case said the weight has been gradually reduced during the last few years. With the very early equipments the contacts were brought to about twelve inches space, with thirteen contacts. This was finally cut down to less than one-half, and all of the contactors were placed in three boxes as a first step. As a next step, all of the contactors were placed in a single box, completely wired up ready for installation. This did not materially reduce the weight, however, except that there was no necessity for providing cleats on the bottom of the car for supporting the wires; the wiring itself was greatly reduced on that account, and the expense of installing also went down.

William Cooper, of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., said he quite agreed with the remarks made by Mr. Case in regard to the general subject. The point of getting all of the higher voltage wiring, all the main circuits, under the car and keeping them off the platform, seems to be the main consideration. His company has developed a controller which is small enough to go on almost any car. It has a capacity of two 100-horse-power motors, or even more. It is calculated to run it up to about 300 horse-power total. A controller sixteen inches long, fourteen inches wide and about fifteen inches deep weighs from 300 to 325 pounds. This seems not to be an excessive weight or size for almost any car that it might put it on. Of course there are some considerations which go with it as far as location is concerned. For smaller equipments, a switch screw, as it is called by itself, is used. For larger equipments, when they run up to, say, four seventy-five-horse-power motors, there is added what are called line switches for safety, and also as a part of the combination in the controller circuit. The largest installation made with that size controller is four ninety-horse-power motors. In that case two separate line switches are used and they are of about the same general construction, with one switch in each box, and weigh sixty pounds apiece. There seems to be quite a demand for control apparatus to go under cars for all sizes of equipment, and, of course, it will have to be met.

The next paper, entitled "Ties, Poles and Posts," was read by C. A. Alderman, chief engineer, Cincinnati Northern Traction Company, Cincinnati, Ohio.

Ties constitute nearly one-third the total cost of the material for the construction of the modern interurban track, exclusive of ballast and roadbed. Their selection and use is therefore a matter of special concern from the fact that their life is short and constant renewals must be made. Poles are of somewhat less, although of very great, importance in the make-up of the material account of the road. Posts for the road built on a private right of way form quite an important item in the cost of construction and maintenance. The author gives the specifications for standard cross-ties worked out by the Cincinnati Northern Traction Company. Ties purchased under these specifications are costing from sixty-five to seventy cents delivered at convenient shipping points in Ohio and Indiana. Tie inspectors are located at the shipping points, and all ties are accepted and classified before shipping. The greater part of these ties come from Kentucky, and some from southern Idaho. The chemical treatment of ties with preservatives is becoming an important industry in the United States. Tie preservation is to-day being scientifically investigated and practised by nearly all of the leading steam railroad systems of this country. The various methods for the treatment of ties are as follows: creosote, chloride of zinc, zinc and tannin, and zinc and creosote. The treatment of ties with creosote of the dead oil of tar is acknowledged by all authorities on the subject to be the best, but it is also the most expensive. The author's experience with fence posts has been that a good grade of red cedar is about the best that can ordinarily be obtained. Black locust is said to be, and undoubtedly is, the best timber that can be found for posts, but it seems to be a hard matter to get it. Concrete for ties, poles and posts has been proposed and used to a limited extent by a few. The author's own idea is that concrete is not very well adapted for use as a railroad tie, but he sees no reason why it should not be a success in trolley poles or fence posts. The greatest objection to the concrete post is its weight. Concrete posts have been used to quite an extent and are no longer an experiment. Undoubtedly steel cross-ties will be used to quite an extent as soon as timber advances in price, say, ten or twenty per cent. There are now in the United States about 200,000 miles of railroad, which with second track, sidings and yard tracks all added, will aggregate over 250,000 miles. This 250,000 miles of railroad requires 660,000,000 ties. The average life of a tie untreated is not over eight years. This means that 82,000,000 ties are required annually for renewals, or the timber from half a million acres of forests.

F. G. Simmons, Milwaukee, Wis., said that the life of a wooden trolley pole is dependent almost entirely on the action of decay at the ground line, and he thought that if a post is subjected to a preserving process which will carry to or slightly above the ground line, the objection as to its conductivity from the trolley down will be overcome. In Milwaukee they are setting poles in concrete, right straight through, and in placing the concrete it is brought to or a little above the ground line, with a collar two or three inches in depth and about an inch in thickness all around the pole where it projects above the ground, forming a channel which is later filled with paving cement or tar mixture.

A. B. Lambe, Toronto, described some concrete pole work being done at St. Catharine, Ontario, where there is a very deep valley running through the centre of the town across which a 20,000-volt line is going. In order to save going down and following the contour of the ground it was decided to put up two 150-foot poles, built of reinforced concrete. The poles are, roughly, about two feet square at the base and taper with a slight bevel on the corners, and weigh somewhere about fifty-five tons apiece. They were

Digitized by Google

built on the ground horizontally, and then raised by means of a derrick. The first one was broken putting it up because they did not pick it up at enough points, but they remedied that afterwards. Two poles are now up and so far are doing very satisfactory work.

G. H. Kelsey asked for information concerning the probable life that is being obtained in traction work from cedar poles, seven-inch, forty-foot, spaced possibly 100 feet apart. He has several miles of such construction that is now six or seven years old and several miles which is two or three years old. In figuring a steel tower it is quite important to know how long the cedar poles are lasting or how long they will last.

In reply G. F. Smith stated that during the past summer he replaced nine miles of white cedar poles, spaced 100 feet apart, that had been in service thirteen years. That is in the western end of Missouri.

F. G. Simmons stated that he has about ten miles of road in which the poles were placed between eight and nine years ago, white cedar poles, spaced a little over 100 feet apart, and on a recent inspection about six or seven per cent of them only showed a necessity of replacement on account of rotting at the ground line. These poles were placed without any protection at the base. He has another line, much shorter, in which the poles were placed without protection at the base, and these poles show no deterioration at the ground line after eight years.

E. J. Dunne stated that with good sound first-class cedar poles, the average life would run from fifteen to twenty years. He has taken them out of the ground when they were twenty-five years in service, and found them in fair condition. That would not apply, however, to street railroad work, but this refers to poles on telegraph lines. It may not be safe to let them stay that length of time for side pole suspension, but it is safe to say that one could get good white cedar poles which would be good for fifteen or twenty years. In other words, the wooden pole is double the life of the iron pole. That is his experience. He has had some experience with the concrete butt, and thinks it is all right for bracket suspension. A good pine pole, with a concrete butt, he thought would be a good substitute for cedar.

The paper entitled, "Ballast," was read by Charles H. Clark, engineer of maintenance of way, Cleveland Electric Railway Company, Cleveland, Ohio.

The author describes particularly the method of ballasting used by the Cleveland Electric Railway Company. In Cleveland the greater portion of the underlying foundation is composed of sand, some of which contains a large percentage of loam. In the sandy streets, before laying the tracks, the trench is puddled. This is done by building earth dams and flooding the trench with city water. As a general rule this will cause a settlement of the original earth of from three to six inches. In clay and shale, where sewers have been constructed and the tracks must be laid immediately, the practice is to excavate the clay or shale to a greater depth than will be needed for ballast and partly fill with sand, and then cause the sand to be settled into the voids by liberal use of water. The simplest way of tamping track is to use the material thrown out of the trench. Tamping bars are used on gravel and sand, and tamping picks on broken stone. Tamping bars are also used on concrete under the ties and under the rail. Another type of construction used by the Cleveland City Railway Company previous to 1903 was to lay four inches of concrete on the bed before laying the ties. This was then covered with one inch of sand and the ties tamped with the sand. The space between the ties was then filled with concrete and sand laid on top for the paving bed. Steel ties have been used with great success by the Cleveland company on some of the heaviest lines. The Lorain Steel Company's ties were laid every ten feet, alternating with a wooden tie spaced the same distance. Eight inches of concrete was laid under the steel ties and four inches under the wooden ties, and a beam ten inches deep under and along the rails. The author considers that the steel tie laid in concrete is cheaper than the white oak tie laid in concrete or broken stone. This is on the assumption that white oak ties cost eighty cents apiece. The life of the steel tie can be placed at twenty years, and the white oak at about twelve years. In repairing old tracks the author has found that the concrete which has been laid for four or five years was very poor. It has been his practice not to make any but first-class one-three-six concrete. This may cost more than the concrete that would pass city inspection, but in the long run it will be found that the best is none too good for the company. In conclusion, the author recommends that drainage pipes be placed in clay soils and in all wet, sandy soils, and that when the traffic can be kept off the track that a solid foundation of concrete, made in the proportion of at least one-three-six, with best Portland cement, be used. The concrete should be brought up to within one inch of the bottom of the pavement. The first cost of this foundation may seem large, but the annual maintenance cost thereafter will be greatly reduced.

F. G. Simmons said that he believed that in using concrete construction the twelve years ordinarily designated as the life of the cedar tie has been overcome; that the concrete preserves the wood of the tie whether white oak or cedar, to such an extent that its life becomes almost indefinite. He has taken up track that has been laid under almost similar conditions to that described in this paper, where the cedar ties have been in sixteen and eighteen years, and placed back into the construction anywhere from forty to sixty per cent of the same ties, encased again in concrete.

C. A. Alderman said that in central Ohio during the past few years they have been inclined to believe that concrete under ties was not the best thing to use. It is his belief regarding the situation as affecting interurban traffic. He feels that concrete under ties is an almost impossible proposition from the standpoint of getting good permanent track. The different companies he has been connected with have been quite uniform in their conclusion that a well-ballasted track with something besides concrete was the best thing either in city streets or in the country. They lay the concrete wherever necessary, of course. Concrete for heavy interurban cars weighing 70,000 pounds, and going at a high rate of speed, is not an easy thing to get in in such shape that it will not break up, and when it breaks up it becomes loose, disintegrates, and it is not much better than using so much ashes under the track. It is a very hard thing to get a track laid with as little as six inches of concrete under the rail, and have it so that it will stand the traffic of interurban cars coming into the city. Several cities in this neighborhood have specified gravel and broken stone for ballast, and have discarded the concrete. The city of Dayton allows nothing but T rail, with gravel or broken stone ballast. Indianapolis is not quite as pronounced as that, but they are laying a great deal of track there with gravel and broken stone ballast. They are starting it now in Columbus, although they are not allowing the two things to go in at the same time—if you lay T rail they tell you to put in concrete ballast. If you lay girder rail they will sometimes allow gravel. The city of Cincinnati is experimenting with track laid on broken stone ballast and nearly all of the smaller towns through which the interurban cars pass are allowing gravel ballast to be used instead of concrete.

C. H. Clark asked Mr. Alderman what the proportions are in the concrete he used in Columbus.

Mr. Alderman gave the proportions 1-2½-5, Portland cement, the city specifications being one-two-four for natural cement, and one-four-eight for Portland cement.

Mr. Clark stated that he had had a great deal of experience in the use of concrete, having built a large dam sixty feet high, and that had stood well, and the proportions were one-three-five. He does not believe concrete will be pounded up if the right proportions are used. If concrete is made carefully it will not disintegrate.

E. B. Kirk, of Oshkosh asked Mr. Alderman if he believed in using thin gravel to fill the voids in his crushed rock and whether he had found in using crushed rock of one and one-half-inch size, the subsoil does not work up into the void?

Mr. Alderman said the only cases where he has had to use broken stone has been in the northern part of the state. All through the central and southern part of Ohio excellent gravel is secured and it is considered as good or better than broken stone. If it is absolutely necessary to use broken stone he thought the idea of using gravel with it is very good. The usual thing is to use broken stone where gravel can not be found and use gravel where it is found. Any ballast, of course,

Digitized by Google

is liable to mix with the soil underneath it, and that is the great trouble with the road, to keep it so that the ballast will stay there after it is placed there. In a well-ballasted track, however, in city streets, he does not find that the gravel or broken stone pounds down into the soil as much as it does on grades outside.

F. G. Simmons said that while admitting the force of Mr. Alderman's arguments as to using a loose ballast, he believed that the efficacy of a concrete ballast is a matter of workmanship. He has had construction six inches under the ties, filled up between the ties and up to a point where the pavement is superimposed with an inch cushion of sand on the concrete, that has been in nine years, and it has not been looked at. He tries to have his concrete mixed of a combination of one part best Portland cement, two and one-half parts of sand, and five parts of rock, and with this mixture and keeping the cars and all traffic off of the tracks for six or seven days, so that the concrete will have enough time to properly settle, there will be no trouble with the construction afterwards. That also presupposes the proper treatment of the foundation below the concrete. He excavates on city streets, and digs a trench; rolls the foundation with heavy rollers, or tamps it with tamping bars, or floods it and is sure the foundation has settled to as great an extent as it is possible to make it before the concrete is superimposed on it.

The report of the "Committee on Maintenance and Inspection of Electric Equipment," was read.

The reliability of operation and economy in maintenance of electrical equipments are dependent primarily upon the selection of apparatus to meet the conditions of service. The committee's report consists principally of a description of the system of maintenance and inspection introduced by the engineering staff of the Interborough Rapid Transit Company, New York city. This company is to be credited with taking the initiative with respect to reducing fire risks on electrically equipped cars, both in semi-fireproofing the wooden type through the use of composite board and asbestos, and also in providing an all-steel type of car. The company has introduced a merit system among the shop force, which has reduced the cost of labor 31.7 per cent on the Manhattan division and twenty-nine per cent on the subway division. This system provides for an itemized comparison of the cost of labor and material among the five inspection shops each month, together with a bulletin showing the number and character of delays to service, from all of which the ability of the various foremen and inspection force is determined. The object of this is to constantly maintain an efficient inspection force. The most competent foremen receive an increase in salary, and the incompetent are either decreased in rank or dismissed from the service. The inspection and overhauling of equipments have both been placed on a mileage basis. The old method was to inspect the cars every three and one-half or four days. Upon investigation this was found to give an average of 450 miles per car. Through a series of experiments it was found that this mileage could be increased to 1,000 without affecting the reliability of service. The average mileage of general repair cars in service during a period of from twelve to fourteen months under the old system was found to be 53,000 miles, and the maximum 90,000 miles. It was decided to adopt an average of 65,000 miles between general repairs. The items of oiling motors, journals, compressors, etc., together with the wear of carbons, brake shoes and other parts, are based on mileage comparisons. In addition to these alterations the Interborough company is at present experimenting with a piecework system for the purpose of providing a means for increasing the employés' wages, thus obtaining a better class of men and also effecting further economies. So far this has proven very satisfactory, for the amounts paid the employés affected have increased on an average ten per cent, while the cost of the work has been reduced twenty-six per cent.

Mr. Winsor in reply to a question concerning the recording of mileage, said that on the surface cars he has the night starters at the various stations keep the mileage. They use the register sheets for that purpose. His fare register sheets are made up by car numbers, following that car through the various routes that it runs during the day, so that by knowing the number of trips it ran on each route and referring to a mileage table of routes, he can very easily make up the figures. Then, he carries, by a system of cards, the car number on a car. He enters down each day the mileage made that day and the total to date, and sends those cards every morning to the car-house foreman, having checked on each card the cars that have run about the mileage or run up to the inspection mileage.

J. S. Doyle stated that on his equipment the armature bearings are oiled every thousand miles irrespective of time and the motor axle and journal bearing are oiled every ten thousand miles.

TUESDAY MORNING SESSION.

President Adams called the meeting to order at 10.20 o'clock on Tuesday morning and requested J. M. Larned, Pittsburg, Pa., to read the report of the "Committee on Standardization."

After a careful consideration of the subject it was decided to confine the work of the year to the standardization of brake shoes, flange and tread of wheels, rails, journals and journal boxes. Data sheets and circular letters have been sent in duplicate to over 800 street and interurban railway companies, to be filled out and returned with accompanying drawings and sketches. A considerable number of the data sheets on brake shoes and on flange and tread of wheels have been filled out and returned with sketches and suggestions as to proposed standards. A number of the data sheets relating to rails and to journals and journal boxes, together with accompanying drawings and sketches, have also been received, although it was not practicable for the committee to issue these data sheets before the middle of September. The information obtained by means of these various data sheets must be carefully collated and summarized in order to make it practicable for the committee to properly use them. The drawings and sketches must also be studied and new ones made up which embody the recommendations of the various companies. This means a large amount of detail work on the subjects now under investigation, which must necessarily devolve upon the standardization committee during the coming years. It therefore does not appear to the committee to be advisable for the association to undertake much new work in the standardization of equipment at the present time. The committee recommends that the association decide to add the standardization of motor parts to the work of the Standardization Committee for the coming year. It is also the desire of the committee to emphasize the necessity of standardization of equipment. Owing to the extensions and consolidations which are constantly taking place in the various railway systems, an interchange of cars and equipment will ultimately become necessary, and it is the hope of the committee that the companies which have not already returned the data sheets will give them prompt and careful consideration.

Fitz-William Sargent stated that as a manufacturer of brake shoes, he has had some experience in the various designs of brake shoes that are used throughout the country and it is very evident that there is a tremendous waste and expense incident to the present practice in regard to brake shoes. He referred particularly to the difference in patterns. A large number of roads use the combined head and shoe, weighing all the way from thirty to fifty pounds, and scrap it when less than half worn out, and that is a loss, especially where high-priced shoes are purchased.

There are a number of roads in this country, principally in the west, which are following closely into the lines of the steam railroad practice, and are using a separable head and shoe known as the Master Car Builders' Standard in steam practice, and that is in the line of the greatest economy in brake shoe maintenance because that shoe has the metal so disposed that you get the maximum material for wear and the minimum for scrap.

The secretary read a communication from the Central Electric Railway Association recommending the following standards:

Brake Shoes—We recommend the adoption as standard of what is known as Master Car Builders' standard type of brake shoe, brake head and key.

Journals and Journal Boxes—We recommend the adoption as standard for journals and journal boxes the Master Car Builders' adopted standard so far as applicable to motor trucks for axle journals, known as 3¾ x 4¼ x 8 and 5 x 9. We further recommend the adop-

Digitized by Google

tion as standard for these different sizes of axle journals the Master Car Builders' adopted standard journal boxes, journal bearings and journal bearing keys.

Tread and Flange of Wheels—We recommend the adoption of a wheel-tread three inches wide with flange seven-eighths-inch high and one and three-sixteenths-inch thick at the throat for both city and interurban work.

Rails for Street and Interurban Railways—We would recommend the adoption as standard of what is known as the "T" form section of rail for both city and interurban work.

President Adams suggested that the matter be turned over to the committee and there was no objection.

Thomas K. Bell, Philadelphia, Pa., said that as a matter of fact and record, we are to-day using from five-eighths to three-fourths-inch depth of flange and a greater depth; in other words he should say that the average flange throughout the street railway proposition in this country is very close to seven-eighths depth. Along with that there is possibly only four or five girder rails that are rolled by the combined girder mills of the country to-day, that are really suitable for a flange any more than three-fourths-inch in depth. If the gentlemen will stop to consider that part of the proposition, they will find that the question of wear, the life of the rail, brings the head of the rail close to the trams in a very short time. As a tram rail, there have only been one or two sections placed in the market within the last year or eighteen months. In regard to the question of guard-rails, there is not a guard-rail to-day rolled that will accommodate a seven-eighths-inch flange in a forty-two-foot six-inch radius, with a seven-foot six-inch wheel base, without planing that groove. That has brought on the buyers an additional expense. They pay more for their special work, the cost of the planing of the rail, and the rails themselves are destroyed after having the original rolling scales planed off. There is to-day a crying necessity on the part of the street railways of this country to get together on the question of the adoption of a suitable design of rail, and insist on the rolling mills of this country getting them out. That is one of the most urgent things.

After considerable further discussion President Adams appointed a committee to get up resolutions and submit them on Wednesday afternoon, this committee to consist of Paul Winsor, G. J. Smith, W. H. Evans, Thomas K. Bell and John S. Doyle.

The next paper, "Gas Engines", by Paul Winsor, chief engineer, motive power and rolling stock, Boston Elevated Railway Company, Boston, Mass., was read.

This paper deals with the experience of the Boston Elevated Railway Company in operating two gas engine substation plants. The author considers that a gas engine will hold its efficiency much better than a steam engine. The water required is considerably less for a gas plant than for a condensing steam plant, and considerably more than for a non-condensing steam plant. The only two serious troubles have been premature explosion and back-firing in the engines and noisy exhaust. Both plants are small, one of 700 kilowatts, and the other of 975 kilowatts capacity. Both equipments are operated on producer gas, and the average engine load-factor has been about seventy-four per cent. As a result of the author's experience with these plants he is convinced of the economy and reliability of a gas-engine power station. The fuel consumption will be about one-half as compared with a steam plant, running from 1.5 pounds to 1.75 pounds, according to the load-factor, and almost regardless of the size of the plant. The cost of the gas plant, including producers, is undoubtedly considerably higher than the cost of a similar-sized steam plant, and whether the fuel saved will justify the increased capital depends on the price of coal; but it seems that with coal at $3 and upwards per ton there will be a material net saving by the use of gas.

After reading his paper Mr. Winsor discussed in detail the securing and utilizing of various characters of fuel gas. In reply to a question concerning regulation Mr. Winsor stated that with the direct-current apparatus he used there had been no difficulties whatever.

H. M. Benghler stated that he had operated a 1,400-horse-power, four-cylinder gas engine very successfully with a three-phase, sixty-cycle alternator. In parallel operation with a steam unit there was no trouble.

Edwin Yawger suggested that the whole subject seems to line up in this way: That gas engines are at the present time to be looked upon as desirable in special locations; where coal costs $3 and upwards per ton, where water is scarce and other conditions like the saving in copper, etc. Of course the cost per horse-power of the gas engine is bound to be a good deal more than the cost of a steam engine unless we learn to make gas engines a great deal lighter per horse-power than we do now. The weight in a large engine will run about 500 pounds per horse-power and the price of coal seems to be about the same as it has been and the cost of labor is not getting cheaper, so that he does not see where there is going to be any great thing in that unless it is in a change in design.

The next paper, entitled "Underground Cables," by Henry G. Stott, was read.

Higher voltages than 25,000 have not been attempted as yet in underground cables, but there seems to be no reason why a voltage of 44,000 should not be used with exactly the same degree of safety as 25,000, provided a star-connection be used in the transformers and the neutral point be grounded, for then the maximum strain is limited to 25,000 volts to ground. For economic reasons rubber insulation is used only where local conditions seem to demand an insulation which is impervious to moisture, so that in case the lead sheath should be punctured the cable will not necessarily fail. As an instance, where cables have to be installed in ducts which are under water part of the time, or for submarine cables, the extra investment for rubber insulation would seem to be justified, as in the event of a leak in a submarine cable lead sheath it usually becomes a total loss if insulated with paper or other non-moisture-proof material; whereas good rubber will last indefinitely under water. For potentials above 22,000 volts it seems likely that some form of varnished cambric or impregnated cloth will take the place of paper, owing to its higher puncture resistance for a given thickness. But experience with working pressures above 22,000 volts is so limited that we must wait for some time before any definite conclusions can be reached. The most satisfactory solution of problems of avoiding electrolysis and saving the lead sheaths of cables from destruction seems to be in the use of an insulated negative bus in the power-house and substation, and insulated negative feeders right up to the track rails. For this purpose the negative feeder should preferably be insulated with some material which does not require the use of a lead sheath. The ideal solution of the problem will be found in the use of feeders without lead sheaths, and such tests are now being made on experimental lengths of 650-volt cable of this type; but it does not seem probable that any cable can be constructed at present which will safely stand being drawn into wet ducts and manholes and used continuously on pressures above 2,000 volts without the protection of a lead sheath to keep out the moisture.

W. Boardman Reed, New York city, called attention to the necessity of giving particular attention in laying duct systems to secure good alignment and a smooth interior.

Mr. Winsor stated that he had had a great deal of trouble with return current on the lead sheath and had a cable burn out and it would turn up in neighboring ducts, and ducts some distance away, the heavy return currents burning the leads out at bonds where they touched and had a good ground. This was so serious that in almost all cases now he cuts a lead sheath an inch or two off each side where it enters—breaks the continuity of the lead sheath.

Regarding cable testing H. W. Latey, New York, said that about the only tests he makes on the direct-current cable is the voltmeter insulation resistance test. He is getting the insulation resistance by means of a 700-volt voltmeter. The high-potential cables, he believes are not tested periodically. He has to test them occasionally on changing connections and in the case of breakdowns, and that is about the only test so far as he knows that the cables are getting.

TUESDAY AFTERNOON SESSION.

President Adams called the meeting to order at 2.30 o'clock, and asked for the first paper, "Relative Economy of Turbines and Engines at Various Percentages

Digitized by Google

of Rating," by Walter Goodenough, engineering department, Stone & Webster, Boston, Mass.

The author considers that it is becoming evident that what is needed in the power station is not so much more economical prime movers, but rather more intensive operation of the particular type of machinery which may be installed. The author gives a number of tables and a series of curve sheets showing costs per kilowatt-hour and taking into consideration interest, depreciation, maintenance and taxes, cost of engine and generator, condensing apparatus and foundations, cost of turbine, generator, condensing apparatus and foundations, together with motor-generator apparatus and switchboards per kilowatt.

H. W. Latey stated that during the last year Mr. Stott has been making some tests on the Fifty-ninth and Seventy-fourth street plants in New York city, and finds that there is a very marked economy on running on an under load, that is, a 5,000-kilowatt unit operating at considerable underload will operate cheaper than it will on the rated load of the machine; that is, the engines are apparently designed for a fluctuating load, with the engine underloaded rather than overloaded, and it is losing economy, a little bit, on running up on a load that carries a practically steady load as is got in the rush hours at those power-houses.

The committee on nominations was appointed, consisting of W. B. Reed, New York; D. F. Carver, Rochester; H. B. Fleming, Chicago; M. O'Brien, St. Louis; and Alfred Green, New York.

The next paper, entitled "Economy in Car Equipment, Weights and Schedules," by E. H. Anderson, Schenectady, New York, was read.

N. W. Storer said that one of the greatest features in selecting motor equipments for successful operation is to get the right reduction for the motor. There have been thousands of dollars wasted and thousands of equipments given a very bad reputation simply because of the selection of a bad gear ratio. The motors may be geared for entirely too high a speed or they may be too low a speed. A proper study of the conditions was not given before the gear ratio was selected. Suppose a gear ratio is selected which is too high-speed, suppose you select one which is geared for a speed of thirty miles an hour, when your service requirements are such that you only need maximum speed of fifteen or twenty miles an hour. You are going to run your motor at a low voltage practically all the time. He had in mind a road where the motors are operated at an average voltage when the power is on the motors of about only 275 volts while the line voltage will average practically double. That means the motors have their capacity cut in two, and they are operating about half the horse-power capacity which they would have if they were operated more on the high voltage.

WEDNESDAY AFTERNOON SESSION.

The Wednesday afternoon session was called to order by President Adams at

H. H. ADAMS, PRESIDENT AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION.

2:45. The Question Box was presented and the report from the committee appointed to prepare resolutions in reference to the standardization committee was called for.

Paul Winsor, as chairman, reported for the committee as follows:

"The Committee on Resolutions, to which was referred the vote of the Central Electric Association on certain standards, beg leave to offer for your consideration the following Resolution:

"RESOLVED, That the Resolution of the Central Electric Railway Association on the subject of Standard Brake Shoes, Journal Boxes, etc., dated September 27, 1906, be referred to the Standardization Committee, with the request that that committee submit as soon as possible to the members of this Association their report on these subjects, in whole or in part, so that the members may anticipate what the standards will finally be."

Upon motion of Mr. Simmons the resolution was unanimously adopted.

Mr. Simmons offered the following resolution:

"RESOLVED, That The American Street and Interurban Railway Engineering Association at this time extend to The American Street and Interurban Railway Association, and more especially to its president, Hon. W. Caryl Ely, its thanks for the great amount of sympathy, assistance and encouragement given in the reorganization proceedings during the past year," which was unanimously adopted.

Mr. Evans moved a vote of thanks to Henry Wallerstedt, commending him for his work on the "Standardization Committee," which was unanimously adopted.

Mr. Olds paid an eloquent tribute to the great zeal which President Adams had shown and moved a hearty vote of thanks to him and his associates, which was given with good will. Mr. Adams responded briefly and gracefully.

The report of the committee on nominations was then presented as follows:

President, H. H. Adams, superintendent of shops, the United Railways and Electric Company, Baltimore, Md.

First vice-president, Fred G. Simmons, superintendent construction and maintenance of way, the Milwaukee Electric Railway and Light Company, Milwaukee, Wis.

Second vice-president, J. S. Doyle, superintendent of car equipment, Interborough Rapid Transit Company, New York.

Third vice-president, Paul Winsor, chief engineer motive power and rolling stock, Boston Elevated Railway Company, Boston, Mass.

Secretary and treasurer, S. Walter Mower, general manager, Southwestern Traction Company, London, Canada.

Members of the Executive Committee, Officers and F. H. Lincoln, assistant general manager, Philadelphia Rapid Transit Company, Philadelphia, Pa.; Fred N. Bushnell, chief engineer, the Rhode Island Company, Providence, Rhode Island; W. T. Dengan, engineer, maintenance of way, New York; H. B. Fleming, chief engineer, Chicago City Railway Company, Chicago, Ill.

Alfred Reed was instructed to cast the ballot.

The convention adjourned *sine die*.

American Street and Interurban Railway Association.

The president, Hon. W. Caryl Ely, Buffalo, N. Y., called the convention of the American Street and Interurban Railway Association to order on Wednesday morning at 10.45 o'clock, introducing the Hon. Lewis C. Laylin, Secretary of State, who extended a welcome to the state of Ohio.

Mr. Laylin said that Ohio is perhaps among the very foremost in development of electric railway lines. Something over a hundred companies have made reports for the year 1896, where the authorized capitalization was over $171,000,000, with a subscribed capital of over $151,000,000, with a mileage of over 3,100 miles and gross receipts aggregating something over $23,000,000.

Robert Sheldon, president of the Columbus Railway and Light Company, was then introduced.

Mr. Sheldon said that the last year his company operated with horses it carried between six and seven millions of people, with gross receipts of something less than $400,000. Fourteen years ago, at the time of electrification, and not stopping

Digitized by Google

to mention the intervening years to 1898, it reached fifteen millions of people with a gross of nearly $700,000. Last year it carried fifty millions of people, and this year will carry fifty-five millions with gross receipts of approximately $1,600,000.

The Hon. Dewitt C. Badger, mayor of the city of Columbus, was then introduced.

Mayor Badger welcomed the delegates to the city, commenting upon the great strides made in electric traction development and the part it had played in building up the state of Ohio.

John Y. Bassell, Secretary of the Columbus Board of Trade, was then introduced, briefly welcoming the delegates and extending a warm invitation to meet again in Columbus.

The secretary, Bernard V. Swenson, then proceeded to read the minutes of the various meetings of the executive committee during the year, outlining the arrangements which had been made for the management of the affairs of the association and the plans for the Columbus convention.

On motion, the report of the executive committee was accepted and filed.

Secretary Swenson presented the report of the secretary, which showed the membership to be as follows:

October 1, 1906:	
Associate members	113
Active members, old	145
Active members, new	55
	200
Joined since October 1	23
Old companies paid dues since October 1.	5
	228

The report of the treasurer showed the following financial transactions during the year:

Cash on hand and balance from last year and receipts during 1905-1906	$25,444.11
Expenses	18,467.21
Balance	$6,976.90

On motion, the reports of the secretary-treasurer were approved and filed.

President Ely addressed the convention, saying in part:

Gentlemen of the convention and members of the allied organizations—I am standing here before you to address you in the capacity of president for the last time. Three years ago at Saratoga you all remember the condition into which the affairs of the association had drifted by some chance, and it transpired that I was flung into the breach. There were many men who had given careful thought to the affairs of the association, and its condition at that time was apparent to all. We were in fact a social organization, with some business, which we transacted in a certain desultory fashion. The organization had done a lot of good work, but its work was failing because of certain conditions inherent to a situation that had grown up. It was in the first place an organization dedicated to a business that was small, and that was based on conditions that had been outgrown, when a few individuals were largely the owners of the street railways. But there had come into the business a tremendous accretion caused by the electrification of street railways in the cities and the construction of great lines of arteries of interurban traffic, so that where a few millions had been represented in the business, billions of dollars had actually come to be represented, and instead of men for the most part of a moderate degree of ability there had come into the profession thousands of men of the finest ability possible for money to obtain.

Now, is it worth $600 for the largest companies in the United States to belong to this association and is it worth to the other companies, as you come along down the scales, graduating them by their gross earnings the various sums that they respectively pay toward this organization? I think that is a fair question, and every man is entitled to be "from Missouri" and to be shown. It is impossible for the executive committee or the officers of the association to show to any one a chain of $600 in nickels actually going into the treasury of the company—that is an impossibility; or the amount of money that any one pays in. But to the work of the past year I invite your careful attention. It is impossible for me to more than outline it to you, but in the printed bulletins which have been sent to you from time to time in the reports, circulars and letters of the various committees and the data sheets, which have been distributed by them, asking for information in order that they might view the actual facts, and in the programme of this convention and the work that is going as you have seen it in the manufacturers' association and its splendid exhibit that has been put up here so far away from the homes of the manufacturers, in this, the largest attendance that I have ever seen at the opening session of our convention, and in the committee rooms, wherein our affiliated organizations since Monday morning have been carefully and systematically carrying on lines of work that are parallel, though well defined, to the lines of work of this organization and all dove-tailing together and working comprehensively together—in all these evidences it seems to me is proof of the value of the work accomplished through the money that has been expended in bringing about the reorganization. A great corporation that takes in ten, fifteen or twenty million dollars can afford to hire the best technical men and bring to its aid the best ability in every line of this work of ours; that is to say, those companies are justified in an attempt to get the best, but when you think you hire the best it takes time to prove whether you have done it or not; and, suppose it were possible to conceive of an organization wherein all the men were the best, or almost the best in their respective lines of work, then you would have the very best organization that it would be possible for a single corporation to bring to its assistance. But then it would be limited to a very few men compared to all the thousands that throughout this land and throughout this continent—because our representatives come from all over it—are carrying on the different branches of business. Then, in addition to that point, which possibly I should clarify, my idea is that organization, even in that part where men are hired to do certain lines of work, is helpful in many ways, because all the thousands get together in these conventions, and through this line of work as it is now proposed to carry it on, all standing shoulder to shoulder, each one helps the other. In the technical branch of the business a corporation is best able to fortify itself by paying handsome salaries and getting good men, but there are other things in which the large corporations are more vulnerable than the small corporations. The corporations of the great cities are reached far more quickly by the accidents of time and the changes in conditions than are companies in the smaller cities and interurban districts, and when you come to the last final analysis the security of the rights under which these corporations transact their business finally rests upon an honest and fair sentiment actuating the minds of the whole people, and no line of work can be carried on to greater advantage by this great organization than in proper ways, well revised and well calculated, to educate the people of the country to a just and thoughtful conception of the rights of corporations, not only for themselves, but as they touch the people, and also of the business conditions under which they operate. I fancy that there is not a man to-day who is well read and well informed in this business who doubts for a moment the right of the people of any community to take over in a fair way and operate the public utilities, any of them, through their municipalities or other territorial domain. As a matter of right it is undoubted. Then it is up to you to say to the people that as a business proposition it is unwise for the municipalities to attempt to do a business which you are able to establish to the satisfaction of everybody can be done more cheaply for the people by private business interests than by municipal corporations. (Applause.) For years we were afraid to discuss the question. For years we said, "Don't bring it out and talk about it in the convention," and during all those years all the other fellows were talking about it, all the newspapers were spreading what was largely misinformation before the people, and a sentiment was forming against us that, had the people who entertained it had the just and fair means of information, might have been very different from the manifestations that have become apparent within the last few years all over the country.

As has been known for years and so often said, the proof of the pudding is in the eating. A year ago we had a certain number of member companies, and this idea of reorganization was comparatively new, and I wondered, and so did many of the officers, how many we should have left at the end of the year. It gives me great pleasure to say to you in summarizing briefly the report of the secretary and treasurer that whereas last year we actually had paid up at the time of the convention and in good standing less than 187 members—I mean actually paid up and in actual good standing—we have this year 228 member companies and 140 associate members. (Applause.)

President Ely then paid an eloquent tribute to the work of Secretary Swenson and called attention to the hearty way in which the affiliated associations had taken hold of the work of reorganization.

At this point John I. Beggs made a ringing speech in behalf of the officers and executive committees of the five affiliated associations and presented Mr. Ely with a noble bronze statue, mounted upon a marble pedestal, the figure typifying "Triumph." This statue was fitted with a tablet suitably inscribed and was carried in and placed upon the platform by a corps of picked railway employés in uniform. Mr. Ely was visibly affected and briefly thanked all for their token of appreciation and affection.

The presidents of the affiliated associations then made brief addresses, after which the session adjourned.

WEDNESDAY AFTERNOON SESSION.

President Ely called the session to order, and the secretary read several announcements and invitations.

Hon. John I. Beggs, first vice-president, assumed the chair and called for the report of the committee on "Subjects," which was presented by E. G. Connette.

Secretary Swenson then read the report of Committee on Car Wiring.

The next paper on the programme was the report of the Committee on Standard-

Digitized by Google

ization of Equipment, by H. C. Page, Springfield, Mass., chairman.

W. E. Harrington, New York City, then presented the report of the Committee on Promotion of Traffic.

After considerable discussion a vote of thanks was tendered to the committee for the thorough manner in which they had compiled their report.

The report of the Committee on Insurance was presented by H. J. Davies, Cleveland, Ohio, chairman.

This report reviews the efforts which have been made during the past year to secure a better rating of traction risks, and states in the beginning that the insurance companies, through their inspection and rating bureaus, have, in many cases, somewhat lessened the hazard of fire, and with a slight betterment in the risk conceded a material decrease in premium. Heretofore there has been practically no competition among insurance companies for street railway business. The Factory Mutual Companies compete with stock insurance companies for insurance on "protected" properties—that is property equipped throughout with sprinkling devices that operate automatically upon the occurrence of a fire; or buildings so constructed as to be practically fireproof. But these companies have been unwilling until within about a year to carry insurance even on protected buildings of traction companies. Experiments have been tried during the year at Cleveland, Ohio, and at Newark, N. J., in the presence and under the direction of leading insurance engineers, which have developed apparatus considerably reducing the fire risk and bringing about a condition of willingness on the part of companies in general to write traction risks. The committee reports that a number of street and interurban railway companies in the East and the Middle West are perfecting the organization of a stock insurance company with mutual features, to write insurance upon all classes of traction and lighting company properties. This company is to have a paid-in capital stock and surplus of $1,000,000 in cash. The rates will probably be the same as those charged by the "old line" companies, because this company and the traction mutual companies will have their own inspectors, who, confining their attention to traction and lighting properties, will become experts in their line and will make the insurance rates for their members. All the premium receipts of this company, in excess of fire losses, expenses and six per cent on the capital and surplus of the stock company, are to be returned to the insured. It is the opinion of the committee that all the members of the American Street and Interurban Railway Association may be profitably consolidated into one company, to the extent, at least, of the insurance of their properties against destruction or damage by fire.

This report precipitated a very lively discussion. H. A. Robinson, of New York city, seemed to think that a mutual traction insurance company was an impossible proposition as far as New York state was concerned. Many of the New York properties are covered by large mortgages, in each of which the company making the mortgage has agreed to procure insurance satisfactory to the trustee of the mortgage; and in a number of the leases where the properties of other companies have been taken over—companies which are held by wholly independent stockholders—the holding companies are obliged to give them insurance which is satisfactory to their boards of directors. He did not think it would be possible to get attorneys or officers of trust companies in the state of New York to agree to take insurance for the benefit of $15,000,000 or $20,000,000 of bonds in the policies of mutual insurance companies organized under the laws of Ohio. Owing to the peculiar insurance laws of New York state, which provide against outside insurance except by going through certain formalities before the insurance commissioners at Albany, difficulties would be in the way. It did not seem to him exact protection to bondholders to give them insurance of this character, when it would be necessary for the bondholders to go to the state of Ohio to get the bills paid in the case of a loss. It did not seem to him to be fair treatment of the bondholders to have a contract made for their benefit under the laws of the state of New York.

B. E. Loomis, of New York city, representing twenty-six fire insurance companies which lost about $80,000,000 in the San Francisco conflagration, said that for six years his companies have been carrying on inspection of street railways and power stations throughout the United States. The companies have made it a point to recommend improvements which would reduce the rate. They have cooperated with the Car Wiring Committee, which was appointed some five or six years ago. The Car Wiring Committee was also invited to attend the various tests held by the insurance companies. The insurance companies are more than willing to cooperate with the street railway companies. The National Board of Fire Underwriters would be glad to make an appointment with a representative committee of the Street Railway Association to formulate rules and schedules and to adopt standards of insurance which would be mutually satisfactory to both parties.

Henry N. Staats, of the insurance department of the Cleveland Electric Railway Company, said that he represented twenty-four traction companies in the matter of insurance. In reply to the remarks of Mr. Robinson he stated that the kind of insurance Mr. Robinson had in mind and the kind that the mutual company wished to present were different in character. The kind of insurance he suggested for the "American Street Railway Insurance Company" is a stock insurance with a capital of $500,000 and a surplus of $500,000 before a single policy is issued. That enables the company to enter any state in the Union, and the policies will be made acceptable at any bank or any trust institution. The capital of the company will be subscribed by individuals of the railway companies representing the association. Twenty-four railway companies have already subscribed to the insurance company, and it has been organized under the laws of the state of Ohio. He expressed a lack of faith in the protestations of the insurance companies concerning their cooperation in the matter of better rates. He believed that a cooperation of the traction companies for the purpose of carrying their own insurance would be better than to attempt to cooperate with the "old line" insurance companies and permit them to make their own rules and regulations, and low rates temporarily, which, after competition has ceased, could be put up again.

E. R. Townsend, of Chicago, did not think that the electric light and traction companies could combine to take care of their losses as well as the insurance companies which had a capitalization of over $80,000,000. These insurance companies spread their losses over all the country. They have been making insurance rates of late subject to conditions that the insured shall put in certain improvements which will warrant a reduction in the rates. The elimination of defects and corrections in the electrical equipment and in the physical hazards have produced a high class of properties which has made it possible for the stock companies to make better rates.

A. H. Ford, of New York city, described the difficulties found in effecting mutual insurance in New York state. He showed that where competition had been brought to bear considerably better rates had been made by the "old line" companies, although he would admit that the risks had been very much improved. He thought that Mr. Staats was working in the right direction, but that what he had to give was not adequate. The trustees of the properties would not accept mutual insurance. If Mr. Staats would organize a company with $20,000,000 of capital, he could then talk to him about going into his insurance company. He did not believe that a $1,000,000 company was big enough.

Mr. Davies thought that the suggestion made by Mr. Loomis, to have a representative of the National Board of Fire Underwriters confer with the Insurance Committee, was a good one. The committee does not condemn the stock insurance companies. It wants cooperation for the benefit of the traction companies.

Vice-president Beggs said that he had given a great deal of attention to this matter. He had been for some years in the fire insurance business, and was now in a position to place many millions of fire insurance. The justification for the appointment of the committee was very evident. This is the first time that he had seen one of the "old line" fire insurance companies send representatives to the meeting to say anything to indicate that they cared about the traction business. A few years ago the traction properties were on a prohibitive scale, and, as Mr. Ford said, it was difficult now in certain sections of the country to cover large amounts of insurance. He did not think that a $1,000,000 company would be able to undertake the insurance proposition. He did think that

Digitized by Google

the association had among its members material for a good strong stock company complying with the laws of the most stringent state of the Union, and had within its ranks the best ability to inspect these risks and to know what would be the proper precautions to make for the success of the undertaking. The association could employ men as good as could any fire insurance company in the United States to conduct its business. It would know what the insurance was costing and would have some guide. He did not think the association could organize a company that would be large enough to carry all the insurance, but thought there was ability in the association to organize a company which would be a guide as to what are the proper charges.

THURSDAY MORNING SESSION.

The Thursday morning session was called to order by President Ely at 10 o'clock. The first order of business was the report of the Committee on Heavy Electric Traction. Calvert Townley, chairman of the committee, presented the report, and said that the steam and trolley roads have so many points in common that it is safe to class them together. He is impressed with the possibility of a development of electric traction whereby the trolley roads, instead of primarily competing with, can become feeders to the steam roads, so that the two classes of transportation will be friendly, and will assist one another. He thought that the committee should be continued as a standing committee, and should take every possible advantage of the experience of steam roads in dealing with the problem of heavy electric traction.

A vote of thanks was extended to this committee for the able and instructive manner in which it had handled the subject.

There being no discussion, the paper entitled "Elevated Railways and Their Bearing on Heavy Electric Traction," by H. M Brinckerhoff, of New York city, was presented.

There being no discussion, the paper entitled "Electric Railways in Sparsely Settled Communities" was presented by E. P. Roberts, of Cleveland. This paper took up in detail the determination of what constitutes a sparsely settled community. the treatment, however, being applicable to any interurban electric railway. Under separate chapter headings the following items were considered: Value of statistics and their proper and improper use; statistics relative to interurban electric railways and discussion of the same; examination relative to an operating or proposed electric railroad; passenger income. Mr Roberts also stated that the value of the promoters or the speculative interest in a proposed electric railway is generally in stock, and as the margin of profit is nearly always quite small, even though the gross income may be large, therefore a quite small percentage difference in the amount of the gross and net receipts may, and frequently will, make such a difference in the amount available for dividends on stock as to practically determine whether or not the stock will have any value. It is therefore very evident that it is impossible to give too much time and expense to the preliminary investigations in order to be sure that the location and design of the road are such as will give maximum dividends, considering the effect of variations of route, first cost, operating expense, gross income and the net income resulting from the foregoing considerations. It is very easy to affect the gross income from five to fifteen per cent by changes in route or by the character of terminal facilities, and such changes may be accompanied by a greater or less first cost, or a greater or less operating expense, or both.

The paper entitled "Interurban Freight and Express," by E. C. Spring, general manager of the Dayton, Covington & Piqua Traction Company, West Milton, Ohio, was then read. A diversity of opinion exists among the managers of the electric roads whether it is more advantageous to handle merchandise at express or freight rates. Each manager has his own personal opinion and ideas along this line, and in summing up these ideas it is seen that each man's opinion is based upon peculiar circumstances prevalent to his own property. The steam roads of the country have the advantage over the electric lines in this respect, as their conditions are more of a universal or standard nature. The author considers that a determination on the part of the electric lines to follow steam road methods is an excellent one. He would not for a moment recommend any cut below the steam rates for express traffic, particularly between competing points. The electric properties have a chance now in this comparatively new field of service to maintain a standard of rates, and not again experience a condition of affairs the same as has been experienced in the passenger business. The drawing of the line between freight and express business is one which must be decided by the operator. He does not believe that an express service on a short line can be maintained as profitably by the railway company itself as it can be by a regular line express company operating over connecting lines.

After considerable discussion on this subject the paper entitled "Tickets and Rates," by F. W. Coen, secretary and treasurer of the Lake Shore Electric Railway Company, Cleveland, Ohio, was read.

There was no discussion, and the paper entitled "Some Notes on the Evolution of Electric Transportation," by Theodore Stebbins, expert of the National Civic Federation, Cohasset, Mass., was read by title.

The Committee on Nominations, to consist of C. D. Wyman, Massachusetts; G. Tracy Rogers, New York; A. H. Nicoll, Indiana; John A. Beeler, Colorado; E. K. Stewart, Ohio; and on resolutions, consisting of R. E. Danforth, New York; L. D. Mathers, Iowa, and D. A. Hegarty, Arkansas, were appointed.

The meeting was then adjourned.

THURSDAY AFTERNOON SESSION.

The afternoon session was called to order by Vice-President James F. Shaw, of Boston, at 2.30 o'clock. The first order of business was the reading of the paper entitled "Electric Railway Employés and the Young Men's Christian Association," by E. M. Willis, secretary of the International Committee of Young Men's Christian Associations, New York city. Mr. Willis detailed the admirable work which the Young Men's Christian Association is doing among the electric railway employés, and the great interest which is met with in every city where branches have been established. A vote of thanks was tendered to Mr. Willis for his interesting and valuable paper.

The paper entitled "Selection of Trainmen," by C. E. Learned, superintendent of inspection, Boston Elevated Railway Company, Boston, was read.

There being no discussion, the next paper, entitled "Discipline of Train Men," by F. W. Brooks, assistant general manager, Detroit United Railways, Detroit, was read by the secretary.

The paper entitled "Uniforms and Badges," by John R. McGiveney, purchasing agent, New Orleans Railway and Light Company, New Orleans, was then read. This paper described the method of taking care of this problem in the city of New Orleans.

The report of the Committee on Rules was presented by E. G. Connette, chairman. This committee reported that replies received from data sheet No. 11 show that a large number of street railway companies have adopted the standard code of rules approved by the association at its annual convention in St. Louis in 1904. From the replies received, the committee has deemed it advisable to revise the interurban rules which were submitted to the St. Louis convention, so as to conform to the practice of moderate-speed interurban service. The committee submitted for the consideration of the convention a set of rules in pamphlet form for the operation of trains on high-speed electric railroads. These rules conform, as far as practicable, to the rules of the American Railway Association for the operation of steam lines, as the operating conditions of high-speed electric railroads are so nearly identical with the operation of steam railroads that the committee does not believe it wise to depart from steam railroad practice any further than changed conditions necessary for the operation of electric railroads may require. The committee has not made any alterations in the standard code of rules as adopted by the association at its meeting in St. Louis, except in the case of the interurban rules. The report of the Committee on Rules was accepted and the suggestions made by Mr. Connette, that any alterations or additions to the rules that may occur to any of the members of the association be submitted to the Standard Rules Committee for its consideration, and that the committee be continued from year to year until an entirely satisfactory

Digitized by Google

standard code of rules be secured, were approved.

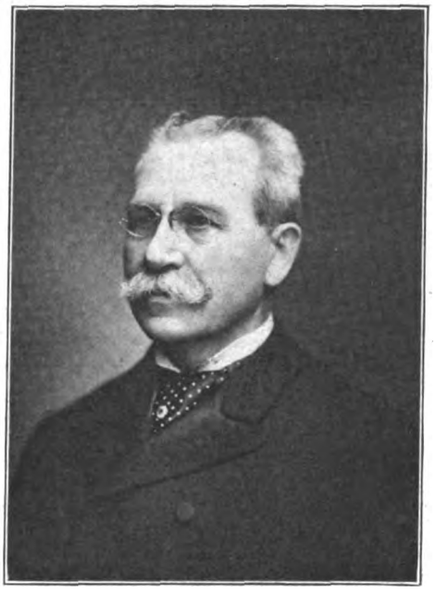
The meeting was then adjourned.

FRIDAY MORNING SESSION.

Vice-President Beggs called the Friday morning meeting to order at 10.30 o'clock in executive session. The report of the Committee on Municipal Ownership was presented by C. D. Wyman, chairman. The report of the Committee on Public Relations was presented by Henry A. Robinson, chairman. Mr. Beggs, who is chairman of the Committee on Compensation for Carrying United States Mail, presented this committee's report.

A paper was presented by John A. Beeler, vice-president and general manager, Denver City Tramway Company, entitled "Handling Public Complaints." Mr. Beeler's paper is made up mostly of incidents relative to the handling of public complaints. Many of these are humorous, but all have some valuable point of interest. Mr. Beeler suggests a printed form for complaints and a method of procedure in handling this part of the street railway manager's routine.

The paper entitled "Leaks Between Passenger and Treasurer" was read by A. H. Stanley, general superintendent, Public Service Corporation of New Jersey. Mr. Stanley thinks that there is an ever-increasing number of the public constantly on the alert to beat the railway company out of a fare, either by evading payment or through unfair use of the transfer. One of the most important features of remedying leaks between the passenger and the treasurer is the creation of a feeling of fair dealing on the part of the public and on the part of the employés toward the corporation. This feeling can be conserved by a satisfactory service better than through any other means. Mr. Stanley suggests that transfers should be carefully inspected in the accountant's office and conductors brought to account for any irregularities either in issuing or receiving. In this way conductors will be more careful, and through them the public will be given to understand that transfers are intended for a continuous ride to their destination only, and not for a stop-over privilege. A daily record should be kept of the condition of the totalizer of each register in every car, whether the car has been in service or not, and sent to the accounting department daily. For this purpose a daily car record blank is recommended. Tickets and transfers should be turned in by conductors each trip. Conductors' day cards and all other reports having to do with the collection and counting of fares should be carefully checked in the accountant's office, and an explanation required for any errors or neglect in making up accounts. Conductors should be made to understand the importance of their reports, and that they must be made up carefully and accurately. Mr. Stanley does not believe that any considerable percentage of newly appointed conductors enter the service with the thought of being deliberately dishonest. What they develop into, whether it be good or bad, is dependent to a very large extent upon the way in which they are trained, their relations with their superiors, and the conditions under which they work.



JOHN I. BEGGS, PRESIDENT AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.

W. G. Ross, of Montreal, Canada, in discussing this paper, called attention to the great utility of the "pay-as-you-enter" closed car in use in Montreal. The company has had fifty cars in successful operation, and inside of the next four months will have 100 more. It had effected an increase in the revenue alone of from ten to fifteen per cent. This car is also a great preventative of accidents on the rear platform. The car does away as well with the accounting between the conductor and the company.

A vote of thanks was then tendered to the Montreal Street Railway Company for placing one of these cars on the exhibition grounds for the inspection of the delegates.

The subject was discussed at some length and much valuable information given by Mr. Ross and also by D. McDonald, of Montreal.

The nominating committee presented its report, which was unanimously adopted, and the following officers declared elected:

President—John I. Beggs, Milwaukee.

First vice-president—Calvin G. Goodrich, Minneapolis.

Second vice-president—James F. Shaw, Boston.

Third vice-president—Arthur W. Brady, Anderson, Ind.

Executive committee—The officers and C. L. S. Tingley, president of the Accountants' Association; H. H. Adams, president of the Engineering Association, and S. L. Rhoades, president of the Claim Agents' Association.

Mr. Beggs thanked the association for elevating him to the responsibility of the executive office. He called attention to the necessity for devising some method of improving the attendance at the open sessions of the association. There was not the attention given to the work in hand that it deserved. Particularly should an effort be made to secure good papers.

The Committee on Resolutions then presented its report.

Ernest Gonzenbach was appointed by the new president chairman of a committee to select members to prepare papers for the next meeting.

A. H. Stanley called the attention of the association to the great confusion which prevailed concerning the stopping points for cars in all large cities. He thought that there should be a uniform rule, so that a traveler might know at what side of the street a car would stop, no matter in what town or city he might be. He moved that a committee be appointed to take up the question and report to the association at the next meeting. This motion was carried.

The convention was then adjourned.

The Claim Agents and Accountants also held several important sessions, electing new officers for the year 1906-7. Notice of these sessions will be printed fully later.

American Street and Interurban Railway Manufacturers' Association—The Exhibition of Appliances.

There is hardly any doubt that this convention and exhibition will go down in street railway history as one of the most successful which has ever been held. Not only was there a very large attendance, but the interest manifested at the various sessions of the affiliated organizations was keen, and in the exhibition stalls the comment was frequently heard that a truly representative body of men was in attendance, men to whom it was a pleasure to demonstrate the apparatus upon exhibition, and who, upon their return to their respective home places, were vested with authority to suggest appropriations for the acquisition of more modern appliances. The manufacturers' exhibition was instructional in the highest degree. A great many of the companies made large expenditures for power, so that the apparatus could be seen under service conditions. In many instances also a portion of the housings of valves and other parts was cut away, so that a close inspection of many details was easily possible.

Below are given the names of many of the exhibitors, the names of their representatives and a partial list of the materials on display. In addition to those enumerated below the following representative men were present: H. M. Littell, Frank Betts, F. C. Hinds, N. P. Baker, A. J. Potter, E. F. Peck, Robert Sheldon, C. Loomis Allen, H. F. Schoepf, H. A. Nicholl, T. C. Pen-

Digitized by Google

ington, Professor F. C. Caldwell, John I. Beggs, Fred Bissell, C. S. Kuntz, Charles F. Scott, J. S. Lapp, Arthur Jones, Frank MacGovern, Jacob Wendell, Jr.; R. L. McDuffie, W. N. Sweeten, Charles F. Johnson, G. C. Knott, W. J. Keenan, F. S. Price and H. E. Eichorn.

Allis-Chalmers Company, Milwaukee, Wis.—As usual, this company was located in a spacious L-shaped booth, providing a large reception room and giving ample space for the placing of various pieces of machinery illustrating electric-railway equipment. A feature of this exhibit was the Christensen air-brake apparatus manufactured by this company. In addition to the standard literature in the form of catalogues and bulletins, there were shown a large number of framed photographs showing typical applications of apparatus made by the company. Represented by F. C. Randall, W. S. Doran, W. W. Power, F. C. Colwell, M. W. Thomas, W. J. Buckley, J. W. Gardner, J. W. Murray, W. T. McCaskey, J. H. Denton, G. Voight, G. B. Foster, W. S. Heger, A. H. Whiteside, H. A. Strauss, H. A. Buell and C. A. Tupper.

American Instrument Company, Philadelphia, Pa.—This company exhibited an attractive line of new "American" voltmeters and ammeters, of both switchboard and portable types. Not only were the railway men interested in these instruments, but considerable attention was given them by the visiting engineers and manufacturers. Represented by James G. Biddle, A. O. Benecke, T. G. Seixas and A. B. Weeks.

American Steel and Wire Company, Chicago, Ill.—The usual jolly crowd was on hand at this company's attractive booth. A feature of the display was a large sign made up of twisted rail-bonds. In addition to this there were fence and trolley wires, cables, rail-bonds and a complete line of rail-bonding tools, including a remarkable new gang-drilling fixture. This company distributed a handsome souvenir in the form of a pressed steel paper-cutter. Represented by George Cragin, C. S.Marshall, F. A. Keyes, C. S. Knight, B. B. Ayers, R. K. Sheppard, J. D. Sutherland, E. Blanchard, George Long, George Chandler, Henry Pratt, Henry Sturdevant, J. M. Holloway and Thomas Lavin.

American Water Softener Company, Philadelphia, Pa.—This company exhibited a model plant showing the method of mixing the chemical solution and elevating the mixture to an automatic tripper and mixer. Represented by W. H. P. Fisher, A. W. Bartlett and A. S. Garrett.

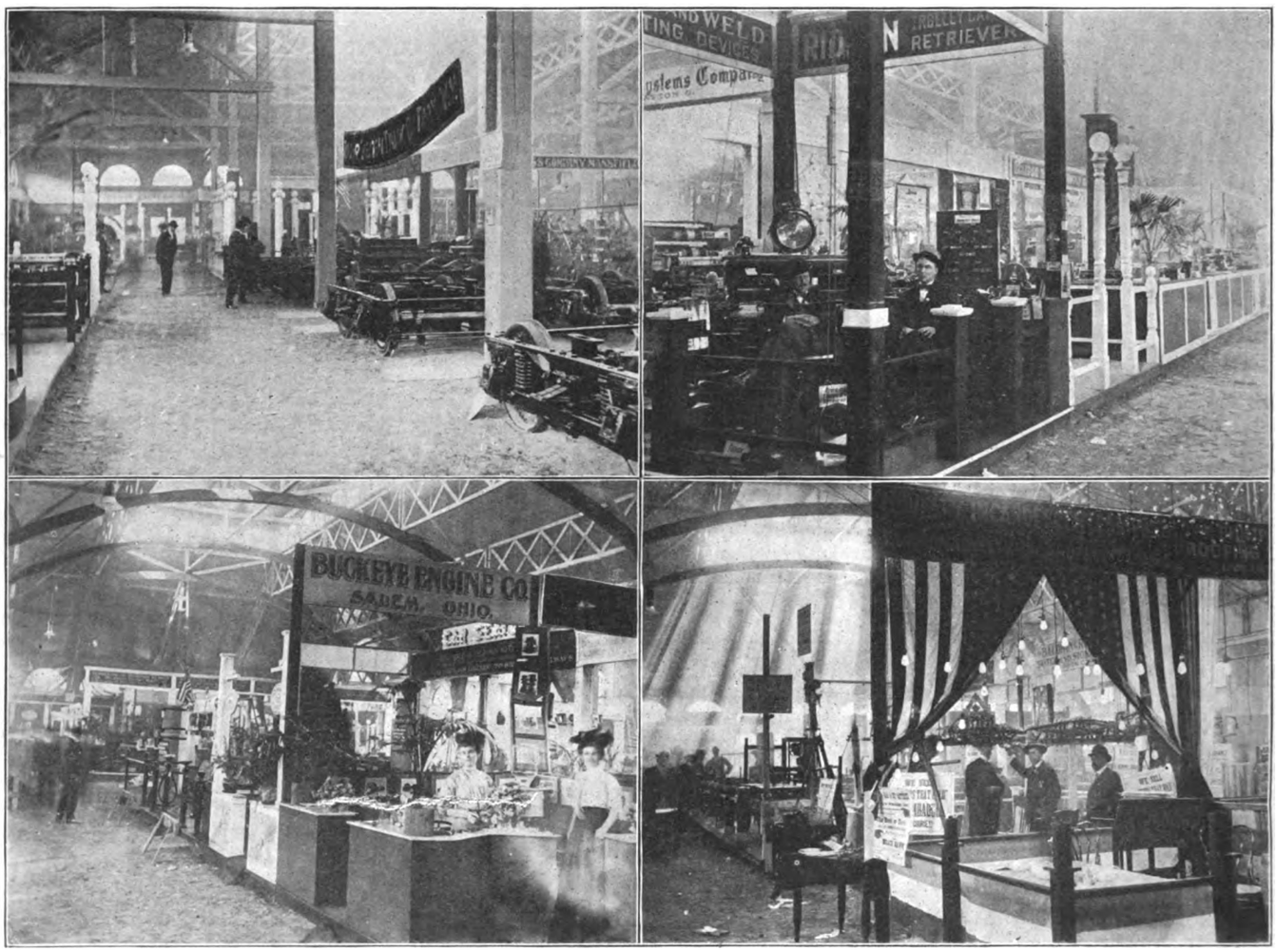
Albert & J. M. Anderson Manufacturing Company, Boston, Mass.—This company exhibited trolley-line material, time switches, and knife switches. Represented by Ernest Woltman, William W. Hincher and J. M. Anderson.

Blake Signal and Manufacturing Company, Boston, Mass.—This company made its usual interesting demonstration of the Blake signal. Represented by E. J. Burke and C. C. Blake.

Brady Brass Company, Jersey City, N. J.—Exhibiting motor bearings. Represented by Daniel M. Brady, George C. Morse, C. M. Reubens and W. F. Kranz.

Harold P. Brown, New York, N. Y.—This veteran exhibited his plastic-bond, solid copper rail-bond, electrical contact alloys, flexible-shaft rail-grinders, high-speed electric rail-drill, magnetic and mechanical rail-clamp, insulated third-rail, and electrical testing laboratory. Represented by Harold P. Brown, F. H. Brown, F. Bissell, R. K. Fast, C. Eccles, J. Hollowood, Julius Alsberg, G. M. Hoadley, Albert Temple, John Roach and J. M. Coote.

Buckeye Engine Company, Salem, Ohio—This company's booth was always attractive and each day a fresh supply of cut flowers was on hand for the decoration of the visitors. In addition to these the company distributed lapel-pin "Buckeyes" as souvenirs. This company exhibited an engine model and framed photographs showing several types of steam and gas engines. Represented by C. H. Weeks, V. T. Price and G. W. Pope.



General Views in the Exhibit Buildings, Street Railway Appliance Exhibition, Columbus, Ohio, October 15–19.

Chase-Shawmut Company, Newburyport, Mass.—Shawmut soldered rail-bonds. Represented by Frank D. Masterson.

Chicago Pneumatic Tool Company, Chicago, Ill.—This company's exhibit was particularly interesting as, in addition to a complete line of pneumatic drills and hammers, there were shown a new 550-volt electric drill, set up with a powerful magnetic rail-clamp. Another interesting feature was a mechanical rail-clamp so arranged as to allow the electric drill to point straight down or normal to the slope of the rail web. Represented by J. W. Duntley, W. O. Duntley, C. E. Walker, C. B. Coates and Edward Aplin.

Consolidated Car Heating Company, New York, N. Y.—Electric car heaters, portable vestibule heaters, switches and switchboards. Represented by Cornell S. Hawley, S. B.

Digitized by Google

Keys, W. S. Hammond, Jr., and F. W. Brownnell.

Consolidated Engine Stop Company, New York, N. Y.—Monarch engine stop, showing method of operating, Monarch testing system, and automatic push-button control. Represented by Arnold W. Lenderoth and H. W. Quackenbush.

Crouse-Hinds Company, Syracuse, N. Y.—Imperial arc headlights and combination arc and incandescent headlights, Syracuse changeable incandescent headlights, Norbitt porcelain specialties, condulets, harpoon guy anchors. Represented by A. F. Hills, N. Shute and C. M. Crofoot.

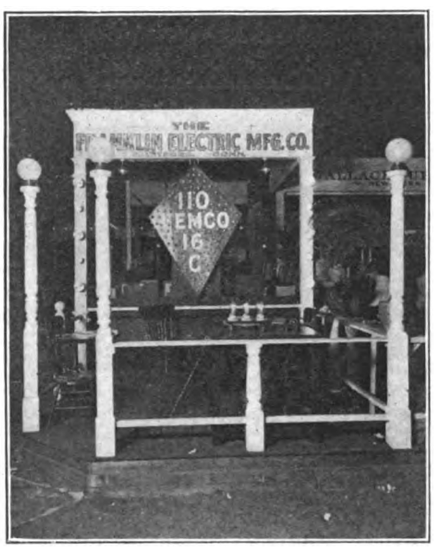
Dearborn Drug and Chemical Works, Chicago, Ill.—With its white and gold embellishments and well-lined shelves, this booth was characteristic of the name. Water-purifying preparations, lubricating oils and greases. Represented by Robert F. Carr, Grant W. Spear, Dan Delaney, Paul T. Payne and W. O. Clark.

Dixon Crucible Company, Jersey City, N. J.—This company made a feature of a huge can, so arranged inside with curvilinear mirrors as to give the visitor an idea of how one looks when "canned." This was a great success. The company also exhibited silica-graphite paints, pipe-joint compounds, American graphite pencils, commutator lubricants, Ticonderoga flake graphite lubricants, graphite greases, plumbago crucibles, foundry facings, motor brushes, and distributed as souvenirs graphite pencils and miniature tin cans, with thimbles for the ladies and dice for the gentlemen. Represented by F. R. Brandon, L. H. Snyder, C. H. Spotts and D. M. Howe.

Dossert & Company, New York, N. Y.—A feature of this exhibit was an iron-pipe railing and fence coupled up with the Dossert solderless splice instead of pipe joints. A new device which attracted a good deal of attention was an insulated two-way motor lead. Represented by Harry B. Logan and E. A. Dossert.

Electric Railway Improvement Company, Cleveland, Ohio—This company showed a new complete, portable bond-welding car and grinder, and electrically welded bond. Represented by C. A. Cadle and J. A. Cadle.

Electric Service Supplies Company, Chicago, Ill.—This company carries a tremendous line of apparatus, but its booth was equal to this range. Extending for some distance along one end and one side of the building, this company's headquarters seemed a veritable exhibition by itself. In addition to the display of apparatus, the appointments were very complete and each day a musical entertainment was given the visitors. Some of the material shown were protected rail-bonds, rail-bond compressors. Keystone overhead insulators, Lyon sheet-steel gear cases, Garton-Daniels lightning arresters and "automotoneers," pole brackets and line fittings, third-rail insulators, Keystone vestibule shades and Keystone cable racks, Mayer & Englund telephones, Philadelphia car fenders, testing instruments, sweeper rattan, high-tension malleable pins, linemen's and constructors' tools and portable lamp guards. Represented by C. J. Mayer, A. H. Englund, J. W. Porter, Max A. Berg, J. V. E. Titus, E. R. Mason, W. P. Cosper, G. W. Cox, J. M. Gallagher, Ernest Boehme, W. D. Hamer, Hugh L. Adams, Wm. A. Armstrong, Jr., Frank B. Massey, Henry R. Swartley, Jr., Edward Hammett, Jr., and Robert Montgomery.

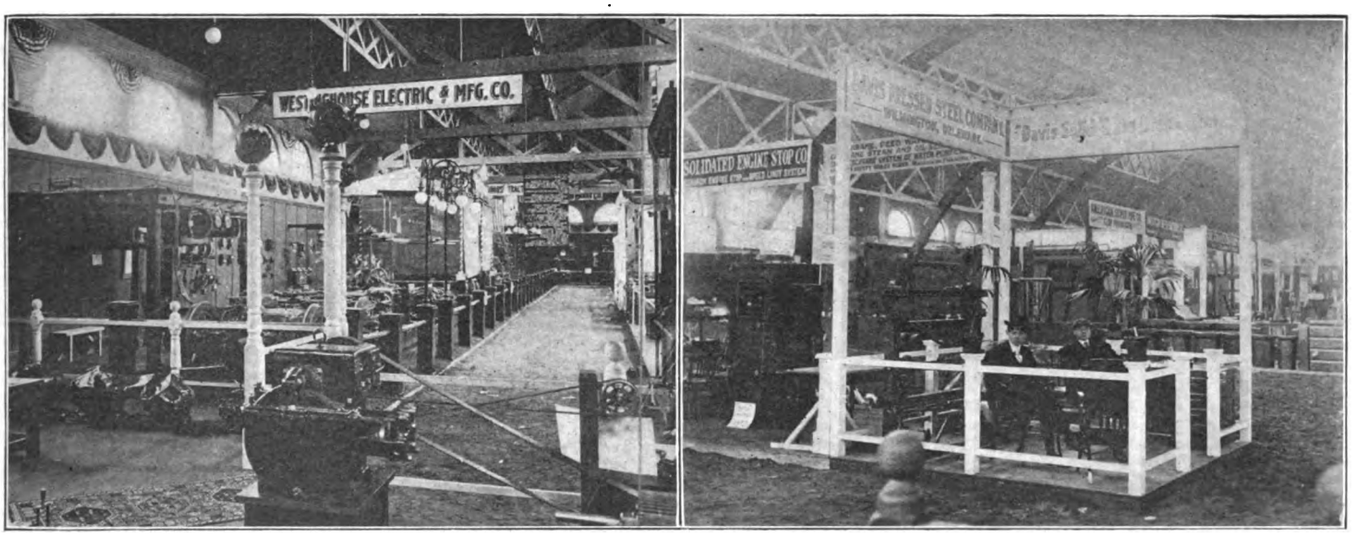


Electric Storage Battery Company, Philadelphia, Pa.—There was the usual "walk-in-and-sit-down" atmosphere about this company's booth, and the representatives on hand found lots to talk about. Two type R cells, one containing eighty-three and the other fifty-five cells were interesting, as were also the carbon regulator, signaling and compensating hydrometers, recording hydrometer and automatic cell filler. Represented by C. Blizard, H. B. Gay and G. H. Atkins.

Franklin Electric Manufacturing Company, Hartford, Ct.—Being distinctly a lamp exhibit, this booth was of particular interest. The Franklin kite made up of blue and white miniature lamps was decidedly effective and a novel offset to the high-powered reflector lamps shown here. But the great feature, however, was a most ingenious device, showing the conditions of vibration to which an incandescent lamp is subjected when a car is under way. This device demonstrated the effectiveness of the new anchored filament lamp which this company has developed for railway service. Represented by P. S. Klees, C. N. Thorpe, C. Leonard and F. E. Wilson.

D. & W. Fuse Company, Providence, R. I.—Deltabeston fireproof magnet wire, enclosed cartridge fuses, enclosed fuse cutouts and fuse boxes. Represented by W. S. Sisson and C. E. Harmon.

General Electric Company, Schenectady, N. Y.—That this company was well represented, both in apparatus and good fellows, goes, of course, without saying. The keynote of this exhibition was instruction. The single-phase system developed by this company was very completely shown, an additional feature being the adaptation of the Sprague-General Electric multiple-unit control system to the single-phase equipment. The CP-21 air compressor was also shown with various parts exposed so as to allow minute examination of the details of this apparatus. For the first time at any convention this company showed its commutating-pole motor for railway use. A large-capacity motor-operated circuit-breaker in combination with a motor-operated main switch, breaking 12,500 amperes at 650 volts was shown. This breaker may be operated at a distance, it being necessary to run only one wire from the switchboard to the point of control. In addition to all this there was a portable air-compressor, mercury arc recti-



General Views in the Exhibit Buildings, Street Railway Appliance Exhibition, Columbus, Ohio, October 15–19.

fier and the booth was attractively lighted by 250-watt Gem lamps with Holophane reflectors, and also with the new tantalum lamps. Represented by J. R. Lovejoy, C. C. Peirce, G. D. Rosenthal, H. L. Monroe, R. E. Moore, E. H. Ginn, J. J. Mahoney, H. H. Crowell, E. H. Anderson, C. E. Barry, H. N. Ransom, E. D. Priest, W. G. Carey, F. E. Case, W. J. Hanley, M. M. Corbin, H. H. Corson and Frank H. Gale.

Gold Car Heating and Lighting Company, New York, N. Y.—Single-rod cyclinder heaters, two-rod panel heaters, six-rod panel heaters, truss plank heaters, cab heaters, portable house heaters, cylinder heater using junction box connection, cross-seat heater, connected up with iron conduit, no wiring exposed, and display of coils, supporting rods, porce-

Digitized by Google

lains and three-way switches. Represented by A. E. Robbins and F. A. Purdy.

Harrison Safety Boiler Works, Philadelphia, Pa.—Cochrane feed-water heater and feed-water separator. Represented by J. E. Harris.

Heany Fire Proof Wire Company, York, Pa.—Demonstrating heat-resisting qualities of Heany fireproof wire. Represented by W. H. Easton and J. J. Kessler.

H. W. Johns-Manville Company, New York, N. Y.—Overhead line material, third-rail insulators, asbestos, transit doors for transformers, "Noark" enclosed fuses, fuse blocks, service boxes, car heaters, brass goods and trolley-wheels. Represented by J. W. Perry, R. R. Braggins, A. D. Newton, H. M. Voorhis, F. E. Johnson, J. W. Hardy and A. A. Forshee.

Lord Electric Company, Boston, Mass.—Thomas soldered rail-bonds and Shaw non-arcing lightning arresters. Represented by Edwin M. Hamlin, George B. Crane and George W. Smith.

Massachusetts Chemical Company, Walpole, Mass.—This company operates the Walpole Rubber Works and the Walpole Varnish Works. The company had on exhibition samplesof "armalac" and special "armalac," No. 50 insulating compound for armature and field-winding, tape No. 264,approved by United States Navy Department, No. 269 waterproof friction tape for outside and mine work, M. C. waterproof paints for exposed surfaces, "Dryfield" tape for street railway motor fields, reinsulating tape for reinsulating old field-coil wire, rubber-splicing compound, and a general line of liquid and rubber insulation. As a souvenir the company distributed a rubber cuspidor mat. Represented by E. C. Green, A. T. Baldwin, R. T. Elwell, L. O. Duclos and A. E. Duclos.

Matthews & Brother, St. Louis, Mo.—Stombaugh guy anchors, Kearney cable clamps, Lima jack-boxes and plugs, O. K. sleet-cutters, "hold-fast" lamp guards, Hargis cable-splicing joints. Represented by Claude L. Matthews and James R. Kearney.

Matthews & Brother, St. Louis, Mo.—Miller guy anchors and ground augurs. Represented by G. H. Miller and F. B. Miller.

National Brake and Electric Company, Milwaukee, Wis.—This exhibit was especially complete and was rendered doubly attractive by the constant operation of the apparatus. The new National air-compressor was shown in full operation with part of the housing cut away to allow of close inspection and examination. The new type N oil pneumatic governor was also shown in operation and there was also shown a new engineer's valve which permits of 150,000 movements with one oiling. A complete two-car schedule air-brake equipment was shown in full operation, and in addition there was a complete line of repair parts for new types of apparatus as well as parts of formerly made types. The company's new line of type N L motors was shown in sizes from three to forty horse-power. Represented by S. I. Wailes, R. P. Tell, W. L. Waters, Griffith Johnson, J. T. Cunningham, C. N. Leet, Bert Aikman, W. M. Bisel, H. W. Beattys, Jr., George S. Hastings, J. T. Perry, W. H. Coble, Arthur Jones, R. W. Woodward and R. W. Hutchinson, Jr.

Novelty Incandescent Lamp Company, Emporium, Pa.—Elk "new" and Novelty "renewed" incandescent lamps. Represented by R. K. Mickey and A. J. Jackson.

Oleson-Williams Company, Toledo, Ohio—Lightning arresters and fuse boxes for electric railway feeders, transmission lines and motor circuits. Represented by Albert Oleson, W. A. Williams and Charles C. Williams.

Rail Joint Company, New York, N. Y.—This company's booth was centrally located and was headquarters for many of the representative street railway men in attendance. The company showed samples and literature regarding standard T-rail joints of the continuous Weber and Wolhaupter types, girder joints of the continuous and Weber types, insulated joints of the continuous and Weber types and various joints in combination with rail-bonds. Represented by B. M. Barr, E. A. Condit, Jr., D. J. Evans, G. M. Hager and W. T. Smettum.

John A. Roebling's Sons Company, Trenton, N. J.—Rail-bonds, armature and field coils, cables and appliances for installing rail-bonds. In addition there were framed photographs of installations and as a souvenir the company distributed miniature rail bonds. Represented by G. R. Mitchell, H. L. Shippy, J. E. Nolan, J. W. Brooks, W. W. Affleck, W. P. Bowman, A. B Conover and James Henry.

Speer Carbon Company, St. Mary's, Pa.—Carbon brushes and carbon specialties. Represented by J. S. Speer and G. P. Fryling.

Southern Exchange, New York, N. Y.—Poles, ties and cross-arms. This company distributed a valuable match-box and cigar-cutter as a souvenir. Represented by E. G. Chamberlin.

National Carbon Company, Cleveland, Ohio—Carbon brushes. Represented by N. C. Cotabish, A. G. Summerell, F. D. Kathe and J. F. Kerlin.

Automatic Electric Company, Chicago, Ill.—Complete selector switchboard with six lines connected up. Desk and wall instruments. Model board for manual and automatic interconnection. This service was operated in conjunction with the local lines of the Citizens Telephone Company of Columbus. Represented by E. S. Batchelder.

Standard Paint Company, New York, N. Y.—P. & B. tape and insulation. "Ruberoid" roofing and insulating varnish. As a souvenir this company distributed a handsome match-safe. Represented by H. W. Benedict, John H. Thomas, J. H. Vail, F. P. Barker and H. H. Cowherd.

Standard Varnish Works, New York, N. Y.—Sections of field and armature coils impregnated under vacuum, solid and fluid insulating compounds and insulating varnishes. Represented by J. C. Dolph, L. Robinson, F. A. Elmquist, W. W. Schler and H. B. Chiccote.

J. H. Wagenhorst & Company, Youngstown, Ohio—Electric blue-printing apparatus. Represented by Donald Parsons.

Westinghouse Company, Pittsburg, Pa.—It must have done the hearts of the railway men a deal of good to run amuck in the Westinghouse exhibit. There was a constant come and go, accompanied by the clank and hiss of the apparatus under demonstration. The exhibit for the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company consisted of air brake equipments for all classes of electric traction and a blower outfit for power-houses and the like. The exhibit of the Westinghouse Automatic Air and Steam Coupler Company consisted of a working model of the air and steam coupler. The Westinghouse Electric and Manufacturing Company showed the Westinghouse electro-pneumatic control system, operating two No. 121 motors mounted upon trucks. There was also the usual display of measuring instruments, motors, fans, arc and incandescent lamps, line material and views. The companies were represented as follows: Westinghouse Electric and Manufacturing Company—R. W. Beebe J. A. Brett, R. S. Brown, L. M. Cargo, William Clegg, W. L. Conwell, C. S. Cook, Thomas Cooper, W. Cooper, H. P. Davis, J. L. Davis, G. B. Dusinberre, W. F. Fowler, Guy H. Gibbs, J. J. Gibson, J. R. Gordon, S. J. Keese, S. M. Kintner, J. C. Kyle, W. M. McFarland, H. C. Marsh, C. F. Medbury, W. E. Parker, D. D. Pendleton, T. S. Perkins, C. S. Powell, C. W. Register, F. F. Rohrer, F. H. Shepard, O. T. Smith, G. V. Williams, H. C. Stier, N. W. Storer, T. Varney, J. E. Webster and G. B. Griffin. Westinghouse Air Brake Company—G. W. Baker, W. S. Bartholemew, R. H. Blackall, Robert Burgess, C. W. Cass, H. S. Clark, E. A. Craig, E. A. Dewson, C. R. Ellicott, Joseph R. Ellicott, F. V. Green, A. L. Humphrey, S. D. Hutchins, A. Johnson, John F. Miller, F. N. Nellis, C. J. Olmstead, C. W. Townsend and W. V. Turner. Westinghouse Machine Company—John B. Allen, J. H. Wagenhorst, Edwin Yawger and H. D. Watson. Nernst Lamp Company—James L. Anderson. Representing joint interests, J. C. McQuiston and F. S. Smith.

Western Electric Company, Chicago, Ill.—General railway material and "Electrose" insulating products. The company distributed a handsome pamphlet showing views of its Hawthorne works for the manufacture of power apparatus and heavy material, and as a souvenir distributed a valuable pin tray made from "Electrose" insulation. Represented by Fred R. Babcock, W. L. Stockton, D. C. Guest, E. A. Burrows, F. D. Killion, R. H. Harper, L. T. Milnor, C. A. S. Howlett and H. Walton Heegstra.

Yale & Towne Manufacturing Company, New York, N. Y.—This company exhibited two new types of high-voltage electric hoists, designed especially for operation on street railway power circuits. These may be used where the voltage changes are great and are especially adapted for use in boiler rooms, repair shops and car barns. A twenty-ton chain hoist of the "Triplex" type was also exhibited. Represented by Charles W. Beaver and Harry E. Dickerman.

In addition to the exhibit under cover there was a fine display of rolling stock and complete car equipments upon the tracks of the "Big Four" adjoining the exhibit buildings.

The following manufacturers also made elaborate displays of apparatus and were well represented by corps of attendants:

American Brake-Shoe and Foundry Company, Mahwah, N. J.; American Railway Supply Company, New York, N. Y.; Armstrong Oiler Company, Philadelphia, Pa.; Atlas Railway Supply Company, Chicago, Ill.; American Mason Safety Tread Company, Boston, Mass.; Atha Steel Castings Company, Newark, N. J.; Adams & Westlake Company, Chicago, Ill.; Acme Automatic Street Indicator Company; Bayonet Trolley Harp Company, Springfield, Ohio; J. G. Brill Company, Philadelphia, Pa.; Burnham, Williams & Company, Philadelphia, Pa.; S. F. Bowser & Company, South Bend, Ind.; L. M. Booth Company; Cleveland Frog and Crossing Company, Cleveland, Ohio; Consolidated Car Fender Company, Providence, R. I.; Cook's Railway Appliance Company, Kalamazoo, Mich.; Curtain Supply Company, Chicago, Ill.; Creaghead Engineering Company, Cincinnati, Ohio; Cambria Steel Company, Philadelphia, Pa.; Carnegie Steel Company, Pittsburg, Pa.; Duff Manufacturing Company, Pittsburg, Pa.; Dayton Manufacturing Company, Dayton, Ohio; Duplicate Transfer and Rebate Company, Philadelphia, Pa.; DuQuesne Steel Foundry Company, Pittsburg, Pa.; Dressel Railway Lamp Works, New York, N. Y.; O. M. Edwards Company, Syracuse, N. Y.; Electric Railway Equipment Company, Cincinnati, Ohio; Charles I. Earll, New York, N. Y.; Eclipse Railway Supply Company, Cleveland, Ohio; Franklin Car Heating Company, Syracuse, N. Y.; Felt & Tarrant Manufacturing Company, Chicago, Ill.; Galena Signal Oil Company, Franklin, Pa.; W. R. Garton Company, Chicago, Ill.; Goldschmidt Thermit Company, New York, N. Y.; Globe Ticket Company, Philadelphia, Pa.; Griffin Wheel Company, Chicago, Ill.; General Systems Company, Dayton, Ohio; Hale & Kilburn Manufacturing Company, Philadelphia, Pa.; F. P. Harrison Electric and Manufacturing Company, Incorporated, New York; Albert B. Herrick, Ridgewood, N. J.; Heywood Bros. & Wakefield Company, Wakefield, Mass.; George S. Hastings & Company, Cleveland, Ohio; Helios Manufacturing Company, New York, N. Y.; Indianapolis Switch and Frog Company, Indianapolis, Ind.; Ingersoll Company, Pittsburg, Pa.; International Register Company, Chicago, Ill.; International Sprinkler Company, Philadelphia, Pa.; Kalamazoo Railway Supply Company, Kalamazoo, Mich.; Kinnear Manufacturing Company, Columbus, Ohio; Keystone Brake-Shoe Company, New York, N. Y.; Lagonda Manufacturing Company, Springfield, Ohio; Lorain Steel Company, Philadelphia, Pa.; George W. Lord Company, Philadelphia, Pa.; Lumen Bearing Company, Buffalo, N. Y.; John W. Masury & Son, Brooklyn, N. Y.; Maryland Steel Company, Sparrow's Point, Md.; McGuire-Cummings Manufacturing Company, Chicago, Ill.; National Brake Company, Buffalo, N. Y.; National Lock Washer Company, New-

Digitized by Google

ark, N. J.; Niles Car and Manufacturing Company, Niles, Ohio; R. D. Nuttall Company, Pittsburg, Pa.; National Car Wheel Company, Pittsburg, Pa.; Ohio Brass Company, Mansfield, Ohio; Ohmer Fare Register Company, Dayton, Ohio; Pantasote Company, New York, N. Y.; Pressed Steel Car Company, Pittsburg, Pa.; Pennsylvania Steel Company, Philadelphia, Pa.; Pittsburg Insulating Company, Pittsburg, Pa.; Quincy, Manchester, Sargent Company, Chicago, Ill.; Recording Fare Register Company, New Haven, Ct.; Joseph T. Ryerson & Son, Chicago, Ill.; Frank Ridlon Company, Boston, Mass.; Sherwin-Williams Company, Cleveland, Ohio; Standard Steel Works, Philadelphia, Pa.; Peter Smith Heater Company, Detroit, Mich.; Security Register and Manufacturing Company, New York, N. Y.; Star Brass Works, Kalamazoo, Mich.; St. Louis Car Company, St. Louis, Mo.; Sterling Varnish Company, Pittsburg, Pa.; The T. H. Symington Company, Baltimore, Md.; Schoen Steel Wheel Company, Philadelphia, Pa.; St. Louis Car Wheel Company, St. Louis, Mo.; Sterling-Meaker Company, Newark, N. J.; Taylor Electric Truck Company, Troy, N. Y.; Trolley Supply Company, Canton, Ohio; United States Metal and Manufacturing Company, New York, N. Y.; United States Engineering Company; W. T. Van Dorn Company, Chicago, Ill.; Van Dorn & Dutton Company, Cleveland, Ohio; Wallace Supply Company, Chicago, Ill.; William Wharton, Jr., & Company, Philadelphia, Pa.; Wheel Truing Brake-Shoe Company, Detroit, Mich.; Wilson Company, Chicago, Ill.

RAILWAY SIGNAL ASSOCIATION.

ANNUAL MEETING HELD AT WASHINGTON, D. C., OCTOBER 16, 17 AND 18.

The tenth annual meeting of the Railway Signal Association was held at the New Willard Hotel, Washington, D. C., October 16-17-18, with President C. H. Morrison, signal engineer of the Erie Railroad, in the chair. Commissioner MacFarland, of the District of Columbia, welcomed the delegates to the city at 10 a. m., October 16, before they went into regular session.

There were two sessions daily. Two hundred and thirty-one delegates were present and 538 persons attended the sessions. The programme, as published in advance notice No. 5, was followed as closely as permissible. However, on account of the importance of many of the subjects, papers and reports were set over to accommodate the convenience of the members, as well as many men prominent in the railroad world who came long distances to participate in the discussions. Every railroad in the United States was represented.

A well-arranged programme of entertainment was provided for the women, ninety being in attendance, and such men who found spare time between sessions. The visit to the Executive Mansion and the reception by the President of 267 of the members on Wednesday afternoon was much enjoyed. A theatre party at the National to witness "The Mountain Climber" by Francis Wilson was much enjoyed by 285 persons on Tuesday evening. The first annual dinner was held at the New Willard on Wednesday evening. There were 300 present. Commissioner MacFarland addressed the delegates and their friends. There were fourteen other speakers.

Fifty firms exhibited apparatus and supplies. Fibre, measuring apparatus, signal appliances and mechanisms of many designs, some in operation; derails, mercury arc rectifiers, crossing alarms, various makes of storage batteries, etc., were included.

"Standard Specifications for Mechanical Interlocking and Material for Construction Work," which was presented by a special committee, was adopted as printed, with slight alterations.

Committee No. 8 presented its report on "General Specifications for All Electric Interlocking." It was received as a progress report and the committee instructed to make recommendations next year.

The report of Committee No. 4, "Installation and Maintenance of Storage Batteries," was accepted as printed in advance notice.

"Specifications for Rubber-Insulated Signal Wire, 600 Volts or Less," which is a report from Committee No. 12, was accepted as printed, with the following exceptions, there being a very interesting discussion on many of the paragraphs:

Paragraph A was corrected to read "and must provide the company's" instead of "manufacturer's."

Same paragraph to read "Tests may also be made upon the finished product," etc.

Paragraph 8 to read "submerged in fresh water at a temperature," etc.

In table of sizes, etc., to read "B. & S. No. 2 test voltage A. C. 10,000" instead of 12,000.

The Special Committee on Interlocking and Block Signals elicited a great deal of good, healthy discussion, which disclosed many new and interesting points on the question of color scheme for night signaling, as well as upon the position of the arm—as to whether it is to be placed in the upper right-hand quadrant, or as now generally applied in the lower quadrant.

Recommendations "that two lights shall be displayed on every high-speed signal" and "that the stop indication shall be given by red lights in a vertical line" were adopted.

The report of Committee No. 11, "Signal Lamps," etc., was accepted and the committee instructed to confer with the lamp manufacturers and make further recommendations next year.

The special committee on "How to Remedy the Effects of Foreign Current on Automatic Block Signals" was accepted as printed and the committee instructed to confer with the various signal companies in an effort to gather more data, and make a further report, with recommendations, next year.

Committee No. 1, "Circuits for Automatic Block Signals for Steam and Electric Roads," made recommendations of specifications for relays, which were adopted with but slight modification. This is a very interesting subject and is always well discussed. This report is thought to be, without exception, the best on record. The specifications will no doubt be used generally on the steam roads.

Dr. William Churchill, of the Corning Glass Works, presented an unusually interesting paper on "The Optics of the Signal Lens." It is a valuable addition to the literature of the association. Dr. Churchill, it will be recalled, presented the paper entitled "The Rowndel Problem" last year, it being widely circulated.

The committee on "What Shall Constitute Cost in Estimate for Installation and Record of Maintenance?" presented a progress report.

Committee No. 3 presented a valuable report on "Circuits for Interlocked Signals," the historical matter being especially good and valuable.

Mr. Francis G. Shaw, of the International Switch and Signal Company, presented a paper entitled, "Devices to Keep Railroad Switches from Becoming Clogged with Snow and Ice." While there was no discourse on this paper on the floor, many inquiries were made into the matter and there was quite a lot of discussion elicited.

The annual meeting for 1907 will be held on the second Monday in October at Milwaukee, Wis.

The election of officers for 1907 resulted as follows:

President—J. A. Peabody, signal engineer Chicago & Northwestern Railway, Chicago.

Senior vice-president—A. H. Reidd, assistant signal engineer, Pennsylvania Railroad, Philadelphia.

Junior vice-president—L. R. Clausen, signal engineer, Chicago, Milwaukee & St. Paul Railway, West Milwaukee, Wis.

Secretary-treasurer—C. C. Rosenberg, consulting signal engineer, Bethlehem, Pa.

These gentlemen, together with the following, comprise the executive committee: H. C. Hope, superintendent Telegraph and Signals, Chicago, St. Paul, Minneapolis & Omaha Railway, St. Paul, Minn.; J. C. Mock, electrical engineer, Detroit River Tunnel Company, Detroit, Mich.; C. H. Morrison, signal engineer, Erie Railroad, Jersey City, N. J.; A. R. Raymer, assistand chief engineer, Pittsburgh & Lake Erie Railroad, Pittsburg, Pa.; H. S. Balliet, engineer of maintenance of way, Grand Central Station and Electric Division, New York City.

The entertainment committee and the committee of arrangements comprised the following—F. P. Patenall, signal engineer, Baltimore & Ohio Railroad, Baltimore, Md.; A. H. Rudd, H. S. Balliet, A. P. Eckert, Safety Insulated Wire and Cable Company, New York; L. Griffith, Federal Railway Signal Company; S. Johnson, Union Switch and Signal Company; J. M. Waldron, signal engineer, Interborough Rapid Transit Company; C. C. Anthony, inspector of signals Pennsylvania Railroad, Philadelphia, and J. W. Young, signal inspector, Erie Railroad, Jersey City, N. J.

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

Among the larger central-station companies the practice has been developed of making use of a specific character of stationery for certain of their lighting departments. The New York Edison Company has probably carried out this idea more completely than any of the other public service corporations. The accompanying illustration shows a sheaf of letterheads which are being used by the sign department. For the residence lighting department, the power department, apartment-house department, and, in fact, for every department, there is a carefully selected form of stationery. The paper is a fine bond, and is utilized in the most pleasing colors, such as pale pink, pearl grey and other popular tints. Where this can be afforded it is certainly very effective in promoting in the prospective consumer's mind the feeling that whatever business is under discussion is a personal and pertinent matter between the company and himself.

BUSINESS centers change, but the Edison Service is everywhere. When the Gorham building was erected on Fifth Avenue, the Edison service was on the spot ready to give it light, move its elevators, revolve its fans—ready for any service, great or small.
IT takes nine tailors to make a man, but it takes only two tailors to do the work of nine if they are helped out by an Edison goose. Such a goose keeps hot all the time, and only one goose is required, because it is heated while it works with the Edison current.
TENNYSON says:
Edison says that if the infant is crying only for a light, an electric light can be turned on by touching a button, but that most infants who cry in the night cry for something more substantial than light, and here again comes in the Edison service to heat the baby's milk with an Edison electric heater so as to reduce its crying to the lowest possible terms.
EUGENE FIELD has written down the gospel of reading in bed sufficiently well to satisfy every one. He deals more with the sort of books to be read in bed, and has said nothing about the light.
The only objection we have ever heard against reading in bed has been due to the badness of the light. Here the Edison Service steps in and provides the ideal bedside light to make reading in bed not only a delight but also harmless.
The Edison Service does so many little things so well that we wonder if you know all about all of them. If not, write, telephone or call.
The New York Edison Company
55 DUANE STREET

ONE-COLUMN AD. FROM A DAILY NEWSPAPER.

In addition to the selective character of the stationery, the Edison company makes a very extensive use of literature written especially to interest the particular class of consumer at whom the campaign is aimed, and from time to time use is made of the columns of the daily papers for some effective advertising, the characteristics of even this advertising being the same as those used in the company's direct-by-mail literature. The illustration herewith, taken from one of the daily papers, shows how the "Edison people" are brought to the attention of the reader and the utility of Edison service impressed upon his mind.

SOME LETTER-HEADS USED BY THE SIGN DEPARTMENT OF THE NEW YORK EDISON COMPANY.

Electric Railways in New South Wales.

United States Consul F. W. Goding reports that the number of miles of tramways open in New South Wales on June 30 was 126 and the average cost per mile, including workshops and rolling stock, was $141,576. The percentage of profit to capital invested was $24.71, as compared with $17.11 in the previous year and $9.63 in 1888. The percentage of working expenses to earnings was 78.11, being a reduction of nearly six per cent. The return per average mile open, after paying working expenses, $7.197, the earnings per tram mile $0.25, the working expenses $0.19, leaving a return of $0.05. The number of passengers carried was 145,262,779 and the mileage run 16,309,907.

Test of an Electric Car Brake.

A report has been presented to the town clerk of Halifax, England, dealing with a recent test of an electric car brake on one of the city cars. Trials were made on grades varying from five to nine per cent. With the car running at a speed of sixteen miles per hour it was possible to bring it to a standstill in four seconds without the application of the brake, and within a distance of fifty feet. When running at twenty-one miles an hour it was stopped in 170 feet in ten seconds. When passing over a grade of four and one-half per cent at a speed of twenty-four miles an hour, the car was stopped in sixteen seconds after running 360 feet.

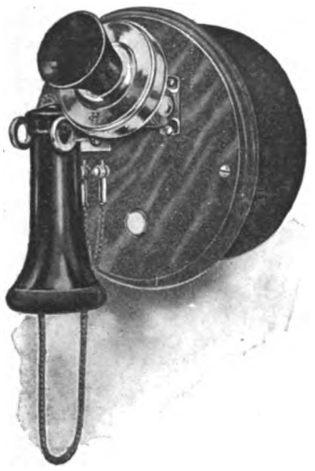
Digitized by Google

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

New Types of Interior Telephones.

The accompanying illustrations show three new types of interior telephone instruments which have recently been placed on the market by the Holtzer-Cabot Elec-



SINGLE-POINT CIRCULAR FLUSH WALL TELEPHONE.

tric Company, Brookline, Mass., and Chicago, Ill. They are built along lines similar to other standard instruments manufactured by this company, and yet are distinctly new in the combination of the different parts which enter into their make-up.

The single-point circular flush wall

SINGLE-POINT SCHOOL TYPE TELEPHONE.

telephone is designed for use in locations where space is somewhat limited and where an instrument that protrudes from the wall would not be desirable. The working parts are enclosed in a metal case six inches in diameter which sets into the wall, allowing the face of the instrument to rest flush with the wall surface. The transmitter is of the solid back, granular carbon type, mounted on an adjustable bracket so that it may be used by persons of different heights. The receiver is of the standard bi-polar, enclosed terminal type, mounted in a hard-rubber shell. The face of the instrument may be finished in any one of a variety of woods which is best suited to the location where the instrument is to be installed. A flush push button for calling is mounted on the face and if desired a number of buttons may be added so that the instrument can be used in connection with others of a similar nature, making a complete interior telephone system. These instruments can be used in connection with the Ness automatic central, or may be used as branches of a telephone exchange.

The single-point school type of telephone is one of the latest types of tele-

HAND MICROTELEPHONE.

phone instruments brought out by the company. It will be found especially adapted for use in schools, hospitals and similar buildings. The equipment of the instrument is much the same as that of the flush telephone just described. A solid back, granular carbon transmitter is used, mounted on an adjustable bracket, and the receiver is of the bi-polar, enclosed terminal type, in hard-rubber shell. Standard battery telephone bells are used and a flush push button is provided for calling. A feature which has been added to this instrument is that of a chain connecting the receiver cord to the switch hook, so that if the receiver is accidentally left hanging, the contacts are closed and the instrument is connected into circuit. Instruments of this type can be used with good efficiency in connection with a Ness automatic central, or with a telephone annunciator. They may also be used in pairs if desired. The standard finish of these instruments is quartered oak, but they may be made to match the surroundings where they are to be installed.

In the hand microtelephone there is a unique combination of a bi-polar, watch-case receiver and a granular carbon transmitter. The construction is such that when the receiver is held to the ear, the mouthpiece of the transmitter is in proper position for speaking. The handle, which is of hard rubber, contains a push button which throws the batteries in or out of circuit at the will of the operator, thus prolonging the life of the batteries, as they are automatically cut out when the set is not in use. The instrument is solidly and durably built and may be readily taken apart for inspection or adjustment. It is provided with a ring so that it may be hung up out of the way and it is especially adapted for use as a desk instrument in connection with a local telephone exchange or as a branch instrument with the Ness automatic central, and in fact in all capacities in which a portable instrument can be used. These instruments may be provided with a metallic mouthpiece for the transmitter, when used where they will receive hard usage. The instrument is neat in appearance and conveniently light to handle.

Monthly Dinner of the Boston Edison Company.

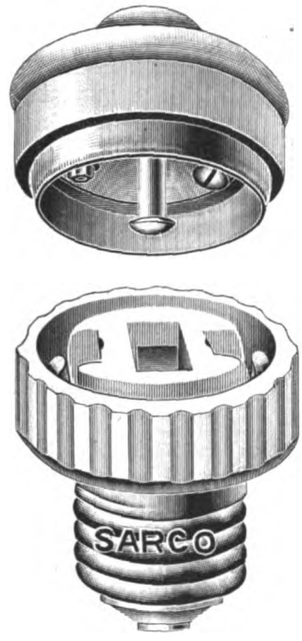
The Boston Edison Company, Boston, Mass., held its monthly meeting and dinner on Friday evening, October 12. Van Rensselaer Lansingh, engineer and general manager of the Holophane Glass Company, gave an informal talk on the general principles of illumination, with particular examples of different classes of lighting for residences, stores, etc. Lantern slides were shown illustrating both good and bad features of the lighting of bedrooms, parlors, libraries and kitchens.

The address was followed by a discussion of the features of the latest forms of lamps, such as the tungsten, tantalum, and "Gem," and the necessity of using these lamps in the best possible way, especially with proper and correct reflectors designed for them.

Digitized by Google

A New Separable Switch Attachment Plug.

An innovation in attachment plugs recently placed on the market by the Sarco Company, 906 Sixth avenue, New York city, is shown in the accompanying illustrations. This is designated as the Sarco swivel separable attachment plug. This attachment plug, in addition to being separable, is also a swivel plug, and, at the same time, will pull apart at any angle.



SEPARABLE ATTACHMENT PLUG—OPEN.

By an ingenious locking device in the bottom part of the plug the top part is gripped firmly, and at the same time has a ball-bearing revolving contact. The heavy circular band in the top part of the plug makes contact with two heavy phosphor-bronze spring contacts in the bottom plug, making one pole; while the centre stud in the top locks into the centre of the bottom plug, thereby giving a very large contact surface.

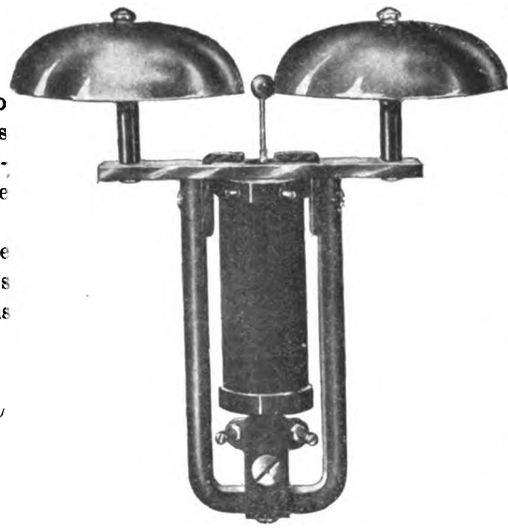
SEPARABLE ATTACHMENT PLUG—CLOSED.

Should the cord attached to the plug become twisted it is not necessary to separate the plug, but simply to revolve the top part, as this part swivels in either direction. If, however, the cord should be accidentally struck or strained, the top part will become separated from the bottom, automatically disconnecting the circuit.

The plug has ample room inside the top part for a knot in the cord, and will take any size of standard re-enforced cord. It may be used to advantage for heating apparatus, motors and massage machines, on account of its heavy carrying capacity, and is also adapted for physicians' appliances, X-ray machines, charging of storage batteries, etc.

"Wotton" Single-Coil Ringers.

The accompanying illustration shows the new "Wotton" single-coil ringer made by the Electric Manufacturing and Equipment Company, Atlanta, Ga. This ringer is the result of exhaustive experimental work covering several years' development of a single-coil ringer and more than six years' successful manufacturing experience in the production of the "Wotton" loud-ringing extension gong, in which the same principles are employed. The company claims great reliability for these ringers because of an improved magnetic circuit and permanent magnets. The coils are wound on insulating tubes, so that grounding of the core is eliminated and a greater sensitiveness ensured. It is stated that this ringer will operate through twenty per cent greater resistance or a condenser of twenty per cent less capacity than the average double-coil ringer of the same resistance. The ringer operates clearly on frequencies from two to sixty-six cycles and can be rung direct from an alternating lighting circuit when desirable.



"WOTTON" SINGLE-COIL RINGERS.

With a total length the same as a double ringer, the width of the mechanism with the single-coil ringer is a little more than half.

Electrical Engineering Department, Columbia University.

The electrical engineering department of Columbia University has secured Ernest S. Holcombe, B.S., '01, Cornell, to take charge of its instrument and standardization laboratory, with the title of lecturer. S. S. Watkins, E.E., Columbia '06, has been secured as assistant in the direct-current laboratory, and C. Otto von Dannenberg, B.E., Union College '06, as assistant in the alternating-current laboratory.

The electrical engineering department of Columbia University is now the official testing laboratory for electricity meters for the city of New York. Complaints from consumers made to the Department of Water Supply, Gas and Electricity are sent to Columbia University, when a test officer immediately makes a test of the complainant's meter and reports to the department.

A Correction.

Through an error in preparing the list of New York installations of the C & C Electric Company in an advertisement which appeared in the ELECTRICAL REVIEW last week, the Hotel Astor was given as one of this company's installations. The electrical installation of this hotel, however, was made by the Western Electric Company.

Special Announcement.

Our readers will be sorry to learn of the partial destruction of the splendid printing establishment of the James Kempster Printing Company, New York city, where for the past twenty years the ELECTRICAL REVIEW has been printed. For sixteen years also this company has printed the transactions of the National Electric Light Association, and for thirty-one years has been printing the stationery of the Western Union and its predecessors. The rapidity with which new facilities were established and the work in hand carried on is worthy of all praise.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

LARGE MORTGAGE FILED—The Long Island Consolidated Electrical Companies, a subsidiary concern of the Long Island Railroad Company, has filed a mortgage to the United States Mortgage and Trust Company, of New York city, as trustee, to secure an issue of $10,000,000.

NEW ALABAMA POWER COMPANY—Articles of incorporation have been filed with the probate judge of Montgomery County by the Mussel Shoals Hydroelectric Power Company. The company is capitalized at $1,000,000, and will develop the power of the Tennessee River at Mussel Shoals in Colbert County. The incorporators are New York, Nashville and Montgomery capitalists.

NEW ELECTRIC ROAD—With a capital of $1,000,000, the Hornell, Bath & Lake Keuka Railway Company has been incorporated at Albany, N. Y., to construct an electric road in Steuben and Yates counties forty-six miles long, connecting the Pittsburg, Shawmut & Northern Railroad in Hornell with Jerusalem. The directors are John F. Turk and Charles G. Wheeler, of Hammondsport; Leslie D. Whiting, of Canasteo, and Frederick W. Hastings and Wilson R. Campbell of Bath.

UNITED GAS IMPROVEMENT COMPANY NEGOTIATING FOR SYRACUSE LIGHTING COMPANY—Negotiations are under way which may result in the taking over by the United Gas Improvement Company of the Syracuse Lighting Company. This company owns the Electric Light and Power Company, of Syracuse, N. Y., and the Underground Electric Wire Company, of the same city. In 1902 it acquired a controlling interest in the Syracuse Gas Company, exchanging $1,500,000 of its common stock for an equal number of shares of the gas company. The Syracuse Lighting Company has a capital of $3,000,000 common and $1,000,000 preferred, while its funded debt amounts to $2,165,000.

WASHINGTON, BALTIMORE & ANNAPOLIS ELECTRIC ROAD TO VOTE ON AN INCREASE IN CAPITAL STOCK—The stockholders of the Washington, Baltimore & Annapolis Electric Railway Company will meet in Annapolis on November 2, to vote on a proposition to increase the capital stock from $4,000,000 to $5,250,000. The new capital will be used in connection with the financing of the Baltimore Terminal Company, which is to furnish an entrance into Baltimore for the line. Arrangements were recently completed in Cleveland for underwriting $1,250,000 of the Baltimore Terminal Company's five per cent first mortgage bonds. It is said that the Washington company will acquire all the stock of the Terminal company.

NEW WASHINGTON RAILWAY AND POWER COMPANY—There have been filed articles of incorporation of the Cowlitz Valley Railway and Power Company, with the principal place of business in Seattle, Wash., and branch offices in Chicago, Ill. The company is capitalized at $5,000,000, divided in $100 shares, and is entitled to construct and operate railways of any motive power, to operate steamboat lines on the Columbia river or any of its tributaries, on the Pacific ocean, and on Puget sound, to develop and operate electric power plants and to engage in mining operations. The trustees, five in number, who hold office until April, 1907, are: Carl Mueller, of Chicago; J. R. Deahl, of Chicago; C. C. Brown, of Castle Rock; C. W. Riddell, of Cascades; H. H. Riddell, of Portland.

ELECTRICAL NOTES FROM MEXICO—The Schoendube & Neugebauer Company has obtained a contract to execute the work necessary to utilize 10,000 litres of water per second, as a maximum, from the Conchos river, in the Iturbide district, in the state of Chihuahua. Aerial or subterranean lines may be used for transmitting electric power. Within twenty months from October, 1906, construction of the works must begin, and the plant must be completed in seven years. The concessionaires agree to contribute $250 per month to the inspection fund in the Federal treasury. Free importation of the necessary material is allowed for once only, and the capital invested is exempted from all taxation, except stamps, during a term of five years. The concessionaires, or the company they may organize, are authorized to issue shares, bonds and obligations, and to dispose of these. Due compliance with the terms of the contract is guaranteed by a deposit in the National Bank of Mexico of $5,000 in bonds of the consolidated public debt. The usual franchises are granted in addition to the foregoing. An American company has been formed in the state of San Luis Potosi for the purpose of using the Tamasopa falls in that state for the development of power. It is understood that engineers have practically completed all the preliminary work and that operations for harnessing the falls will be begun at once.

ELECTRIC RAILWAYS.

MARYSVILLE, CAL.—The Northern Electric Company is to erect a substation at Marysville.

BRYAN, TEX.—The trolley line from Bryan to the Agricultural and Mechanical College is now assured, the full required amount of $15,000 to be subscribed by the people of Bryan having been raised.

GALLIPOLIS, OHIO—The city council has granted M. K. Duty, of Pennsboro, W. Va., a twenty-five-year franchise to construct and operate an electric street railway in Gallipolis. The preliminary survey has already been made.

SAULT STE. MARIE, MICH.—Street cars will be running between this city and the suburb of Algonquin by the first of December, it is announced by the Trans-St. Mary's Company. Construction work on the extension of the line will be started shortly.

WILKESBARRE, PA.—Plans have been arranged by the Wilkesbarre & Wyoming Valley Traction Company to expend $500,000, in order to extend the Georgetown line to Georgetown, the Sugar Notch line to Warrior Run and to make other improvements.

TRINIDAD, COLO.—The Trinidad electric street railway contemplates an extension of its lines. Frank P. Read, the president, states that the company will build to Berwind, Stonewall, Aguilar and perhaps to Walsenburg, tapping the various camps en route.

SHELBYVILLE, MO.—The Shelby County Railway Company has been incorporated to build a road from Shelbina to Shelbyville. The officers are: president, W. C. Blackburn; vice-president, M. S. Smith; secretary and treasurer, L. G. Scofield. Work will commence immediately.

ATLANTA, GA.—The proposition known as "workingmen's fares," or a three-cent rate for certain hours, is being considered by the Georgia Railway and Electric Company for its trolley lines in this city. Steps are also being taken for the enlargement and improvement of the service.

LAFAYETTE, IND.—The board of county commissioners has given to the Lafayette & Hoopeston Interurban Railway Company a franchise to construct and operate an electric railroad through Tippecanoe county from the west town line of West Lafayette to Otterbein, the grant being for a period of fifty years.

RED BLUFF, CAL.—W. D. Nicholson, locating engineer for the Shasta Southern electric road, has intimated that when the proposed first section of the electric road is completed between Hamilton City and Red Bluff the company will build a branch road from Corning to tap the fertile Paskenta section, some twenty miles west, along the foothills.

HUNTINGTON, L. I.—As a result of the trolley franchise hearing, in the matter of the application of the Huntington Railroad Company to extend its line from Huntington to Amityville, it was resolved that the highway commissioners of the town of Huntington prepare the draft of a proposed franchise to be submitted to the applicants for their acceptance.

NORWICH, CT.—At a meeting of the incorporators of the Lebanon Street Railway Company the following directors were chosen: N. C. Barker, F. B. Fowler, L. E. Livermore, G. H. Hewitt, Isaac Gillette, S. W. Troop, J. Henry King, John Clark and L. R. Smith. At a subsequent meeting the directors chose officers as follows: president, J. E. Livermore, of Lebanon; secretary and treasurer, L. R. Smith, of Lebanon; attorney, C. W. Comstock, of Norwich. The company voted to accept the charter which was granted by the

Digitized by Google

last legislature. The financing of the project will be looked after at once. It is believed the eleven miles of road can be built for $250,000.

COLUMBUS, OHIO—It is reported that J. A. Vandegrift, C. H. Paist and W. C. Neuhaus, of Philadelphia, have concluded negotiations for the purpose of the traction line between Delaware and Magnetic Springs. It is stated that they propose to extend it to connect La Rue with the Lima, Kenton & Marion electric line. At a meeting of the Lima, Kenton & Marion stockholders, the capital stock of the company was increased from $100,000 to $1,000,000.

CARTHAGE, MO.—Promoter Rawlins of the proposed Missouri-Kansas electric railroad, states that work will positively begin on the system shortly, and that it will be pushed through to completion as rapidly as possible. He says that $25,000 worth of material is already in transit and will soon be on the ground. The proposed road will be 150 miles long. It starts at Carthage, runs through the lead and zinc mining districts of southwest Missouri, the coal, gas and oil fields of Kansas, and terminates at Coffeyville.

KENTON, OHIO—The organization of the Columbus, Magnetic Springs & Northern Traction Company has been completed. The following are the first officers: president, W. S. Galbraith, of Pitts burg; secretary and assistant treasurer, W. N. Embert, of Baltimore; treasurer, C. Magee, of Pennsylvania; board of directors, W. S. Galbraith, W. N. Embert, C. Magee, Jr., J. H. Leonard, of Larue, and J. S. Horn, of Richwood. The company will incorporate at $400,000, buy the Magnetic Springs & Delaware line and extend it to Larue *via* Richwood.

POTTSVILLE, PA.—The Eastern Pennsylvania Railway Company and the General Utilities Company, which corporations have bought up all the trolley lines and electric light plants in this part of the state, are to make extensive improvements. The power-house at Palo Alto is to be equipped for furnishing heat and light, and the Pottsville plant is to be abandoned. Another large power-house will be erected at Tamaqua. The current from that place will be supplied for the upper section of Schuylkill, while the Palo Alto power-house will supply the lower county.

KUTZTOWN, PA.—The Allentown & Reading Traction Company will inaugurate a new system for supplying power to its line between Kutztown and Allentown. At present the company has two power-houses, one located near Allentown, which furnishes power from Allentown to Breinigsville. The other is located here and furnishes power from Kutztown to Temple and from Kutztown to Breinigsville. The company has decided to do away with the Allentown power-house and to install sufficient additional machinery in the Kutztown plant to operate the entire system.

OMAHA, NEB.— F. N. Clarke, treasurer of the Omaha Commercial Club, has been authorized to go to New York with William J. Dobbs, of Tabor, Iowa, president of the proposed Council Bluffs, Tabor & Southern Electric Railway Company, to enlist $2,000,000 capital in financing the enterprise. The line for the road has been fully surveyed, the plans prepared and everything ready for to begin work when the money is available. The proposed road will extend from Council Bluffs to Tarkio, Mo., a distance of seventy-six miles, passing through half a dozen towns in the choicest grain and fruit district of southwestern Iowa and northwestern Missouri. It has been demonstrated satisfactorily to the Commercial Club that the road would add 43,000 people to Omaha's population.

NEW HAVEN, CT.—The important work which has been planned by the Connecticut Railway and Lighting Company for its electrical plants in the Housatonic and Naugatuck valleys is taken by local capitalists to indicate that there is no prospect of the company's being sold out to the Consolidated Railway Company. This new work covers an outlay of $750,000 for a new dam about twelve miles below Bull's Bridge dam on the Housatonic river, and also a similar outlay for a steam generating plant at Waterbury, to be used in case of breakdowns. Besides this, the lighting company is working steadily to finish its line of trolley road from Waterbury to connect its lines down from Naugatuck to Ansonia, on the east side of the Naugatuck river. This line will parallel the new double tracking of the New Haven steam road between the same points on the west bank of that river. The Waterbury generating plant will be built at once.

TELEPHONE AND TELEGRAPH.

PONTIAC, MICH.—The rebuilding of the Michigan State Telephone Company's system will be completed by November 15.

LEAVENWORTH, KAN.—R. B. Yoakum has been awarded the contract for the new building of the People's Home Telephone Company. His bid was $14,000.

SPOKANE, WASH.—Representatives of the Pacific Telegraph and Telephone Company state that the concern has set aside more than $125,000 for the development of the field in central Washington.

ALBANY, N. Y.—Negotiations have been completed by the United States Message Company for the taking over of the Commercial Union Telephone Company, which operates in Troy and surrounding towns.

SPOKANE, WASH.—Ten thousand eight hundred telephones are in operation in Spokane under the direction of the Pacific States Telegraph and Telephone Company. This is an increase of 1,200 over three months ago.

PHILADELPHIA, PA.—The American Telephone and Telegraph Company has leased for a term of ten years, from February 1 of next year, the entire seventh floor of the Bourse. The rental will be at the rate of $15,000 a year.

SPOKANE, WASH.—C. L. Wilson, solicitor for the Pacific States Telegraph and Telephone Company, is reported to have secured all the farmers' lines in the vicinity of Nez Perce, Ida., southeast of Spokane, and in connection with this it is announced that five other lines will be built this fall.

SPOKANE, WASH.—The Interstate Telephone Company is making progress with its line from Post Falls, Ida., to Spokane, and it will probably be in operation before the end of the year. It is announced that no rural telephones are to be installed for the present, but that a majority of the ranchers south of the foothills in Idaho and eastern Washington will be given service the coming year.

SPOKANE, WASH.—Plans have been completed for the headquarters of the Home Telephone Company, in Spokane, to cost $60,000. The structure will be of reenforced concrete, fireproof, and is to be completed in May, 1907. It will have a frontage of seventy-one feet with a depth of 100 feet, height two stories and basement. A substation to cost $5,000 will also be erected in Spokane. An automatic switchboard will be installed on the second floor of the main building.

SPOKANE, WASH.—The capital stock of the Interstate Telephone Company, as already announced, is to be increased to $500,000, which will be used in building extensions. M. A. Phelps, president of the company, announces that already 250 miles of line is in operation and that lines will be built in various parts of Washington, Oregon and Idaho. An exchange is to be established in Spokane, which will probably be headquarters for the company. Mr. Phelps has called a meeting of the stockholders for November 2, when several plans will be discussed.

NEW BEDFORD, MASS.—Important changes, including an increase in the capital stock and a replacement of the present equipment with new, have been decided on by the Automatic Telephone Company, of New Bedford. The adoption of the new system will relieve the company of the obligation of paying the royalties that are now required and will, it is expected, place the company on an improved financial basis. The capital stock, it is understood, will be increased from $100,000 to either $150,000 or $200,000, and the present equipment will be replaced with new to a large extent.

NEW HAVEN, CT.—The new Stamford exchange of the Southern New England Telephone Company has been completed, making one of the most substantial buildings used by the company in the state. The installation of the new common battery switchboard is in progress, and the work on the terminal apparatus is also well advanced. There are 4,500 single wires running into the terminal room, and five cables, each containing 400 pairs of wires, one containing 200 pairs and one fifty pairs. The date for the "cut over" from the old exchange has not been set. The new exchange will, however, be opened as soon as practicable, and will double the telephone facilities in the Stamford district.

Digitized by Google

PERSONAL MENTION.

MR. C. O. BAKER, the widely known platinum importer and refiner, is also prominent in banking circles, and is a large stockholder and director in the National State Bank of Newark, N. J. Last week Mr. Baker and his wife attended the National Convention of Bankers at St. Louis, to which Mr. Baker was a delegate.

DR. SAMUEL SHELDON, professor of physics and electrical engineering at the Polytechnic Institute, Brooklyn, N. Y., received the honorary degree of doctor of physics from the University of Pennsylvania upon the occasion of the dedication exercises of the university's new engineering building last week. Dr Sheldon has been at the head of the electrical and physical departments of the Polytechnic since 1889.

DR. ANDREW FLEMING WEST has been formally invited to accept the presidency of the Massachusetts Institute of Technology, as the successor of President Pritchett. Dr. West was born in Allegheny, Pa., May 17, 1853. He is a son of the Rev. Nathaniel and Mary Tassey West. He was fitted for college in the private schools of Brooklyn and Philadelphia, and entered Princeton in 1870, taking the regular four-year classical course and graduating in 1874 with the degree of bachelor of arts. At Princeton he gained special distinction in Latin and Greek. He was appointed to the chair of Latin at Princeton in 1883, and in 1901 he became dean of the Graduate School. Dr. West is a prolific writer on educational topics, and has been honored by a number of institutions, including his own, with honorary degrees. In 1883 he received the degree of doctor of philosophy from Princeton; in 1897, doctor of laws from Lafayette, and in 1902, doctor of literature from the University of Oxford, England. He was president of the American Philological Association 1901-1902, and has been chairman of the American School of Classical Studies at Rome. He was married on May 9, 1889, to Lucy Marshall Fitz Randolph.

NEW PUBLICATIONS.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS—The proceedings of the annual meeting of the Association of Railway Telegraph Superintendents, held at Denver, Col., June 20 and 21, have been printed. The volume includes also the constitution, by-laws and list of members.

PUBLIC LECTURES, DEPARTMENT OF EDUCATION, NEW YORK CITY—The department of education of the city of New York has prepared a prospectus giving the subjects of various public lectures, and dates and places where they will be delivered, for the season of 1906-1907. Henry M. Leipziger, Ph.D., is supervisor of lectures.

RESISTANCE OF TUBES TO COLLAPSE—The engineering experiment station of the University of Illinois has issued bulletin No. 5, dealing with the resistance of tubes to collapse. This gives the results of some elaborate experiments by Dr. A. B. Carman, professor of physics, and Maurice L. Carr, on the resistance of thin brass tubes to collapse.

AN EFFICIENCY METER FOR INCANDESCENT LAMPS—An article describing an efficiency meter for electric incandescent lamps, contributed to a recent issue of the *Bulletin of the Bureau of Standards* by E. P. Hyde and H. B. Brooks, has been reprinted in pamphlet form. This describes an apparatus arranged to give direct readings of incandescent lamp performance.

ELECTRICAL SECURITIES.

The market, which for four days of the week was dull and with slowly sagging movements, was changed on Friday to a more or less demoralized condition on the news that the Bank of England had raised its discount rate to six per cent. This is an unusually high level and one in force only in times of emergency. The effect of this was shown in the rise in the home money market, the call rates going to seven per cent, with foreign exchange also moving up. The announcement of the new dividend for Amalgamated Copper putting the annual dividend on an eight per cent basis, failed to effect a rally, and this was looked upon as an ominous factor. However, industrial and business conditions are held to be much too sound and prosperous to permit any extensive price break. Railroad earnings, the iron and steel trade, bank clearings and all other immediate data reflect continued commercial prosperity, and will very likely prove a decided market mainstay.

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 20.

New York:	*Closing.*
Allis-Chalmers common	16⅝
Allis-Chalmers preferred	43
Brooklyn Rapid Transit	76⅞
Consolidated Gas	138
General Electric	175
Interborough-Metropolitan common	36⅛
Interborough-Metropolitan preferred	75⅝
Kings County Electric	155
Mackay Companies (Postal Telegraph and Cables) common	71¼
Mackay Companies (Postal Telegraph and Cables) preferred	70
Manhattan Elevated	142
Metropolitan Street Railway	107
New York & New Jersey Telephone	125
Western Union	86
Westinghouse Manufacturing Company	154

The formal notice of the special meeting of General Electric stock holders, to be held November 20 in Schenectady, N. Y., has been issued, the object of the meeting being to authorize the increase of $20,000,000 in the capital stock recommended by the board of directors. Secretary Ely, of the New York Stock Exchange, has been notified of the proposed increase in the capital stock of the General Electric Company from $60 000,000 to $80,000,000.

Directors of the Western Union Telegraph Company, at a meeting on October 17, reelected all the old officers of the company with the exception that W. E. Atkins was made vice-president of the contracting department. The executive committee has been reduced in number from twelve to nine. On account of a possible defect in advertising the special meeting of the stockholders of the Western Union held on October 10 to authorize an issue of bonds, and on account of the magnitude of interest involved, counsel has advised that another special meeting of the stockholders be called with a view of reenacting the proceedings of the meeting of the tenth. The meeting will be held November 23.

Boston:	*Closing.*
American Telephone and Telegraph	136
Edison Electric Illuminating	235
Massachusetts Electric	69½
New England Telephone	129½
Western Telephone and Telegraph preferred	84

The directors of the Edison Electric Illuminating Company have declared the regular quarterly dividend of 2½ per cent, payable November 1 to stockholders of record October 18.

The American Telephone and Telegraph Company reports the output of instruments for the month of September as follows: gross output, 131,926; returned, 69,660; net output, 62,266. From January 1 to September 30 the net output has been 1,124,579. The total now outstanding is 6,882,837.

Philadelphia:	*Closing.*
Electric Company of America	11⅜
Electric Storage Battery common	70
Electric Storage Battery preferred	70
Philadelphia Electric	8⅜
Philadelphia Rapid Transit	28⅛
United Gas Improvement	89½

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	145
Metropolitan Elevated preferred	66½
National Carbon common	87
National Carbon preferred	119
Union Traction common	——
Union Traction preferred	——

Directors of the Chicago Edison Company have declared the regular quarterly dividend of 2 per cent, payable November 1 to stock of record October 20.

The finance committee of the Metropolitan West Side Elevated Railroad Company has funded its loans of $600,000 for a period of six years in favor of the First National Bank. The company has given its notes for this amount, bearing 5 per cent interest, securing the loan by deposit of extension bonds. A payment of $50,000 is due April 1, 1907, and a like amount every six months until the entire obligation is canceled on October 1, 1912. The Metropolitan, however, has the option of calling any one of the unpaid notes upon giving thirty days' notice.

Digitized by Google

ELECTRIC LIGHTING.

SHELBY, ILL.—The electric light plant at Tower Hill has been sold to Ross Shride.

ASHTABULA, OHIO—The city council has voted to sell the municipal lighting plant.

CUSHING, TEX.—Messrs. Yother & McCuen will begin work on the light plant as soon as the material arrives.

DAYTON, OHIO—The Dayton Citizens' Electric Company has taken out a building permit for the new power plant which the company will build at Third and Webster streets.

MEETEETSE, WYO.—A company is being formed by capitalists of Meeteetse and Kirwin to erect a large electric power plant at Kirwin to operate the mines at that place and an electric trolley line between the mining camp and Meeteetse.

GREENVILLE, PA.—The plant of the People's Electric Light, Heat and Power Company, including buildings and equipment, is advertised to be sold by the trustees on November 8. Financial difficulties of long standing forced the company to make an assignment several weeks ago.

GRAND FORKS, WASH.—The substation for the West Kootenay Power and Light Company at Grand Forks is now completed. It is fifty-two by fifty-five feet with a switch tower fifty feet high. This substation building has cost $20,000 to build, and the machinery to be installed will cost another $20,000.

HOUGHTON, MICH.—The Tamarack mine has made arrangements to install an electric plant with a capacity of 150 horse-power. The equipment will be put in place probably early next year, as it will not be possible to get the necessary machinery before that time. The building for its accommodation will be provided in the meantime.

BIG RAPIDS, MICH.—The Grand Rapids-Muskegon Water Power and Electric Company has secured the contract for lighting the streets of Big Rapids. They have been in darkness since last spring, when the flood on the Muskegon river tore out the dam which furnished power for W. E. Donley's electric light plant. His contract with the city expired in August.

BURLINGTON, N. J.—The Burlington Electric Light and Power Company has elected the following officers: president, Griffith W. Lewis; Thomas Daniels, treasurer; Theodore F. Ellis, Jr., secretary. Directors, Nathan Haines, G. W. Lewis, Thomas Daniels, George A. Allinson, Theodore F. Ellis, Jr., George W. Anthony, Forrest K. Curl, William J. Fry, James O. Glasgow.

SPOKANE, WASH.—The Spokane County Electric Light and Power Company has been incorporated with these officers: president, D. L. Huntington, Spokane; vice-president, H. L. Bleeker, Spokane; secretary-treasurer and general manager, H. W. Collins, Rockford, with headquarters at Rockford, Wash. The company will furnish light and power to towns in the southeastern part of Spokane county.

CINCINNATI, OHIO—Norman G. Kenan, president of the Union Gas and Electric Company, states that the executive committee of the company has decided to wire free of charge small homes, so that the occupants can use electricity for illumination. This is a plan that Mr. Kenan has had in mind for a long time, but was not able to put it into effect until the Union Gas and Electric Company leased the Cincinnati Gas and Electric Company's property.

NEW ALBANY, IND.—Water power sufficient to generate 1,000 horse-power of electricity is said to be going to waste at the falls in Blue river, near White Cloud, Harrison county, and the feasibility of utilizing the falls, owned by William and Julius Rothrock, of Harrison county, is being investigated. It is asserted that there is sufficient power to operate an electric line between Corydon and the Falls Cities, and also to run all the factories at Corydon and illuminate the streets and houses.

SHAWNEE, OKLA.—The city has authorized the mayor to enter into a contract with the Shawnee Lighting Company for the number of lights now maintained at a rate of $6 per month. Additional lights up to 300 will be installed as fast as the taxable valuation warrants the city in expending the money. About thirty-five new lights will be put in within the next two months. The old rate was $8 per month and the contract recently expired. The new rate will remain in force for eighteen years.

ALBANY, N. Y.—Work on the power-house of the Hudson River Electric Power Company, which will be located along the Mohawk river in Niskayuna, just above Vischer's Ferry, will be started, it is thought, next spring. The power-house will be built of brick and will be similar in size and capacity to the Mechanicsville plant. It is expected that between 6,000 and 7,000 horse-power will be generated. The power will be furnished by seven General Electric turbo-generators of 1,000-horse-power capacity each.

JACKSONVILLE, FLA.—Negotiations which have been pending for several months have been closed, whereby the Jacksonville Electric Company agrees to transfer to the city of Jacksonville its franchise for electric lighting and to retire from further competition with the city plant, thus giving it the exclusive right to furnish electricity to consumers. The Jacksonville Electric Company operates the street railway system, and has been furnishing lights and power to consumers in competition with the municipal plant, doing a business of $60,000 a year.

WAYCROSS, GA.—Mayor Knight will take up with the city council the matter of municipal ownership of the electric lights as soon as it is possible to do so. In the meantime, however, the city has installed an electric light dynamo in the waterworks plant and is furnishing electric lights for the city hall, fire station and the waterworks station. Nearly every member of the present city council favors municipal ownership of lights, but nothing can be done toward installing a plant for public use until the present contract which the city has with the Waycross Electric Light and Power Company expires.

UTICA, N. Y.—W. G. Stone, civil engineer, of this city, has completed plans for the development of a water power at Chenango Forks on the Chenango river for Peters Brothers, of that place, who conduct a large flour mill, saw mill and planing mill. In the spring a modern concrete dam and power-house will be constructed. The dam will be 400 feet long and the power-house will be fifty by seventy feet. The spillway will be about 375 feet long. The dam is designed for a depth of seven feet of water on its crest. A system of compensating reservoirs is included in the general plan. Peters Brothers have made arrangements to dispose of all the power that they can produce in addition to that which they need for their business.

JACKSON, MICH.—At a meeting of the stockholders of the Boyne River Power Company, held at Grand Rapids, the following directors were elected: Amos S. Musselman, S. A. Sears, C. C. Follmer, Frederick C. Miller and E. A. Stowe. At a meeting of the directors held subsequently to the meeting of the stockholders the following officers were elected for the ensuing year: president, E. A. Stowe; vice-president, Amos S. Musselman; secretary, C. C. Follmer; treasurer, Frederick C. Miller. Mr. Miller was elected manager as well as treasurer and has left for Boyne City, where he will open an office and direct the erection of a thirty-three-foot dam across Boyne river, three miles southeast of Boyne City, the power thus generated to be utilized to light Boyne City, Boyne Falls, Clarion and the resorts on Walloon lake.

NIAGARA FALLS, ONTARIO—The Hydroelectric Power Commission of the province has submitted its third report and the following matter bearing upon the Niagara Falls power situation is contained therein: The cost and charges of a secondary transmission line from Berlin through Elmira to Elora conveying power from Niagara Falls on a basis of 750 horse-power are given at: Total investment, $39,952; annual charges, $4,435; cost for twenty-four-hour power, per year, at Berlin substation, $17.36; at Elmira, $24.10; at Elora, $26.56; at Fergus, $29.91. The statistical portion of the report gives detailed estimates of the capital, costs and annual charges of five hydroelectric developments of a total nominal capacity of 9,950 horse-power, and in connection therewith detailed estimates of the capital costs and annual charges, etc., of transmission systems and substations necessary to deliver this power to various municipalities; and also some 3,900 additional horse-power from Niagara Falls to meet a demand for power in localities which it has not been found feasible to supply from water powers of the district.

Digitized by Google

NEW INCORPORATIONS.

HARRISBURG, PA.—Junction City Electric Company, Rochester. $5,000.

LANSING, MICH.—Onondaga & Eaton Rapids Telephone Company. $3,000.

ST. LOUIS, MO.—Senath Telephone Company, of Dunklin. Capital increased from $1,500 to $6,000.

PIERRE, S. D.—Sioux Falls & Sioux City Electric Railway Company. $1,000,000. To build a sixty-mile line paralleling the St. Paul road.

AUGUSTA, ME.—Patten & Trout Brook Telephone Company, Patten. $3,500. President, B. W. Howe; treasurer, W. S. Kellogg, Patten.

MILWAUKEE, WIS.—The Cashton Telephone Company, village of Cashton, Monroe county. $10,000. Incorporators: Frank E. Steele and Jorgan A. Moen.

WORCESTER, MASS.—The Worcester Electric Contract Company, Worcester. $10,000. President, Roger T. Morris; treasurer, Clarence W. Hobbs, Jr., both of Worcester.

NASHVILLE, TENN.—The Connally-McIlheran Electrical Engineering Company, Hamilton county. $10,000. Incorporators: W. B. Connally, W. C. McIlheran, W. C. McAfee, H. A. Clark and M. M. Allison.

ELGIN, ILL.—North Shore & Western Electric Railway. To operate a road between Elgin and Evanston. $50,000. Incorporators: William C. McHenry, William A. Love, Ernest R. Fifer, of Chicago, and Harry P. Parsons and George P. Merrick, of Evanston.

JEFFERSON CITY, MO.—Missouri Interurban Railway Company. To build a line between Jefferson City and Sedalia. $20,000. Stockholders: J. W. Meller, of Sedalia; W. B. Myers, of Smithton; J. D. Starke, of Soleville; J. H. Gunn, of Otterville; W. B. Kerens and A. W. Nelson, of Bunceton; Henry Fricke, of Prairie Home; F. P. Glendennin, of Cedron; B. W. Lansdown, of Centretown, and C. W. Thomas, of Jefferson City.

HARRISBURG, PA.—Pittsburg & Westmoreland Traction Company; to construct a twelve-mile line from Greensburg to Latrobe; $72,000; Wesley F. Raymond, of Middletown, president; directors, John R. Geyer, E. K. Condran, Charles Hatton, A. R. Geyer, W. E. Raymond, Middletown, and Henry C. Allen, Erie. McDonald & Midway Street Railway Company; to build a three-mile line from McDonald, Washington county, to Midway; $18,000. Burgettstown Street Railway Company; to build a line one and a half miles long through the streets of Burgettstown, Washington county; $9,000.

NEW MANUFACTURING COMPANIES.

HARRISBURG, PA.—The Lindeman Graham Electric and Manufacturing Company has been incorporated with a capital of $10,000. The company's headquarters will be at Pittsburg.

MUSKEGON, MICH.—Articles of incorporation of the West Michigan Electrical Company, of Muskegon, have been filed with the secretary of state at Lansing. The following officers are named: president, F. W. McMeal; secretary and treasurer, W. G. Peacock; vice-president and general manager, R. R. Raney.

BALTIMORE, MD.—For manufacturing and dealing in attachments for telegraph sounders and other patented telegraphic attachments, the Long-Distance Sounder Manufacturing Company has been incorporated with an authorized capital stock of $50,000. The incorporators are: Mortimer W. West, Jane L. West, John F. Mickey, Clarence H. Grumbine and J. Harry C. Sauer.

AKRON, OHIO—A company to manufacture insulators for all kinds of electrical goods has been incorporated at Columbus with a capital stock of $1,000. The company will be known as the Akron High Potential Porcelain Company, and the incorporators are: M. Otis Hower, George H. Kile, Samuel Kile, A. L. Dyke and H. E. Andress. The company will start operations at once, having purchased the plant of the Barberton Pottery Company. The interior of the building has been remodeled and new machinery installed. Officers have not yet been elected.

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1053 describes and illustrates railway motors and controllers.

MACHADO & ROLLER, 203 Broadway, New York city, have published a new price list devoted to Whitney electrical measuring instruments.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, Mich., is distributing a new series of literature devoted to American "Steel Clad" irons.

THE LORD ELECTRIC COMPANY, Boston, Mass., manufacturer of railway specialties, is presenting to some of its customers a very attractive and handy paper cutter and check stamp. This is one of the most attractive souvenirs that has come to our notice for some time.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing its new fixture catalogue No. 25. This catalogue contains ninety-two pages, is handsomely bound, with a color design on the cover, and shows a great variety of new material in decorative electric lighting fixtures. The catalogue is so arranged that information can be readily secured concerning a wide line of this apparatus. The company will be pleased to supply copies to anyone interested.

DUNTON & FIELD, 117 Main street, Cambridge, Mass., have some new literature describing and illustrating the Dunton tree insulator. This insulator can be used on any electric lighting, telephone, telegraph, railroad or fire-alarm wire running through trees. The metal part of the insulator is of malleable iron, and the arm swings on a sleeve which is lag-screwed to the limb of a tree and turns in a cone-shaped casting pivoted to the lower end of the arm. This allows the glass to be placed in a vertical position at all times when tied to the wire.

THE FOSTORIA INCANDESCENT LAMP COMPANY, Fostoria, Ohio, has favored this office with complete sets of the direct-by-mail literature which it has been sending to lamp buyers during the past few months. To any manufacturer who is interested in this subject these "Fostoria" booklets and circulars will be found suggestive and interesting, as they indicate possibilities of original work along these lines. The pamphlet "Lamps and the Man" is especially unique in physical appearance and in its literary flavor. In the fore-word to this little brochure the editor says: "'Lamps and the Man' is a 'four-phase' article appearing through the fall and winter with a frequency of about one 'phase' a month. A complete article is also bound into a souvenir booklet which will be furnished upon request. Write for it." The Fostoria direct-by-mail advertising system also comprehends a number of especially unique embossed blotters in various hues, such as would decorate a lady's writing table, and other artistic conceits in circular ideas, both to be mailed in envelopes and also on post cards.

THE CANADIAN WESTINGHOUSE COMPANY, Hamilton, Ontario, has contracted with the Yukon Consolidated Gold Fields Company for the following electrical apparatus, to be used in gold dredging in the Yukon Territory: three 100-horse-power, three-phase, sixty-cycle, 400-volt type F motors; three fifteen-horse-power, three-phase, sixty-cycle, 400-volt type F motors; three fifty-horse-power three-phase, sixty-cycle, 850-revolution, 400-volt, constant-speed induction motors; three thirty-horse-power motors; three twenty-horse-power, 1,120-revolution motors; three fifteen-horse-power, 850-revolution motors; three seven and one-half-horse-power, 1,700-revolution motors; nine seventy-five-kilowatt, oil-insulated, self-cooling transformers; two 625-kilowatt, three-phase, sixty-cycle, 2,200-volt, 415-revolution, alternating-current generators, and two seventeen-kilowatt type S exciters for these generators. The order also includes four panel switchboards for controlling the apparatus; four 250-kilowatt, oil-insulated, oil-cooled transformers, and four 200-kilowatt machines of the same type.

Digitized by Google

Record of Electrical Patents.

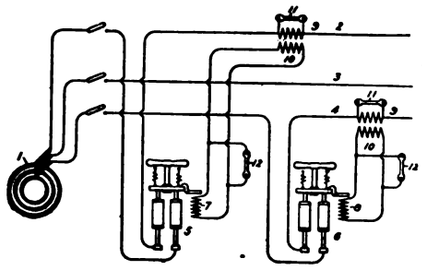
Week of October 9.

833,159. RELAY ATTACHMENT AND ALARM FOR TELEPHONE SYSTEMS. Charles A. England, Van Meter, Iowa. Filed November 13, 1905. Consists of a shell with a hinged cap supported from a pair of vertical arms.

833,169. MAGNETIC ORE SEPARATOR. Camden E. Knowles, Joplin, Mo., assignor of three-fourths to G. B. Young, George T. Cooley and Guy H. Elmore, Joplin, Mo. and W. E. Brinkerhoff, E. O'Keefe and Joseph Herrin, Carthage, Mo. Filed December 5, 1901. The magnetic surfaces converge from the feed to the discharge and terminate abruptly.

833,178. MEANS FOR OPENING AND CLOSING ELECTRICAL CIRCUITS. Gustaf Rennerfelt, Scranton, Pa. Filed June 11, 1904. A system for gradually and automatically closing an electric circuit.

833,194. PROTECTIVE DEVICE FOR ALTERNATING-CURRENT CIRCUITS. Leonard Andrews, Manchester, England, assignor to Stanley-G. I. Electric Manufacturing Company. Filed September 18, 1905. A circuit-breaker actuated when a series transformer becomes saturated magnetically.



833,211. SAFETY SYSTEM FOR HIGH-TENSION TRANSMISSION LINES.

833,211. SAFETY SYSTEM FOR HIGH-TENSION TRANSMISSION LINES. John D. Hilliard, Jr., Glens Falls, N. Y., assignor to General Electric Company. Filed April 20, 1904. The fuse is shunted by an inductance from which leads are taken to the tripping coil.

833,224. RECEIVING DEVICE FOR ELECTRIC TRANSMISSION. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Filed March 25, 1905. Renewed April 4, 1906. A relay which acts to vary the relative resistances of two air-paths rendered conducting for an electric discharge.

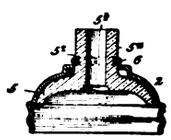
833,225. TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Filed April 14, 1905. Renewed January 18, 1906. A duplex system utilizing high and low frequency current.

833,226. TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Filed June 6, 1906. An all-metallic line operated by grounding at the stations.

833,228. MOTOR CONTROLLER. William A. Lacke, Chicago, Ill. Filed November 29, 1905. An automatic multiple-switch controller.

833,252. COUPLING FOR ELECTRIC CABLES. Charles F. Schwennker, Schenectady, N. Y., assignor to General Electric Company. Filed February 14, 1903. Tapered terminals are clamped together by a helical spring.

833,279. TELEPHONE RECEIVER. Henry F. Albright, New York, N. Y., assignor to Western Electric Company, Chicago, Ill. Filed February 5, 1904. Employs a tubular magnet with a non-magnetic cup, flaring outward from the outer shell.



833,556. INCANDESCENT LAMP SOCKET.

833,290. ELECTRICAL CONDUCTOR. Anson G. Betts, Troy, N. Y. Filed November 30, 1904. A composite conductor of metallic sodium with a reenforcing sheathing.

833,296. JUNCTION BOX. William F. Bossert, Utica, N. Y., assignor to the Bossert Electric Construction Company, Utica, N. Y. Filed September 15, 1904. Is provided with openings closed by partially displaced blanks.

833,297. LOCKOUT SYSTEM FOR PARTY-LINE TELEPHONES. William M. Bruce, Jr., Springfield, Ohio, assignor, by direct and mesne assignments, to the Select Telephone Manufacturing Company, Springfield, Ohio. Filed October 5, 1905. A normally open shunt at each instrument is closed automatically.

833,298. LOCKOUT SYSTEM FOR PARTY-LINE TELEPHONES. William M. Bruce, Jr., Springfield, Ohio, assignor, by direct and mesne assignment, to the Select Telephone Manufacturing Company, Springfield, Ohio. Filed October 23, 1905. A relay, controlled by the hook, locks out other stations through a grounded line.

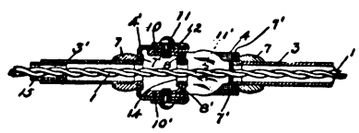
833,312. TROLLEY. Andrew H. Dreijer, New York, N. Y. Filed June 6, 1904. The wheel is centered by two or more rollers carried in the channel.

833,317. CUTOUT. Henry Geisenhöner, Schenectady, N. Y., assignor to General Electric Company. Filed May 8, 1903. A plate holds the contacts in position.

833,337. DISTRIBUTING BOX. Harry H. Hornsby, Chicago, Ill. Filed January 7, 1903. A distributing board with a plurality of openings and leading-in channels.

833,342. ELECTRIC RECEPTACLE. Bert E. Salisbury, Syracuse, N. Y., assignor to Pass & Seymour, Incorporated, Solvay, N. Y. Filed February 20, 1906. Projections are provided for locking the receptacle to a supporting plate.

833,353. TROLLEY-WHEEL. Gustavus Troxler, Jr., Newark, N. J., assignor of one-fifth to himself, one-fifth to Alexander Ober, one-fifth to Robert Neil, one-fifth to Theodore Perry, Newark, N. J., and one-fifth to Arthur H. Moore, Jersey City, N. J. Filed October 10, 1905. Spring-supported radial arms project beyond the edge of the wheel.



833,567. FLEXIBLE JOINT FOR ELECTRIC TUBING.

833,357. ELECTRIC FURNACE. Leonard Waldo, Plainfield, N. J. Filed June 23, 1905. An induction furnace with means for electrolyzing the charge.

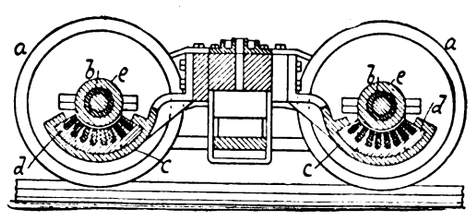
833,361. WAVE AND CURRENT ELECTRICAL GENERATOR. John T. Wilmore, Denver, Col. Filed October 23, 1905. The electric generator is enclosed within a drum which is rotated by the waves.

833,390. SPRING-JACK FOR TELEPHONE SWITCHBOARDS. Howard B. Holmes, Park Ridge, and Edward B. Craft, Chicago, Ill., assignors to Western Electric Company, Chicago, Ill. Filed June 24, 1905. The jacks are mounted on a plate provided with an extended test ring.

833,429. AUTOMATIC SYSTEM OF INTERCOMMUNICATION. Anthony Van Wagenen, Sioux City, Iowa. Filed July 31, 1902. Renewed March 3, 1906. The connections sought are made by means of a service and a switching wire.

833,447. ELECTRIC SIGNAL FOR WEIGHING-SCALES. Stephen J. Derbes, New Orleans, La. Filed November 28, 1905. The movement of the scale beam is indicated by signals.

833,449. TELEPHONE TRANSMITTER. Stanley A. Duvall, Elkhart, Ind. Filed March 5, 1903. A resistance chamber and one electrode are mounted adjustably within a cup.



833,635. ANTI-FRICTION DEVICE.

833,505. TROLLEY. Henry B. Burke, Windber, Pa. Filed December 28, 1905. The wheel is supported on spring arms.

833,556. INCANDESCENT LAMP SOCKET. Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. Filed June 5, 1903. An insulating cap is locked within the top of the socket.

833,567. FLEXIBLE JOINT FOR ELECTRIC TUBING. William E. Ward, Bayonne, N. J. Filed December 5, 1905. A coupling of two parts, which are pivoted together.

833,603. SIGNALING ON RAILWAYS. Charles M. Jacobs and Robert J. Insell, Reading, Edward F. Newton, Cardiff, and Ernest A. B. Bowden, Hanwell, England, assignors to the Western Syndicate, Limited, London, England. Filed October 30, 1905. A signal system actuated by the train.

833,635. ANTI-FRICTION DEVICE. J. S. Rogers, New York, N. Y. Filed January 11, 1906. An electromagnetic device for relieving pressure on bearings.

833,689. APPARATUS FOR DUPLICATING PHONOGRAPH RECORDS. Isidor Kitsee, Philadelphia, Pa. Filed April 20, 1901. A stylus bearing on the original record varies the current through an electromagnet which controls the reproducing knife.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 18. NEW YORK, SATURDAY, NOVEMBER 3, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON
NEW ENGLAND OFFICE, M. W. BARBER, Mgr., DELTA BLDG., 10 Post Office Sq.

LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE
TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single copy, 10 cents. Back numbers, beyond one month, each	.25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
The Electrification of the West Jersey & Seashore Railroad..... 705
Sensible Remarks upon Technical Education..... 705
A New Wireless Telegraph Receiver..... 706
Foolish Testimony..... 707
Electric Lighting in the Zoo..... 707
Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw. 708
Organization of the Virginia State Independent Telephone Association. 711
The Automobile Club Show..... 711
The Largest Movable Dam of the Beartrap Type in the Country, by W. C. Weeks..... 711
Economy in Electrifying..... 712
Data on Indoor Illumination, by J. E. Woodwell..... 713
Electrical Manufacture of Steel..... 716
Electrification of the West Jersey & Seashore Railroad—I..... 717
The 1907 Question Box of the National Electric Light Association..... 722
Convention of the American Street and Interurban Railway Claim Agents' Association..... 722
Convention of the American Street and Interurban Railway Accountants' Association..... 722
The September Earnings of the Manila Electric Railroad and Lighting Corporation..... 723
Electrical Developments in North Carolina..... 723
Vaudeville Performance During Street Railway Week at Columbus, Ohio. 723
American Institute of Electrical Engineers..... 724
The Irish International Exhibition..... 727
An Important Movement for the Introduction of New Electric Lighting and Transit Systems in New York City..... 727
Electric Railways in Sparsely Settled Communities—I, by E. P. Roberts. 728
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE..... 730
METHODS OF GETTING NEW BUSINESS—"Organization and Conduct of a New-Business Department Suitable for Central Stations in Cities of 50,000 Population and Under," by Charles Nathan Jackson..... 732
INDUSTRIAL SECTION:
Westinghouse Managers' Meeting..... 735
The Manufacture of Water-Wheel Governors..... 735
A New Form of Electric Blue-Printing Machine..... 736
New Type Flush Receptacle..... 736
The Opening of the New Plant of the Wagner Electric Manufacturing Company..... 736
"G. I." Flush Receptacle and Attaching Plug..... 737
The Fifth Annual Business Show Held in New York City..... 737
Illuminating Engineering Society..... 737
CURRENT ELECTRICAL NEWS..... 738
RECORD OF ELECTRICAL PATENTS..... 744

Copyright, 1906, by Electrical Review Publishing Co.

THE ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD.

Undoubtedly one of the most important excursion routes in the country of any considerable length is that from Philadelphia to Atlantic City. This route has been well served by two steam railway companies, and is yearly traveled by thousands of passengers. The conversion of one of the two lines owned by one of the companies, the West Jersey & Seashore Railroad, which is operated by the Pennsylvania Railroad Company, to electric traction during the present year is for this reason a very significant development. The route itself is sixty-four miles long and demands frequent express service, as well as good local service at one end; and, at the same time, the route selected has a fairly heavy freight traffic. The advantages of electric traction for meeting the passenger requirements undoubtedly led to the adoption of the new system, although it was believed by the engineers that the new system offered considerable advantage for handling the heavy coal traffic.

As the road is almost entirely in the country, and there are no heavy grades nor peculiar local conditions enforcing a change, the new system is exceptionally noteworthy. There is no doubt, however, that the heavy summer travel had a good deal to do with bringing about the change. The first part of a complete description of this interesting road will be found on another page of this issue.

SENSIBLE REMARKS UPON TECHNICAL EDUCATION.

At the recent dedication of the new engineering building of the University of Pennsylvania a number of eminent engineers and educators made noteworthy addresses. One of these, because of the sensible criticism made of certain educational practices, deserves to be widely read. This was the address delivered by Frederick W. Taylor, president of the American Society of Mechanical Engineers. The theme of the address was a comparison of university and industrial discipline and methods, and the speaker called attention to the lax discipline which often prevails in colleges. The young man just entering college leaves the rather strict discipline of school, where he is treated as a boy, and is at once thrown, to a large extent, upon his own resources, it being assumed that he is now a man. The sudden transition, in many cases, proves disastrous to the young man, who does not at once realize the seriousness of the work which he has undertaken. And this condition is not made any better by the so-called elective system, which permits any student to select any study towards which he feels an inclination. In fact, during the four years which the young men spend at college they are

Digitized by Google

under less discipline than ever before, and have greater freedom than most of them will ever have again.

Regarding the elective system, Mr. Taylor speaks as follows: "Commercial, manufacturing and other enterprises in which men cooperate are managed more and more by delegating all important decisions to a few men whose judgment has been trained through long experience, study and observation in those matters which they are called upon to decide. Yet many of our universities are managed by giving over to the young man, under the elective system, the final decision as to what studies will best fit him for his life's work, although he has, of necessity, but the vaguest idea of the nature of the subjects before him." The logic of this argument is evident, but it should be pointed out that this liberty of selection does not obtain in engineering courses, in which the work is rigidly prescribed—in some cases almost too rigidly. And it is not the function of a technical paper to decide how non-technical courses shall be given.

Regarding the liberty of action in other ways, much may be said both for and against it. Some time or other the boy must be made to realize that he is a responsible person, and he must therefore think before acting. He can not have a set of rules to guide every action throughout his whole life. He must learn to consider what will be the result of every action before it is taken, and he must be made to realize of what he is capable. In other words, the man must find himself, and he will not do this as long as he is treated as a boy.

The sudden transition from school life to university life, in many cases, brings about the desired result. In other cases it is disastrous. It is a question whether a transition period might not be arranged which would save many of those who go to pieces if they are stood too suddenly on their own feet. Mr. Taylor suggests that it would be well for every student to spend six months in some business establishment at the end of his freshman year, as this, by bringing him in contact with actual work, would prove to him that life is in earnest, and must be so treated. Such an arrangement would be rather difficult to make from the standpoint of the college, and there would be considerable difficulty in enforcing it in the spirit, and not merely in the letter. That some good would be effected can not be doubted, if a comparison may be made with the work of those students who enter college after having been at work for some time. These men have a definite purpose in life which they are striving to accomplish. Their college work is a serious matter with them, and, in fact, in very many cases, great sacrifices have been made in order that it may be taken up. Every instructor realizes the steadying tendency on the whole class of a few such students. To these men their studies are work of the most serious kind; while, on the other hand, even the average student would feel, to some extent, that his six months of business was a sort of holiday, and he would return with the feeling that there were still three years of school life before life began in earnest. It is, of course, the function of the college education to prepare men for actual work in life, as well as to give them certain desirable mental training. That they are not always successful is to be expected, particularly if one considers how much more is expected of the college man to-day than some years ago. And it is hardly to be expected that all colleges can keep four years in advance of commercial and industrial development.

However, the whole fault for the present ills should not be laid to the college. Our present school systems are not quite perfect; in fact, fault may be found with the most elementary school. Mr. Taylor touches upon a fundamental trouble when he says: "Somehow the average kindergarten child gets a firm conviction that it is the duty of the teacher to make things interesting and amusing, and from this follows soon the notion that if he does not like his studies and fails to learn much it is largely the teacher's fault." And can the child be blamed for this feeling if the teachers of the higher schools are told that it is their place to teach, and not that of the child to learn? How can any progress be made without a corresponding effort? If a child be too young to make any mental effort, the question may properly be asked, "Then why is he sent to school?"

A NEW WIRELESS TELEGRAPH RECEIVER.

At the recent meeting of the American Institute of Electrical Engineers, Dr. Lee De Forest described a new type of wireless telegraph receiver which he has named "audion," and which he believes offers great possibilities of advance in the wireless art.

As more experience is gained in wireless telegraphy we find that there seem to be innumerable ways of constructing devices which will be sensitive to Hertzian waves. There is nothing novel in this phase of wireless development, for the same was found true in other branches of the art. In the telephone field, for example, it is possible to make a workable instrument out of almost anything; but the main thing, of course, is to construct a device which will give the maximum effect, and which is, above all things, always under control and reliable. Wireless receivers may be constructed in many ways. There is the imperfect-contact type, the magnetic type, the electrolytic type, and now we have the vacuum-tube type. The trouble with some of the earlier forms of apparatus seems to have been that they depended for their action upon a feature which was in itself undesirable. For example, the imperfect-contact type will, unless special precautions are taken, from the very nature of the thing offer different degrees of sensibility from moment to moment, a feature most undesirable in an instrument intended for practical use. Reliability, as said before, and constancy are two essentials.

A feature of Dr. De Forest's new receiver is what he calls its self-tuning properties. The device is, in brief, a peculiar type of incandescent lamp provided with one or more electrodes within the bulb. When the filament is brought to incandescence an electric current may be caused to pass between it and the electrode and through a suitable circuit without the bulb, and if a telephone be included in this circuit it is found that it gives a sound whenever the device is subjected to Hertzian waves. The device may be adjusted by varying either the current through the filament or applying a varying potential in the circuit between the filament and electrode, and this adjustment seems to be practically independent of the natural period of oscillation of the aerial system; in fact, the device seems to depend

Digitized by Google

for its action upon the total energy received by it during the entire period of vibration of the oscillating system, and not upon the maximum intensity of the first impulse. This feature would seem to be of considerable value, as one of the difficulties in wireless telegraphy is to concentrate upon the receiver sufficient energy to operate it.

Further, the fact that the apparatus seems to be more or less independent of the period of vibration of the aerial system, but is affected by a change in the spark frequency of the exciting coil, would make interference of neighboring stations easy to avoid, as it should not be difficult to maintain a definite sparking frequency, while it is difficult to set up in the aerial a simple harmonic oscillation. This has been one of the stumbling blocks encountered by those engaged in developing wireless-telegraph systems.

The apparatus itself, from a mechanical standpoint, possesses considerable advantages. It is easily transportable, and would seem to be little affected by vibration; and we are now so familiar with incandescent lamp construction that we should be able to construct the device without any great difficulty.

FOOLISH TESTIMONY.

Every one must realize the harm that is done by those charlatans who prey upon the real or imaginary ills of foolish people by proclaiming to have discovered wonderful cures for all diseases. Naturally, a good many of these enterprising men claim to have electrical remedies, thus making use of the belief among the ignorant that electricity can do anything. Such men do a great deal of harm; but there is, as well, another class which is responsible for a great deal of trouble and unhappiness. An instance of this kind is mentioned in one of our contemporaries, which we regret to say, endorses the absurd statements to which it gives publicity, so far as we can see, simply for the reason that it is devoted to an industry frequently supposed to be a competitor of electric lighting.

The cause of the trouble was the breaking of a trolley wire in the city of Chicago. This wire fell apparently across the track, causing a violent arc, which temporarily blinded a small girl who happened to be standing near it. The wire, it appears, did not touch the girl, but the shock from the startling phenomenon caused, so the doctor who was called in claims, paralysis. If the doctor had been satisfied to let his case rest here no criticism could be made, although it would remain to be proved whether the girl's condition was due to the shock; but he was not satisfied, and went on to testify before the court as follows: "The girl's condition emphasizes what is happening daily, in a milder form, in every city. The whole atmosphere became charged from the swinging wire, and within 200 feet or more was like an immense Leyden jar. Every one within that radius would have been affected. The current was not so diffused at her distance, and she was affected more strongly." If this argument were worth disproving it would be interesting to know how a large body of free air can resemble a Leyden jar. If the quotation, as given, is correct, the ignorance of the physician is apparent.

If further evidence be necessary the following would be sufficient, for he said, according to our contemporary: "Delicate persons in this age are being constantly affected by electric currents. Almost any person feels a current pass through his body when riding on a street car and the trolley comes off. It is not so much a shock from the light alone, but from its accompanying current." Evidently he does not realize that every time the car stops the main current is shut off and this should cause just as much of a shock as the jumping of the trolley.

To quote further, he says: "These apparently trivial electrical disturbances, the use of electric lights, and its presence in hundreds of other forms, are the cause of so much trouble to the eyes. Eventually the human race will be blind from the increasing strength and influence of electricity. Sight will be the first of our faculties to vanish." It is rather remarkable that these views should be endorsed by a journal which advocates a form of illumination having very great intrinsic brilliancy, as it is a well-known fact that the intrinsic brilliancy of an illuminant is the one factor which most seriously affects the eye.

Our contemporary goes on to say: "The doctor's evidence is but in line with a vast amount of testimony that is constantly coming to the surface, bearing up[on] the electric peril. It should be an eyeopener to those communities that are considering the question of lighting and are not yet committed to electricity." Could any more absurd bosh be found in a journal in which one has a right to expect some evidence of technical knowledge and common-sense?

ELECTRIC LIGHTING IN A ZOO.

The mortality of some tropical birds of long natural life in the aviaries of zoological gardens has long been a problem in such institutions.

The efforts to maintain the natural temperatures and even humidity which prevail in the tropical regions forming their habitats, and to provide their natural foods, have proved futile as to the results.

Another cause for this difficulty has been found to lie in the feeding habits of the birds, which are based on the approximately equal divisions of day and night prevailing throughout the tropics.

It appears that it has been found from the observations of explorers that in the tropics many of these birds wake at sunrise and obtain their food, and also feed again before sunset.

The long nights of Winter in the Northern climates deprive these birds in captivity of their food for an unnaturally long time, and this condition has been relieved in a certain zoological garden where the portions of the aviary containing such tropical birds are lighted by electricity at six o'clock in the morning, when the birds awaken and feed. The lights are turned on again in the afternoon and these quarters are as daylight until six o'clock in the evening.

After all, the old-time query as to whether the crowing of the chanticleer at sunrise is due to instinct or to observation, leads to some interesting parallelisms in the questions of conditions of bird life.

Digitized by Google

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW, F. I. C.

VIII—The Use of Softening Re-Agents and the Tests Necessary to Regulate Their Amount.

(1.) Advantages of Softening—The importance of pure water for the supply of steam-boilers has only been recognized in recent years, and the great extension of the water-softening industry since 1895 is largely due to this fact. There is some danger now, however, that boiler engineers may run into the other extreme, and that they may, by unwise use of softening re-agents, produce greater evils than those they desire to remove.

A water containing chemical salts in solution is just as likely to produce harmful results inside the boiler, when these salts have been added by the user for the purpose of purification, as when they occur naturally. The excessive use of caustic soda and sodium carbonate in many boiler plants is undoubtedly responsible for some of the corrosion of boiler plates and fittings.[2] For steaming purposes a water containing little or no foreign matter in suspension or in solution is desirable, and the purer the water is, the more free from trouble will be the boiler in which it is used. Even dissolved gases (oxygen and carbonic acid) may produce much harm when liberated inside a boiler, and a large proportion of the pitting of boiler plates noticed just above the entrance of the feed-water supply pipe is due to these gases. The water used for steam generation in steam boilers should therefore be as free from solid, liquid and gaseous impurities as it is possible to obtain it. As already stated in the previous article, water containing more than fifteen parts total solids per 100,000 of water, or ten degrees of total hardness, ought to be purified before use.

The treatment of the water with softening chemicals should occur in special apparatus outside the boiler. To carry out the softening treatment inside the boiler is likely to aggravate some of the evils it is desired to avoid.

The proper control of the feed-water of the boiler can only be exercised by aid of systematic and constant sampling and testing of the water, as it enters and leaves the softening apparatus. Occasional tests of the feed-water before and after softening treatment are useless.

In the first place the character of the supply may change from week to week and even from day to day. In many localities the rainfall is the chief agent in causing this variation in the amount of suspended and dissolved impurities present in the natural water supply, in others the dictum of the city water engineer, who, as a rule, has more than one available source of supply. Secondly, the softening apparatus even when of the automatic type requires checking, for owing to this variation in the composition of the natural supply, there is grave danger of excessive chemicals being used at times in the softening operation, and these as already stated may be almost as harmful as the original impurities of the water.

With pure water a boiler may run from 1,000 to 2,000 hours without cleaning, and the evaporative efficiency during this period, owing to the absence of scale, will remain high. With dirty and impure feed-water, on the other hand, the limit of safe work is 500 or less hours, and the evaporative efficiency will fall rapidly towards the end of this comparatively brief working period. It is evident, therefore, that in the majority of works, a water-softening plant will prove a wise expenditure of capital, for it will increase the capacity of the existing boiler plant and reduce the fuel consumption at one and the same time, with only a slight addition to the daily working costs.

(2.) The Chemistry of the Softening Process—The chief salts that can be removed from water by the use of softening chemicals are the carbonates and sulphates of lime and magnesia. Taking these seriatim we have the following:

1. Calcium Carbonate. Chemical symbol $CaCO_3$—always present in natural waters as bicarbonate—$Ca(HCO_3)_2$. This salt can be removed: *a*. By boiling the water. This method yields a precipitate of calcium carbonate which may either form a hard scale, or a soft mud, according to the slowness or rapidity of separation. The chemical equation for this change is:

$$Ca(HCO_3)_2 = \underset{\text{(insoluble)}}{CaCO_3} + H_2O + CO_2.$$

b. By adding slaked lime or lime to the water. This method yields double the amount of calcium carbonate, which occurs in method *a*, as a flocculent precipitate, but it avoids the evolution of carbonic acid gas. The chemical equation is:

$$Ca(HCO_3)_2 + Ca(OH)_2 = \underset{\text{(insoluble)}}{2CaCO_3} + 2H_2O.$$

c. By adding caustic soda to the water. This chemical combines with the second CO_2 molecule of the bicarbonate, and precipitates the calcium carbonate as before, while sodium carbonate remains insoluble. The chemical equation is as follows:

$$Ca(HCO_3)_2 + 2NaOH = CaCO_3 + Na_2CO_3 + 2H_2O.$$

2. Magnesium carbonate. Chemical symbol $MgCO_3$—always present in natural waters as bicarbonate—$Mg(HCO_3)_2$. This salt can be removed:

a. By boiling.

b. By adding slaked lime or lime water.[1]

c. By adding caustic soda.

The chemical equations are similar to those given for calcium carbonate, with the substitution of Mg for Ca in the molecular formulæ. Both calcium and magnesium carbonate are loose flocculent precipitates when first caused to separate from water by the use of lime water, but boiling renders these precipitates dense and crystalline.

3. Calcium sulphate. Chemical symbol: $CaSO_4$.

This salt can be removed from water:

a. By heating it with sodium carbonate. The chemical equation for this change is:

$$CaSO_4 + Na_2CO_3 = Na_2SO_4 + \underset{\text{(insoluble)}}{CaCO_3}$$

b. By heating with barium carbonate. This chemical produces two insoluble compounds instead of one, and the sulphate is removed from the water as barium sulphate. The chemical equation is:

$$CaSO_4 + BaCO_3 = \underset{\text{(insoluble)}}{CaCO_3} + \underset{\text{(insoluble)}}{BaSO_4}.$$

4. Magnesium sulphate. Chemical symbol $MgSO_4$.

This salt can be removed from water by heating it with sodium carbonate, or with barium carbonate. The chemical equations are as in 3 with the substitution of Mg for Ca in the molecular formulæ.

It will be observed that when sodium carbonate is the chemical used for removing sulphates calcium and magnesium carbonates are again the precipitated salts, but that an equivalent amount of sodium sulphate remains in solution. As

[1] All rights of reproduction and translation reserved. Copyright, 1906, by J. B. C. Kershaw.

[2] See abstract of paper upon "The Action of Slightly Akaline Waters upon Iron," read before the Society of Public Analysts, by Messrs. Cribb and Arnaud, *Mechanical Engineer*, London, January 13, 1906.

[1] Magnesium carbonate is converted into magnesium hydrate by treatment with lime water, and this secondary change complicates the removal of hardness in the case of magnesium salts.

Digitized by Google

before, the magnesium carbonate is converted into magnesium hydrate if excess of lime be present in solution.

The precipitated carbonates are flocculent when first separated, but become dense and crystalline on boiling. Barium carbonate on the other hand removes both the base and the acid radical of the calcium or magnesium sulphate, and for this reason would be generally employed, if cheaper and more easily applied to this purpose.

5. Magnesium chloride and magnesium nitrate. These two salts are occasionally present in natural waters in appreciable amounts. They can be decomposed in the same manner as the sulphate; namely, by heating the water into sodium carbonate. The chemical equation for the changes are as follows:

$$MgCl_2 + Na_2CO_3 = MgCO_3 + 2NaCl$$
$$Mg(NO_3)_2 + Na_2CO_3 = MgCO_3 + 2NaNO_3$$

Here again an equivalent amount of sodium chloride or nitrate remains in solution—and the change is from a dangerous salt to a less dangerous one; for magnesium sulphate, chloride and nitrate are all salts which may decompose and liberate corrosive gases, if heated to a high temperature as a scale upon boiler plate.

Magnesium carbonate is stated by some authorities to be slightly soluble in water, and they recommend that it should be converted into the insoluble hydrate, by the addition of an excess of lime water, according to the equation:

$$MgCO_3 + Ca(OH)_2 = Mg(OH)_2 + CaCO_3.$$

The solubility of the carbonate is very slight—(100 parts of cold water dissolve only 0.02 part of the carbonate) and moreover the precipitate obtained when precipitating a hot solution of magnesium sulphate with sodium carbonate, is a mixture of hydrate and carbonate, and not carbonate alone. An excess of lime, however, is required to obtain the separation of the other carbonates when magnesium is present, and its use will add to the bulk of the precipitate which remains to be dealt with in the softening apparatus. Magnesium hydrate alone is a gelatinous precipitate likely to cause stoppage of the filters attached to the softening apparatus.[1]

(3.) The Calculation of the Amount of Softening Chemicals Required—The tests upon which the additions of the softening chemicals are based are those for temporary and permanent hardness. It is not advisable to attempt to remove the temporary hardness by boiling, for long-continued boiling is required to remove the whole of this, and such an expenditure of fuel or of waste heat would not prove economical. It is in fact best to reduce the hardness to the lowest degree possible, by the use of lime and sodium or barium carbonate; and all modern water-softening plants are operated upon this basis. It is possible to remove both carbonates and sulphates by the use of caustic soda alone, when the two salts are present in molecular proportions,—for the carbonate of soda produced by the reaction with the carbonates then enters into reaction with the sulphates. The reaction in this case is expressed by the following equation:

$$Ca(HCO_3)_2 + CaSO_4 + 2NaOH = 2CaCO_3 + Na_2SO_4 + 2H_2O.$$

Carbonates and sulphates do not, however, occur often in water in molecular proportions. Caustic soda is also dearer than caustic lime.

The calculations of the necessary amount of chemicals are made from the chemical equations given in Section 2 of this article. These show that one molecule of calcium carbonate or of magnesium carbonate requires one molecule of calcium hydrate or two molecules of sodium hydrate to precipitate it; and that one molecule of calcium sulphate or magnesium sulphate requires likewise one molecule of sodium or barium carbonate for its decomposition.

The molecular weights are as follows:

Salts present in water as impurities.	$CaCO_3$	100		
	$MgCO_3$	84		
	$CaSO_4$	136		
	$MgSO_4$	120		
Softening chemicals.	CaO	56	or $Ca(OH)_2$	74
	NaOH	40	or 2 Na(OH)	80
	Na_2CO_3	106		
	$BaCO_3$	197		

Since the English degrees of temporary and permanent hardness in water are expressed in grains of calcium carbonate per gallon, and the molecular weight of this salt is just 100, the calculations are considerably simplified. It is only necessary to multiply the degrees of temporary or permanent hardness by 0.56 or by 1.06 to find the grains of lime or sodium carbonate required for each gallon of water. The further calculation is equally simple, since the result multiplied by[1] $\frac{1,000}{7,000}$ (that is divided by 7) gives the pounds avoirdupois required to soften 1,000 gallons of water. Fig. 31 is a diagram showing the pounds of softening chemicals required per 10,000 gallons of water, for the various degrees of hardness from one degree to twenty-five degrees.

For the other chemicals the method of calculation is similar, the factor for caustic soda being 0.80 and for barium carbonate 1.97, in place of those given above. It must be remembered in making these calculations, that commercial chemicals are seldom pure, and that some allowance for impurities and losses in making up the solutions must be made in the final calculations for water softening. For caustic lime, an allowance of twenty per cent is advisable; for sodium carbonate five per cent; and for caustic soda, an allowance of ten per cent.

It is, however, unnecessary to purchase high grade chemicals for softening purposes, and if a chemist be in charge of the softening plant, a considerable saving can be effected in the annual expenditure upon chemicals by purchase of low grade or damaged products from the manufacturers—at fifty per cent below the usual market prices. Thus in the manufacture of caustic soda an impure product known in the trade as "caustic bottoms" is produced which sells at less than half the price of white caustic soda, and yet contains over fifty per cent of Na_2O, as compared with seventy per cent in the standard product. Should it be desired to use caustic soda in the softening plant instead of caustic lime, this impure product is quite good enough for the purpose. Carbonate of soda is usually bought in the form of a "soda-ash"; and here again a low grade product can be bought with advantage.

(4.) The Softening Apparatus—All the well-known and patented forms of water-softening apparatus are based on the chemical reactions given in Section 3. They differ from the other simply in the mechanical arrangement of the plant, and in the devices used for rendering the apparatus automatic in its action. The best illustrated description of water softening apparatus is to be found in a paper read by Messrs. Stromeyer and Baron before the Institution of Mechanical Engineers of Great Britain in December, 1903. This paper was printed in full in

[1] The only other case in which an excess of softening chemicals is required is when the water contains silica in solution. This is a most dangerous impurity, and can only be removed by use of an excess of lime and soda.

[1] One pound avoirdupois contains 7,000 grains.

Digitized by Google

many of the technical journals of that date, and readers desiring further information upon the subject of water-softening apparatus are referred to it.

The use of secret compositions for putting into boilers, in order to prevent scale and grease troubles, is unwise and should never be practised. Apart from the excessive prices paid for such compositions, the impurities of a boiler feed water ought to be removed before the water enters the boiler, and not separated inside it. The addition of caustic soda to the water as it enters the boiler is another practice which must be condemned except when carried out under expert control; for under certain conditions this use of caustic soda does more harm than good, and also increases the tendency of the boiler to produce wet steam.

The water, therefore, must be treated with the softening chemicals in some apparatus outside the boiler plant. If a chemist be available to take charge of and control the operations, the writer considers the intermittent type of apparatus, in which the chemicals are allowed a considerable time to act in large tanks, in which the precipitates can settle by gravitation, to be the best. Any chemical engineer could design such a water-softening installation, and the payment of heavy royalty fees, or of an excessive first cost for the plant, would thus be avoided.

If no chemist be available to control the work of the plant, one of the automatic and continuous types of softening apparatus must be selected. A discussion of the comparative merits of the large number of automatic softeners now in the market would, however, lead the writer beyond the proper scope of these articles, and only two general principles for guidance in the selection can be given. In the first place the softening apparatus must be sufficiently ample in capacity to deal with the whole of the boiler feed. A softening apparatus worked beyond its rated capacity is certain to lead to dissatisfaction.

In the second place, the filtering or separating chamber of the softener must be large, efficient in action, and easy of access for cleaning. The success of a softening apparatus depends largely upon the complete separation of the precipitated carbonate of lime from the water. To allow this carbonate of lime to get into the boilers is to throw away the advantages gained by the use of chemicals. In some automatic softeners the filters and settling chamber are not satisfactory. Finally, whenever possible, the water should be passed into the softening apparatus warm or hot—*i. e.*, after it has passed through one set of economizers. Nearly all chemical reactions are accelerated by heat, and when working with little above the calculated amount of softening chemicals, the speed of reaction is of great importance to the successful operation of the plant.

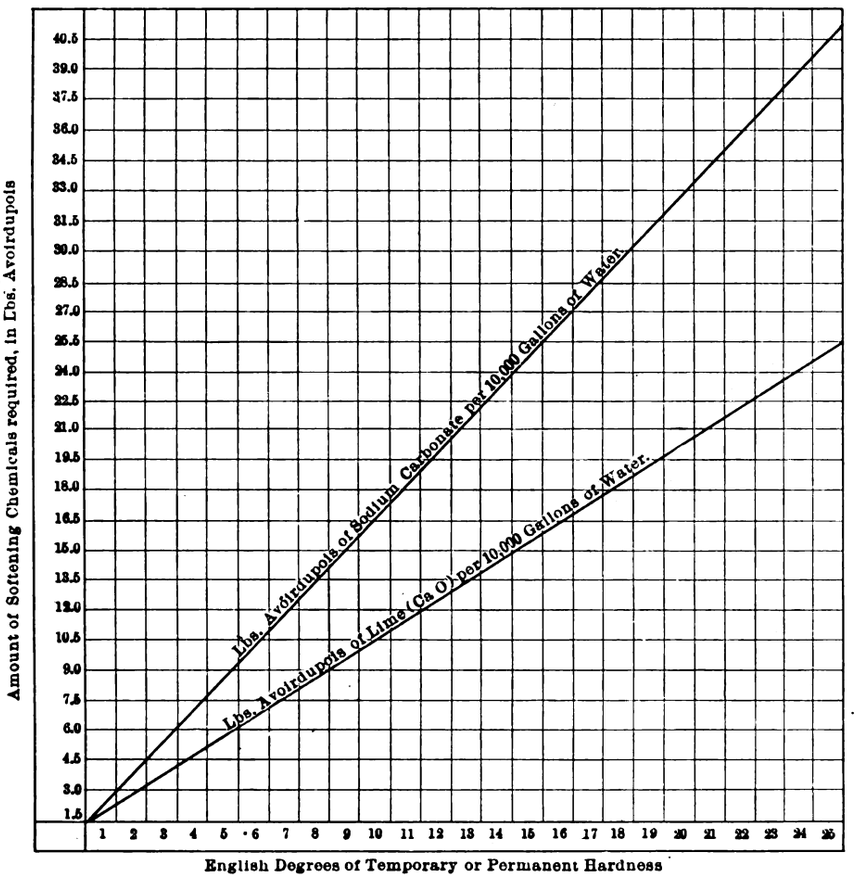


FIG. 31.—DIAGRAM FOR WATER-SOFTENING CALCULATIONS.

(NOTE—Twenty per cent has been added to the theoretical figures for lime, and five per cent to the theoretical figures for carbonate of soda.)

(5.) The Control of the Softening Process—The water sampling apparatus described in Article V of this series must be employed to check the work of the softening plant. The samples of water collected in this way ought to be tested daily by the engineer or chemist in charge of the plant.

It is advisable to have two sets of twelve or twenty-four sampling vessels in use—one set collecting hourly samples of the untreated water, and the other set collecting hourly samples of the softened water as it flows from the softening apparatus to the boilers. A selection from these samples is then made each day for the chemical examination; the general appearance of the water when examined in a tall glass cylinder (Fig. 32) and its effect upon neutral litmus paper, being used as a guide in this selection.[1] The presence of calcium or sodium hydrate in the treated water can also be detected by the use of turmeric paper, which will turn reddish brown when these chemicals are present. This effect will, of course, signify, either that an excess of lime and soda is being used in the softening plant, or that the water is being passed too rapidly through the plant, and that the

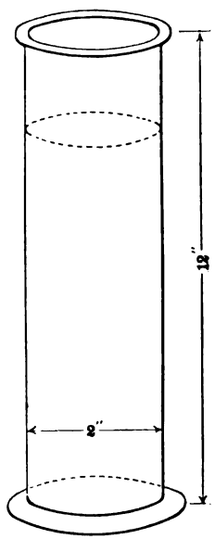


FIG. 32.—CYLINDRICAL JAR FOR EXAMINING SAMPLES OF WATER.

[1] A weak solution of silver nitrate is also of use in this preliminary examination of the water. Carbonates in solution produce a white precipitate of silver carbonate, hydrates produce a light brown precipitate of silver oxide

Digitized by Google

chemical reactions described in Section 2 have not had time to be completed. The time element is, in fact, much more important than many makers of automatic softening apparatus have realized, and it is this time factor which gives the non-continuous tank system of softening, a decided advantage.

When taking samples of water from the tanks shown in Fig. 22 (Article V) it will be necessary to thoroughly mix the water with a wooden plunger, for a sediment of calcium carbonate may be found at the bottom of each vessel, due to unsatisfactory working of the softening plant. When such a sediment is found, either the rate of flow through the softening apparatus is too rapid, or the filtering chamber is out of order, and an investigation must be made to find and remedy the fault without delay. Having selected certain samples for further examination, the temporary and permanent hardness of these must be determined by the methods described in Article VI. The difference between the tests of the untreated and treated water will show the working efficiency of the softening plant, and will also provide the necessary data for any alterations in the amount of chemicals used. Once weekly, or daily if this be possible, an average sample of the water flowing from the softening plant, is tested for total solids and for oil. As already pointed out, the use of sodium carbonate or caustic soda has the disadvantage that sodium sulphate remains in solution in the treated water; and thus the use of these chemicals will not cause any reduction in the total dissolved solids but actually increase them. The softening of a water containing ten degrees of permanent hardness, will add over ten per cent to the amount of dissolved salts in the softened water. For this reason, boilers fed with hard waters that have been softened by the use of sodium carbonate, require frequent blowing off; otherwise the sodium sulphate becomes concentrated to a dangerous extent, and attacks the boiler fittings. As regards the presence of oil, this will not often be found in the water flowing from the softening apparatus; since the precipitation of calcium carbonate in this will carry down the particles of oil. Should oil be found, however, it will be necessary to erect a special oil separator for treating the water after it flows from the softening apparatus, a separator working on the electrolytic principle being most suitable for works where electric power is generated.

Organization of the Virginia State Independent Telephone Association.

The Virginia State Independent Telephone Association was organized at Richmond, Va., on October 11. Independent companies from all parts of the state were represented, and it is announced that the association will be affiliated with the International Independent Telephone Association. The following officers were elected for the ensuing year: president, Albert Parlett, Bristol; first vice-president, F. F. Marbury, Alexandria; second vice-president, W. N. McAnge, Suffolk; secretary-treasurer, B. L. Fisher, Rocky Mount. A constitution and by-laws were adopted, and the report of the committee on credentials showed that companies operating over 10,000 telephones were represented, as follows: Capital City Telephone Company, F. F. Marbury, Alexandria; Farmers' Mutual Telephone Company, of Albemarle, T. E. Powers; Southern States Telephone Company, G. L. Hadyn, Norfolk; Bristol Telephone Company, Albert Parlett, Bristol; West Halifax Telephone Company, Mr. Ingram; Franklin County Telephone Company, B. L. Fisher, Rocky Mount; Chuckatuck Telephone Company, George W. Watts, Suffolk; Harrisonburg Mutual Telephone Company, W. C. Switzer, Harrisonburg; Nansemond Telephone Company, W. N. McAnge, Suffolk; Rockingham Mutual Telephone Company, W. C. Switzer, Harrisonburg; Floyd County Telephone Company, B. L. Fisher, Floyd Court House.

The Automobile Club Show.

The annual exhibition of the Automobile Club of America will be held in the Grand Central Palace, Lexington avenue and Forty-third street, New York city, from December 1 to December 8, 1906. Over 60,000 square feet of space has been applied for by manufacturers and exhibitors. As only 55,000 square feet is available, some of the exhibitors will be compelled to modify their demands for space.

In addition to automobiles there will be an attractive areonautical exhibition in connection with the "old show." In this exhibition everything new and novel in the balloon and air-ship line will be on exhibition. A feature of this part of the show will be Frank P. Lahm's balloon, United States, which won the recent international contest from France to the English coast, and the two balloons, Orient and Centaur, which recently engaged in a distance contest from Pittsfield, Mass.

THE LARGEST MOVABLE DAM OF THE BEARTRAP TYPE IN THE COUNTRY.

BY W. C. WEEKS.

The installation of a beartrap gate, or more properly speaking, a movable dam of the beartrap type, at the north channel controlling works of the extensive power development by the Washington Water Power Company at Post Falls, Ida., on the Spokane river, has awakened considerable interest and speculation as to the manner of its construction and operation, as well as its history and development to its present stage of perfection.

As far as is known to me the beartrap dam at Post Falls is the only one of its kind in the Inland Empire, and a brief description and history of this gate and its prototypes may be of interest to those connected with the various power development enterprises in the northwest, as well as to those who take a general interest in things out of the ordinary.

The design and construction of means for controlling the flow of water in sluices, flumes and locks has been given very close and detailed study by European engineers for many years, and it may here be noted with satisfaction that the beartrap type of movable dam is distinctly an American invention, and, strange to say, was the direct result of the necessity of obtaining a supply of anthracite coal to operate a wire mill in 1818.

No gate or dam heretofore constructed was suitable to the purpose, so Josiah White devoted his talents to constructing a movable dam which could be made to impound water in a pool, and then fold up or collapse sufficiently to allow coal barges to pass over it with the rush of water. He devised such a dam, and in order to demonstrate its practical workings had a small gate built in an experimental sluice in Mauch Chunk creek. Curious persons were evasively answered by the workmen that they were building a bear trap, and this form of dam has retained the name of "beartrap" ever since. A number of dams were built in the river, supplied with beartrap gates, and their use was so successful that they became of great importance in hydraulic development.

The first beartrap dam consisted of two flat, rectangular leaves, the leaves having a width of a certain ratio to each other, and a length equal to the width of the sluice they were to control. The total rise of the dam is limited by means of a number of chains fastened to the under side of the lower leaf, which coil up on the

Digitized by Google

bottom of the chamber when the gate is down. The successful operation of the device depends upon an unbalanced hydrostatic pressure on the leaves of the gate when the pressure of the water above the dam is admitted to the chamber beneath.

With the development of navigation in the United States came a further study of beartraps. A man of prominence, Ashbel Welch, came out boldly with his approval of the type, and we hear of a board of United States engineers recommending the adoption of the beartrap for a dam at Beattyville, on the Kentucky river, in 1886.

Naturally a number of improvements were proposed, some of which were variations, others alterations, and some having distinct merit. The development may be readily traced from the original beartrap to the design recognized as having unusual merit, that of being readily proportioned to all heights of backwater. Passing over some unimportant and grotesque modifications we come to Girard's French patent, in which the lower leaf was hinged near the middle. This was a new idea of genuine merit, but the French engineers failed to appreciate it, and it remained for Thomas Parker, of Menominee, Wis., to improve upon Girard's patent by reversing the gate, pulling the folding leaf up stream, and protecting the gate against destruction by an upstream leaf. Were it not for this leaf, débris would sooner or later jam between the upper leaves and wreck the gate.

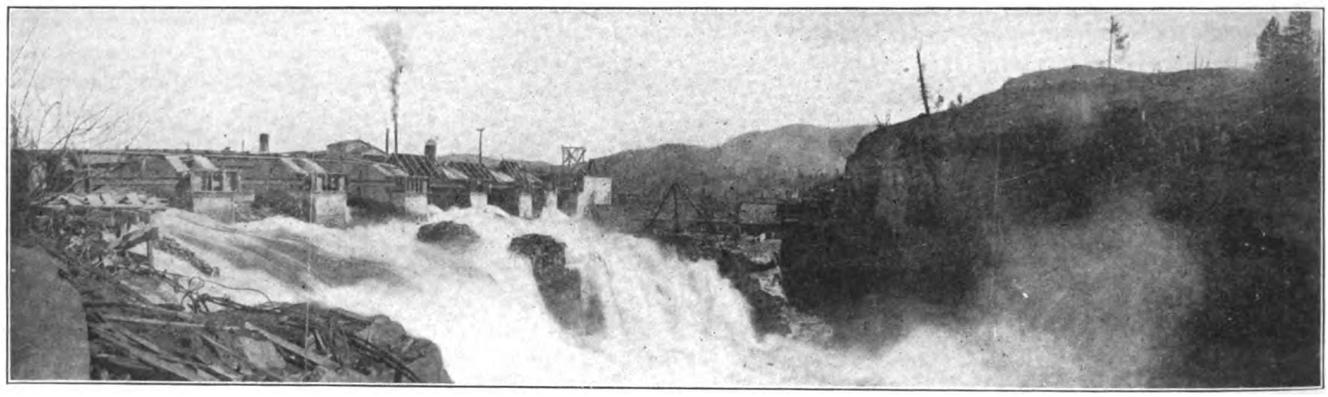
Next we note Lang's improved gate, in which one of the leaves of the Parker gate is replaced by a tie and the upstream protecting leaf shortened. Several dams of the Parker and Lang types of beartrap have been constructed in the middle west, all of which are giving satisfaction. They find particular favor with lumbermen in the improvement of streams for driving logs, and this fact has extended their use.

Next we come to the reversed Parker, a form proposed and patented by Captain A. O. Powell, now chief engineer of the Lake Washington ship canal, and Archibald Johnson in 1896, both these gentlemen being at that time engineers in the United States engineer office at St. Paul. Several of these have been constructed and are in successful operation. It is particularly sensitive to difference in elevation of head and tail water, that installed at Lake Winnibigoshish dam to northern Minnesota rising with a head of but two inches.

The beartrap at Post Falls is of the reversed Parker type. The entire controlling works at the north channel, including the beartrap, was designed by the patentee of the reversed Parker beartrap. It was completed just before high water this spring, but because of freshly placed concrete in the foundation no attempt was made to operate the gate until the flood had partly subsided. It was then found that the gate would not rise, owing to the excessive weight upon the idler or downstream leaf. This leaf was accordingly removed, the location of this gate being such that the idler was not essential, and since that time the beartrap has worked in a satisfactory manner, responding perfectly to the operation of the controlling valves.

Though there are several larger, the beartrap at Post Falls is one of the large beartraps, and probably the largest ever constructed of its type. It closes an opening 110 feet wide and in common with the working of all dams of the beartrap type, is operated with ease by one person. This is one of the features of this class—the ease and simplicity of operation. The beartrap in the Chicago drainage canal spans an opening 160 feet wide; one was built on the Monongahela river 120 feet wide, and there are doubtless others closing passes in excess of 100 feet. The object of the beartrap at Post Falls is to provide an easily controlled opening for the passage of an immense volume of water laden with débris and drift.

By its installation provision has been made to pass, without raising the river in the least above its natural level, all the water and more, that ever came in the highest known high water. In other words, the beartrap type of movable dam, in conjunction with the Tainter gates, has enabled the controlling works at the north channel to be so constructed that the entire development of the Washington Water Power Company at Post Falls has resulted in increased facilities for the passage of flood waters over that afforded by the river in its primitive condition.



BEARTRAP TYPE, MOVABLE DAM OF THE WASHINGTON WATER-POWER COMPANY, POST FALLS, IDA., ON THE SPOKANE RIVER.

Economy in Electrifying.

The work of electrifying the surface plants of the Calumet & Hecla, says the New York *Sun*, which was begun about two years ago, has progressed to a point where results are becoming pleasingly evident. The new electric plant is located at Lake Linden, near the mills and smelters, and four miles from the mine, which is on the hill above, effecting a considerable saving in transportation charges on fuel, as the company burns about a thousand short tons of soft coal daily. The new powerhouse replaces a half-dozen or more isolated plants, all of comparatively small size, and will greatly reduce the cost of motive power in many departments of the mining and milling. The giant hoists and air-compressors of 2,000 to 8,000 horsepower each, for which this mine has been famous for many years, will use steam as before, but the hundreds of small engines will employ electricity hereafter, and it will be possible to equip the various lathes and other machines with individual motors in accordance with the most advanced shop practice.

Digitized by Google

DATA ON INDOOR ILLUMINATION.[1]

BY J. E. WOODWELL.

In approaching a problem on illumination, consideration is first given to the quantity required. This will vary in accordance with the uses to which the spaces to be illumined are to be put. It has been found, moreover, that the eye adjusts itself over a considerable range in intensity, so that between certain maximum and minimum values the artificial lighting is equally effective. The final criterion of satisfactory illumination is, therefore, not a definite intensity as expressed in foot-candles, but a visual effect or physiological sensation incapable of quantitative expression. The primary fact to which we must refer is the light sensation, and this is dependent upon the quality as well as the quantity of the light. Illumination has been defined as the light which in quantity and quality enables the outlines of objects to be discerned and colors to be perceived. It is evident, also, that the visual effect or apparent brilliancy is dependent upon the amount of light reflected from the object illuminated to the eye.

In consequence of the complex relation between the physical laws of light and the resulting physiological sensation, the quantitative measure of illumination is not to be wholly relied upon as the basis for calculation. Data taken from successful examples of indoor illumination where all of the conditions as to reflection values, etc., are known are most valuable, but, unfortunately, illuminometer tests made under such conditions that the errors to which such measurements are particularly subject are eliminated are very scarce. In the absence of actual data similarly determined for almost every variety of indoor conditions, it is necessary to approximate general values for the intensity upon the basis of judgment and experience. It is known, for example, that one foot-candle is an amount which is sufficient to enable one to read print of this size type comfortably, while for newspaper print at least two foot-candles is desirable.

In the postal service, for reading addresses of mail in an endless variety of forms of pen, pencil and print with backgrounds of various color, a local illumination of from two to four foot-candles has been found by extended experience to be required; two foot-candles is generally sufficient for desk illumination, though for work involving much detail, three and even four foot-candles has not been found excessive. For corridors, public spaces, assembly rooms, the figures range from 0.5 to 1.5 foot-candles, while in stores where dark goods are displayed or a brilliant effect is desired, five to ten foot-candles is not uncommon. The latter amount is also required for tracing, drafting, engraving and other similar work. These intensities relate to the working plane, and in addition, consideration must be given to the walls and ceiling and whatever objects in the space are to be illuminated, and the figures determined upon for this purpose will depend principally upon the color and reflection values of such surfaces.

Having determined the intensity of illumination and its general distribution in a given space, it is necessary to choose the illuminant and its accessories for diffusing and directing the light, and to decide upon the number and position of units in order to secure the predetermined result.

In order to determine what may be accomplished with a given light source it is necessary to know its distribution curve, including that of any requisite accessory. Curves of practically all illuminants and many accessories have been widely published recently, and are available to the engineer.

The distribution is generally shown on a polar diagram. Such curves are of great value to the illuminating engineer, but unless the underlying principles are kept well in mind, deductions from a comparison of such curves for lamps and reflectors of different types are apt to be misleading to the layman. To show this properly, recourse must be had to the Rosseau diagram, which is essential to a proper comparison of the performance of various reflectors.

The paper describes the usual method of determining the illumination given by a certain source and shows what allowance may be made for reflection. In practical work, the illumination received by a surface or object is frequently very materially increased by diffused reflection from walls and ceiling, the amount being dependent upon the distance of the light source from the reflecting surface and the coefficient of reflection. For interiors having dark walls or with large dimensions, the increase in illumination due to reflection is small, while under favorable conditions, such as small interiors with white plaster or painted walls and ceilings, or with white marble or similar interior finish, the direct illumination may be increased two or even three times. The theoretical constant is computed by the formula $K = \frac{1}{1-C}$ where C is given a value representing the actual coefficient of reflection of the walls or surfaces as the result of experiment or experience. For public buildings with relatively large interiors and light-tinted walls and ceilings, values of $\frac{1}{1-C}$ will be found to lie generally between 1.25 and 1.50.

In planning a system of illumination for a new building in which the color scheme for decoration has not been determined, very small allowance can safely be made for reflection, particularly in the capacity of wiring circuits. Moreover, a certain margin is required in all calculations of illumination on a theoretical basis to allow for the inevitable loss in practice occasioned by the deterioration in candle-power of the light source. If, on the other hand, the economy is a sufficient object, and the finish of the walls and ceiling of a room of moderate dimensions is planned with reference to securing the full advantage of reflection, the resultant illumination may by this means be more than doubled.

In applying the foregoing principles and factors in a given case it is necessary to fix the location of the light sources. In elaborately finished interiors the position is determined with reference to symmetry and architectural requirements. In such cases the efficiency of the system is not the prime consideration and is subordinated to the esthetic features. In certain offices and workrooms, on the other hand, where no architectural limitations are imposed, the problem may be solved with sole reference to securing the maximum illuminating result for the energy supplied. The subject may be best presented by reference to examples from actual practice in the lighting of public buildings.

In the planning of the new Young Men's Christian Association building, Washington, D. C., the illuminating requirements were first carefully studied and the position of fixture outlets and general type of fixtures and light sources, including accessories, determined. The wiring system was then planned to furnish the electric current in the right place, in the proper amount, and subject to the desired switch control. The third floor of the building is devoted principally to educational work and includes a number of classrooms, of which the room shown in Fig. 1 is typical. As the room was designed for classroom and lecture purposes, it

[1] Abstract of a paper presented before the Illuminating Engineering Society, October 12

Digitized by Google

was necessary to furnish adequate illumination for reading and writing in all parts of the room on a plane about thirty inches from the floor. Between two and three foot-candles illumination was decided upon as necessary, and on account of the blackboards located on one side of the room and the uncertainty of the color value of the remainder of the wall, it was decided not to make any allowance for reflection. A number of light sources were chosen in order to prevent shadows and to secure a fairly uniform illumination over the entire working area.

The natural selection of outlets for such a room, according to conventional methods, would be the two central outlets on the major axis of the room. This method, however, would not result in securing a uniform illumination on the working plane, and in order to bring up the results to the proper amount at the most distant points in the room, an excess illumination would be furnished under the light source. A large number of light sources would result in exceeding the minimum illumination at fewer points, and would therefore be more economical, since by this means the aggregate candle-power could be reduced. The inverse square law also applies here, as with a larger number of light sources the average distance of the source to the point illuminated is less. The arrangement of outlets shown in Fig. 1 was finally selected as the result of preliminary calculation. The actual location of the outlets as shown on the plans are slightly shifted from the theoretical requirements to make the arrangement symmetrical in the room; also in consideration of a possible future division of the room by a partition in the centre.

The light source which was selected as giving a satisfactory distribution was the Meridian lamp with frosted globe and prismatic reflector. By trial calculation the No. 2 unit was chosen, and its height from the ceiling made the minimum consistent with the required illumination on the working plane. The height of the lamp from the floor was thus made nine feet nine inches, a height which also places the light source practically out of the ordinary line of vision. The results of calculations based upon the sum of the partial illuminations from the ten Meridian lamps are shown by the illumination curves in Fig. 1, taken on a diagonal and one transverse section. In the interests of temporary economy in lighting service, the No. 1 Meridian unit, giving approximately one-half the illumination furnished by the No. 2 unit, has been installed. The practical result is an illumination which is satisfactory in distribution but insufficient in quantity. The present result is sufficiently indicative, however, that the illumination furnished by the No. 2 unit, upon which the calculations were based, would be entirely sufficient.

Ceiling clusters of Meridian units are used in the assembly room of this building. In the drafting and typewriting rooms the illumination is secured by cord drops adjustable for height and fitted with a ten-inch green porcelain cone shade with white-glazed interior surface. Both drafting and typewriting require a high intensity of illumination and entire freedom from objectionable shadows, and this result can generally be most economically and satisfactorily secured by local lights rather than by the use of fewer lighting units of high candle-power.

An entirely different solution of such a problem is presented in the illumination of the room on the fifth floor of the New York Post-office, occupied by the International Money Order Division. This room is shown in plan, Fig. 2. When the illumination of this room was planned, a system of local lighting by incandescent lamps was considered, involving 135 sixteen-candle-power lamps on cord drops, and nine eight-light clusters to provide a general illumination, thus aggregating in all 207 sixteen-candle-power lamps which, on the basis of fifty watts for each lamp, would require 10.35 kilowatts energy. It was recognized that the system would be awkward to install, inefficient in operation and unsightly in appearance. An alternative method would have been to install a smaller number of lighting units of high candle-power. Such units, if of high intrinsic brilliancy, would have to be placed near the ceiling to avoid the glare in the field of vision, and should preferably, even in this location, have diffusing globes to reduce the intensity of light entering the eye by direct reflection from the white paper in front of each clerk.

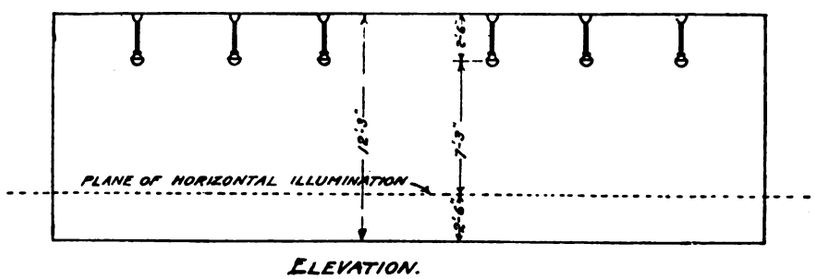


FIG. 1 —CLASSROOM, Y. M. C. A. BUILDING, WASHINGTON, D. C.

Case.	Floor Area. Square Feet.	Ceiling Height. Feet.	Cubic Contents. Cubic Feet.	Total Candle-power.	Watts Input.	Candle-power[12] per Square Feet.	Square Feet[12] per Candle-power.	Cubic Feet[12] per Candle-power.
I as installed....	3,320	25	83,000	3,192	10,784	.96	1.04	26.0
I as used.....	.....	..	.....	2,336	7,702	.70	1.42	35.5
II.....	2,340	30	72,200	3,104	10,032	1.33	.75	22.6
III.....	2,094	18½	38,381	1,740	6,090	.83	1.20	22.1
IV.....	7,525	19½	145,483	3,808	11,805	.53	1.98	38.2

[12] Mean horizontal candle-power rating.

Digitized by Google

The clerical work performed in the room apparently requires a high intensity of illumination, probably not far from three to five foot-candles of illumination normal to the desk plane. The Cooper Hewitt lamp was installed experimentally, as the color value does not affect the usefulness of the lamp for this work. The installation has been in service about ten months and has given entire satisfaction to the employés who use it. It has the advantage of an efficiency of 0.60 to 0.75 watt per candle when installed without the reflector, combined with a low intrinsic brilliancy. A test of the illumination thus secured has shown that it is nearly six foot-candles, which is probably in excess of the requirements.

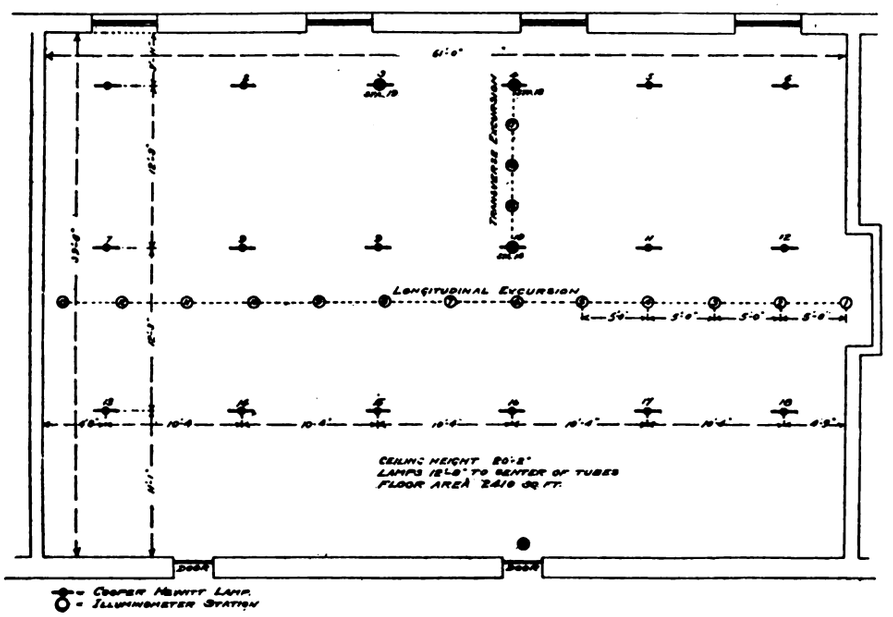


FIG. 2.—INTERNATIONAL MONEY-ORDER DIVISION ROOM, FIFTH FLOOR, NEW YORK POST-OFFICE.

Four typical examples of the lighting of public rooms, presenting as many radically different solutions of the problem of illumination, are exhibited by the following cases:

I. Courtroom, United States Courthouse and Post-office, Chicago, Ill., Fig. 3.

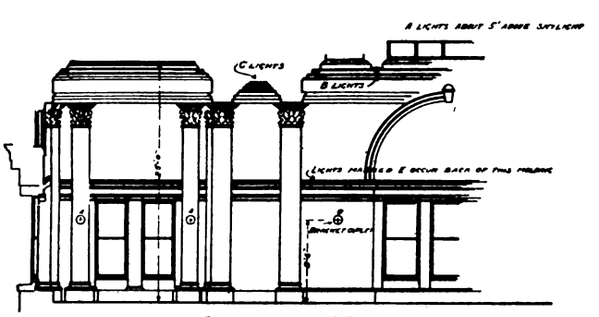
II. Courtroom, United States Courthouse and Post-office, Indianapolis, Ind., Fig. 4.

III. Courtroom, Onondaga County Court-house, Syracuse, N. Y.

IV. Newspaper reading-room, Library of Congress, Washington, D. C., Fig. 5.

In order to present briefly the important characteristics of the lighting installation in a comparative way, the accompanying table has been prepared, showing such data as may prove of interest.

Case I is a room equipped with twelve four-light and four three-light fixtures over the skylight with pagoda reflectors No. 2,673 and sixteen-candle-power lamps, giving a well-diffused downward light through the ground-glass skylight; twenty-two sixteen-candle-power frosted lamps are located on two main transverse ceiling beams and fitted with pagoda reflector shades No. 2,631; thirty-six eight-candle-power frosted lamps are located on ceiling beams under skylight, without reflectors; seventy-one eight-candle-power bare lamps are installed in the cove about midway between the floor and the ceiling. These lamps are used without reflectors and produce illumination of the wall space above far from uniform. The exposed lights below the skylight beams and the cove lights are not necessary in the illumination of the room and are rarely used. The remaining illumination is secured by eight brackets, each with four eight-candle-power frosted lamps and one thirty-two-candle-power lamp in opalescent flame-tip shade, and four double brackets with twice the lamp equipment mentioned. The resultant illumination from the lamps above the skylight, studded lamps on ceiling beams and from the brackets is apparently both adequate and satisfactory. The reflection value is high, the finish being in white marble and plaster. The lighting equipment is typical of that in four similar courtrooms on the same floor.



Case II presents a much simpler treatment. The principal illumination is here secured from sixteen brackets of special design, supporting four six-inch and one ten-inch ground-glass ball globes, the former with sixteen and the latter with thirty-two-candle-power lamps. The brackets are eleven feet above the floor, but on account of the size of the room are within the line of vision. For this reason it was necessary to use diffusing globes by means of which the intrinsic brilliancy is reduced to about one-seventh of one candle-power per square inch. The sixty-six frost-

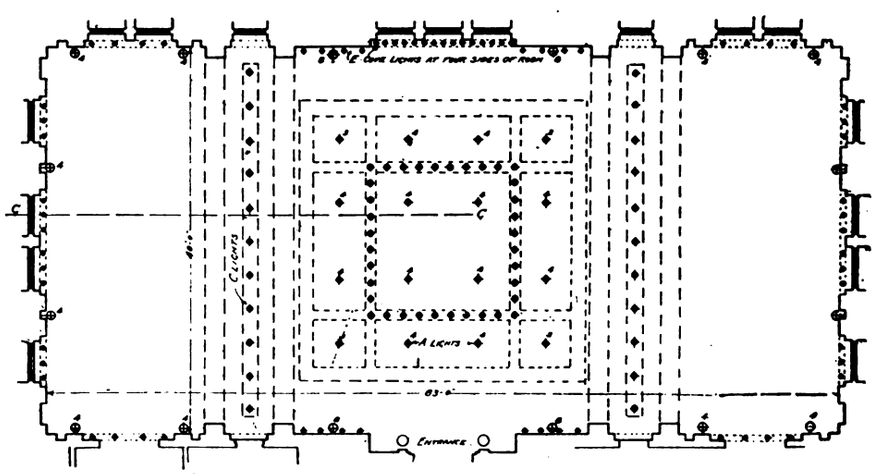


FIG. 3.—LIGHTING DIAGRAM, NORTH AND SOUTH COURTROOMS, UNITED STATES COURT-HOUSE AND POST-OFFICE, CHICAGO, ILL.

ed lamps of sixteen candle-power located under the skylight are used for decorative effect, and aid materially in bringing out the details of the mural dec-

Digitized by Google

oration. The resultant effect is believed to be satisfactory and agreeable to the eye.

Case III. This courtroom is illuminated by pendant fixtures and brackets, all equipped with ground-glass ball globes cut

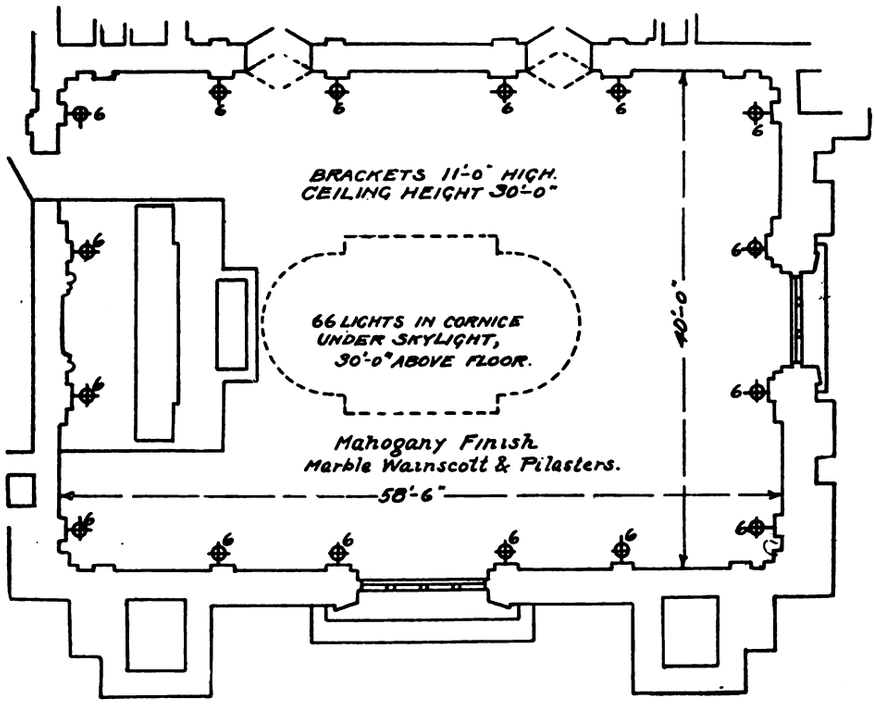


FIG. 4.—EAST COURTROOM, U. S. BUILDING, INDIANAPOLIS.

for decorative effect. The lowest point of the pendant is about twelve feet above the floor, but the intrinsic brilliancy of all light is here reduced to about one-ninth of one candle-power per square inch. The fixtures have not been placed in service yet, so that no statement of results can be made at this time.

Case IV. This room presents a somewhat different problem from that of the illumination of the courtrooms, and one much more difficult. To read newspaper print at the angle of a newspaper rack requires an illumination normal to the paper of about two foot-candles, considerably more than is secured by the present equipment according to a rough calculation, ignoring the effect of distant light. The room is 215 feet long by thirty-five feet wide, and has a lighting equipment of 238 sixteen-candle-power oval-filament lamps distributed about two feet apart on the ceiling beams, as shown in the illustration. The height of the lamps from the floor is seventeen feet. Each lamp is equipped with a pagoda reflector shade No. 2,621.

Independent of the apparent deficiency in candle-power for the requirements of the room as borne out by experience and checked by calculation, this method of illumination appears to have much to commend it. In practice, however, it is open to several objections. The length of the room is such that a very large number of lamps is brought within the field of vision at one time, and though the brilliancy of each unit is small, the effect in the aggregate is to reduce the sensibility of the eye. This effect could apparently be entirely eliminated by the use of a prismatic reflector of conical form with an opaque cardboard cover to cut off the side light. The position of the lamps, however, is not favorable with reference to the natural

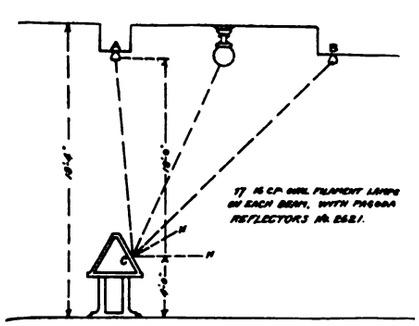


FIG. 5.—POSITION OF LAMPS, NEWSPAPER ROOM; LIBRARY OF CONGRESS.

location of the newspaper racks opposite piers, as shown in Fig. 5. The light rays from lamps on beam A strike the paper at a very oblique angle, while the reader casts an objectionable shadow produced by the lamps at B. One solution of such a problem would be to provide four fixtures in each of the fifteen ceiling panels, consisting of a thirteen or fourteen-inch ground-glass ball globe with single lamp of 75 or 100 candle-power mounted in a suitable holder close to the ceiling. By placing a prismatic reflector above the lamp inside the ball globe the required distribution of illumination is secured with good diffusion and low intrinsic brilliancy. The intensity of the light regularly reflected is also advantageously reduced.

Too much emphasis can not be placed upon the necessity of reducing the intrinsic brilliancy of an incandescent electric lamp, and the advantages of using diffusing globes of the type described is usually more than sufficient to offset the losses due to absorption. Moreover, the use of a large, well-ventilated outer globe of ground glass presenting ample radiating surface does not seriously reduce the life of the lamp, as has been shown to result from frosting the lamp globe itself.

Electrical Manufacture of Steel.

Consul Urbain J. Ledoux reports from Prague that Austrian papers are discussing the introduction of the Kjellin process in the manufacture of steel by the Poldihütte, at Kladno, Bohemia, in concert with the Oberschlesische Eisenindustrie-Gesellschaft, which process, says the Prague *Tagblatt,* may bring about a complete revolution in the Austrian steel industry. Continuing, the Prague *Tagblatt* says:

That such steps may be leading to vastly important results may easily be realized when it is considered that the Kjellin process yields an excellent steel, said to be fully equal to the best crucible steel, while the cost of production is considerably lower than with the mode of production so far in use. The Kjellin product, however, apart from its lower cost, is further praised for its ductility, density, homogeneousness, softness, the possibility of obtaining high degrees of carboniferous quality, and, finally, for its excellent magnetic properties. If these surmises—as appears highly probable —should be proved by facts, all undertakings which have at their disposition the primary requisite for the adaptation of the electric process, *viz.,* cheap electric power by means of sufficiently strong water power, will secure a great advantage over other works. Chief Engineer V. Engelhardt, in his work on the Kjellin process, states that it can compete with the Siemens-Martin method, where the kilowatt hour can be put down at about a half cent.

Digitized by Google

Electrification of the West Jersey & Seashore Railroad—I.

New System Put in Operation on an Important Branch of the Pennsylvania Railroad—Description of Power-House and Substations.

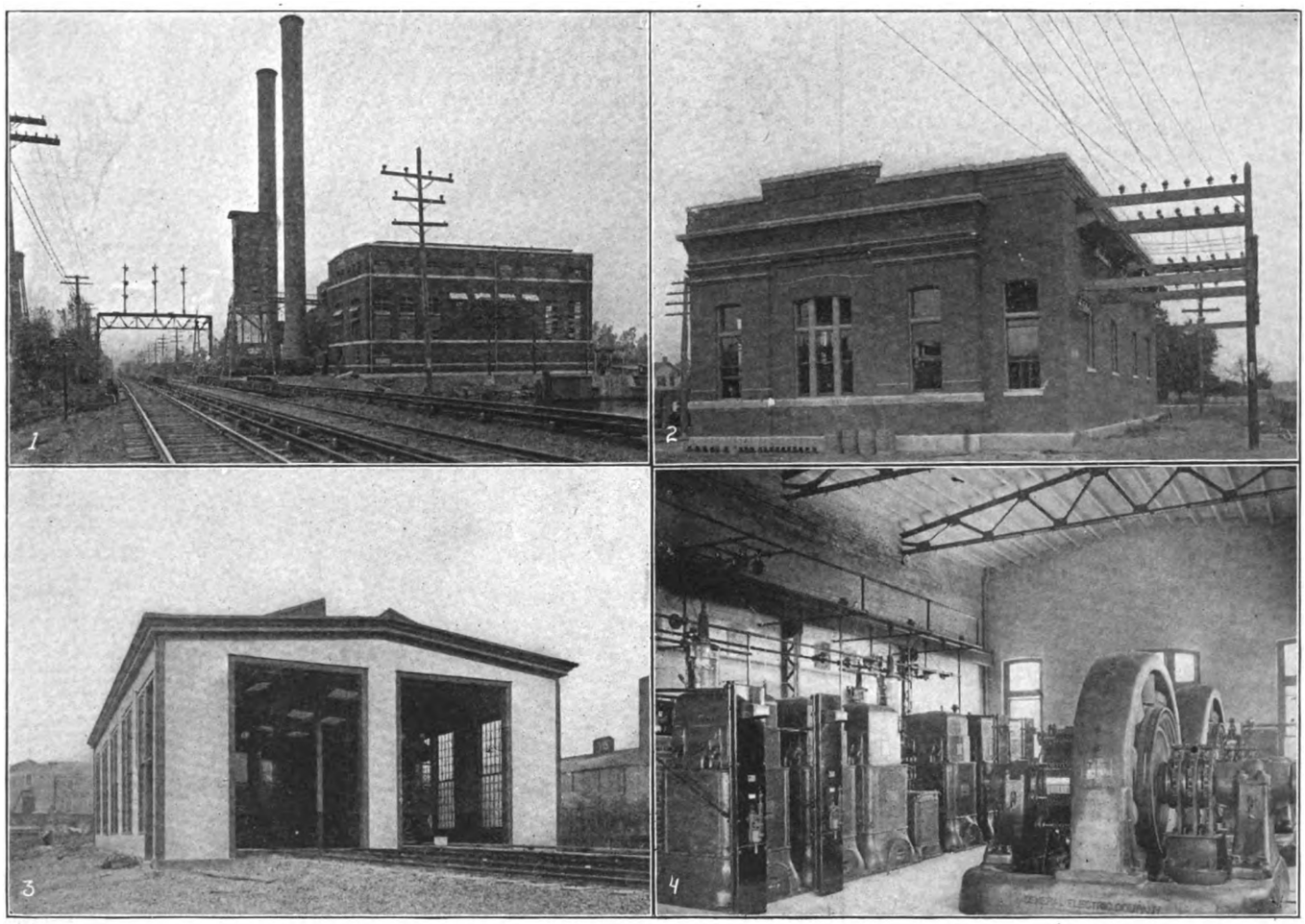
THE Pennsylvania Railroad has equipped for electric operation its West Jersey & Seashore branch, involving the electrification of a main line double track steam road from terminal to terminal of a greater length than any electrified steam road in the country.

This undertaking also involved the construction of a power-house of original design and built in record time. The site for it was chosen on January 17, 1906; the first pile was driven two days later, and on July 1, the first train to take current from the power-house was run on the newly electrified tracks. On September 18, the line was placed in operation.

The line of the electrified system extends from Camden, New Jersey, *via* Newfield, to Atlantic City, a distance of sixty-five miles, and from Newfield to Millville, a distance of ten miles. In addition to the erection of a power-house, this work has called for the building of eight substations, one of which is in the power-house, the electrical equipment of approximately 150 miles of single track, the building of seventy-one miles of duplicate high tension transmission line, and the construction and electrical equipment of sixty-eight cars. In addition, a great deal of other work always incident to extensive undertakings of this nature was done, including the laying of new rails, installation of signals, telegraph and telephone system, building of bridges and fencing and improving the stations.

The extent of the new system is shown on the accompanying map. Beginning at the Camden end of the line, an entirely new terminal has been constructed which adjoins the present ferry terminal. The work at this point includes a number of stub end tracks with suitable sheltered platforms between them, and three-quarters of a mile of new elevated double track trestle, with stone piers and steel superstructure at street intersections, has been built to connect this terminal with the existing lines, at grade, at a point near Haddon avenue.

From a point about two miles from Atlantic City, a new right of way has been secured, and after crossing the Thoroughfare on a new drawbridge the tracks cross the Philadelphia & Reading on an elevated structure and enter the new Atlantic City terminal on a descending grade. This terminal, like that at Camden, consists of a number of stub end tracks with concrete platforms between them, with steel umbrella shelters. It is located on the south of the present steam road terminal. From Camden to At-



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD. 1—POWER-HOUSE, WESTVILLE, N. J. 2—SUBSTATION, GLASSBORO, N. J. 3—CAR INSPECTION BARN, ATLANTIC CITY, N. J. 4—SUBSTATION, ATLANTIC CITY, N. J.

Digitized by Google

lantic City the road has been electrified with a third rail, with the exception of a stretch of track 4.4 miles in length between Haddon avenue and South Gloucester, the track passing through the city streets at grade between these points being equipped with the overhead trolley.

In addition to this through route, the line from Newfield to Millville—ten miles—has been electrified. On this portion of the road the overhead trolley has been installed. New terminal facilities have been provided here, including 100 feet of umbrella shelter sheds.

The line from Camden to Atlantic City is a double track road throughout, and is a three track road between Camden and Woodbury. From the Camden terminal to Newfield the road is laid with 100-pound rails, and from Newfield to Atlantic City it is laid with eighty-five-pound rails. The line from Newfield to Millville is a single track road and is laid with 100-pound rails.

It will be noticed on the map that the Pennsylvania Railroad Company has two roads connecting Camden with Atlantic City, and it is the longer of these routes that has been electrified. This has been done because there is a large coal traffic on the longer route that can be handled more economically and expeditiously by electric traction than is possible with steam haulage.

The importance of the undertaking is further emphasized by the density of the traffic on the electrified section of the road. The power-house and substation equipment and the line are laid out with a view of supplying sufficient power for the operation of all the cars now provided, operating in an express service to Atlantic City, and for a local service of two-car trains between Camden and Millville on half-hour intervals, and single cars between Camden and Woodbury on ten-minute intervals. The express service provided for is three-car trains running on a headway of fifteen minutes in each direction at a speed on straight level track of sixty miles per hour. The initial schedule that has been put into service includes three-car express trains between Camden and Atlantic City on one hour intervals, the running time being ninety minutes, and a local service of two, three and four-car trains run on a minimum interval of fifteen minutes during the rush hours between Camden and Glassboro, every fourth train going on to Millville. The motor, baggage and mail cars are attached to the passenger trains as conditions require. Each car in the electric service is a motor car, no trailers being used.

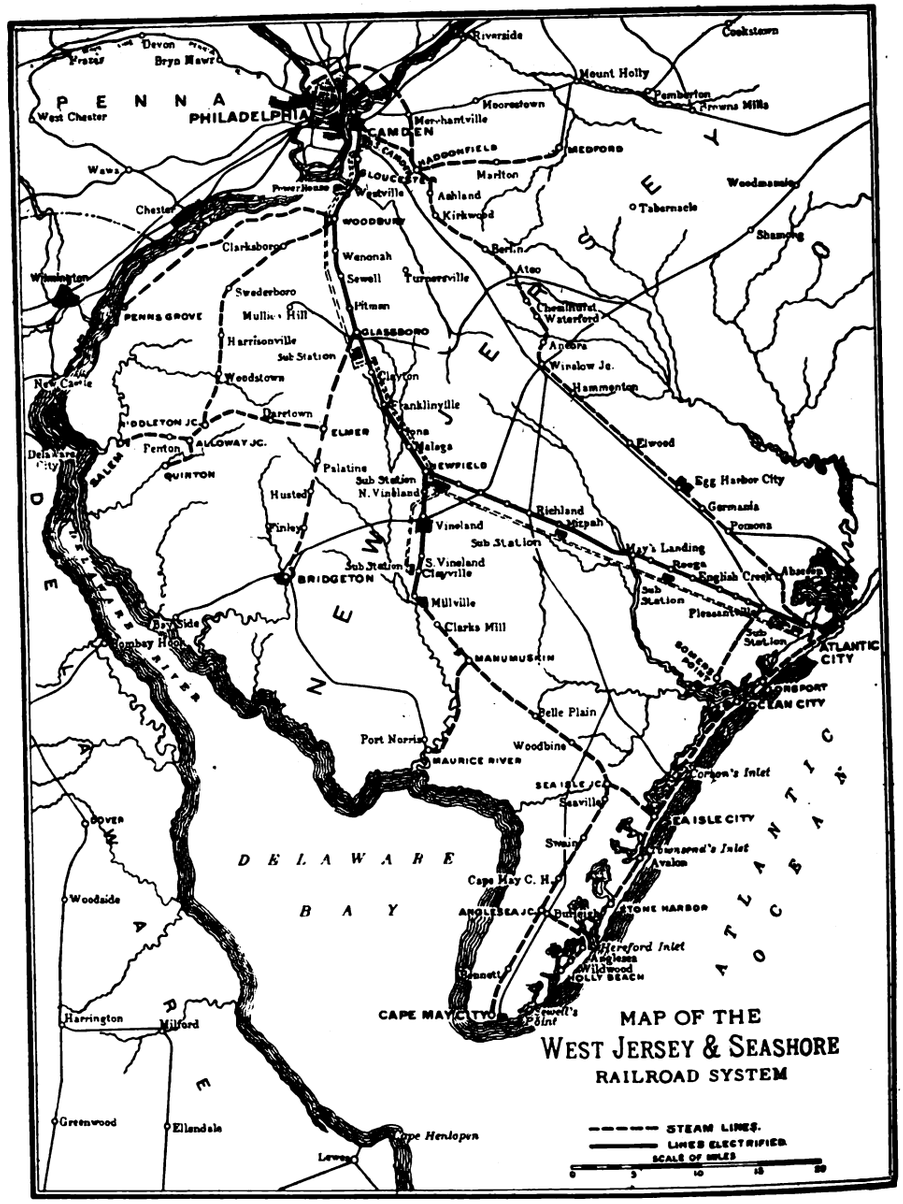
The contract for the entire electrification work was given to the General Electric Company, Schenectady, N. Y., and through them certain portions were sublet. The electrical equipment throughout is of standard General Electric design.

The general scheme of electrification consists of generating alternating-current power at a potential of 6,600 volts at the power-house, where it is stepped up to 33,000 volts. At the latter pressure it is transmitted over the high-tension transmission lines to the substations, where it is reduced to a potential of 430 volts by means of step-down transformers, and then led to the rotaries and converted to direct current at 650 volts, at which pressure it is fed to the third rail for operating the cars.

THE POWER-HOUSE.

The power-house is situated at Big Timber Creek, just to the north of Westville, N. J., at a point 5.6 miles from the Camden terminal, where there is an abundance of water for boiler feed and condensing purposes. The power-house, boiler house and stacks are built on approximately 650 concrete piles. The foundations, which were started on March 15, are of reenforced concrete and are superimposed upon the piles in such a manner that the latter project about one foot into the mass of concrete.

The boiler foundations were completed by March 25, and those for the steam turbines by June 5. The erection of the steel work for the main building was begun on April 18. On March 5 the foundations for the stacks were started and these were completed by the twenty-fifth of the same

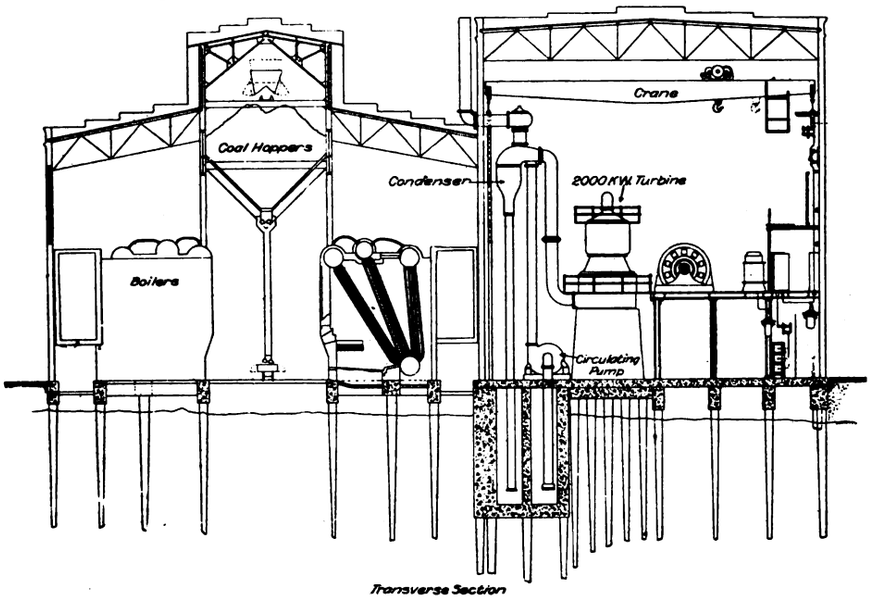


MAP OF THE WEST JERSEY & SEASHORE RAILROAD SYSTEM.

Digitized by Google

month. The steel work for the stacks was started on April 11, and the first stack was erected, lined and ready for use by June 29.

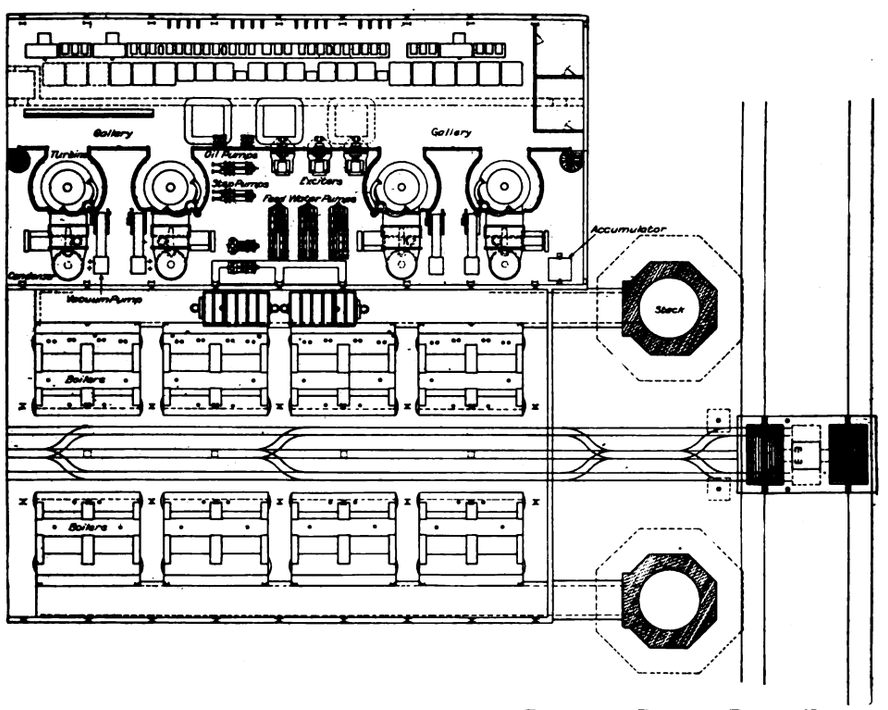
On July 1, five and one-half months from the date upon which the first pile was driven, two boilers were under steam at working pressure, a turbine and all the necessary auxiliaries were running, the substation in the power-house was in operation, and the first car to take current from the power-house was run on the line.



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—TRANSVERSE SECTION OF POWER-HOUSE, WESTVILLE, N. J.

The main portion of the electrical equipment of the power-house is given in the following list: Three 2,000-kilowatt, 6,600-volt, twenty-five-cycle, three-phase Curtis turbo-generators; two seventy-five-kilowatt 125-volt Curtis turbo-exciters; nine 700-kilowatt, twenty-five cycle, air blast transformers, and three blowers, capacity of each, 20,000 cubic feet per minute.

The switchboard consists of: three three-phase generator panels, two exciter panels, three blower motor panels, one synchronizing equipment, three 33,000-volt transformer panels, two sets of lightning arresters and switches, six static potential indicators, and two 33,000-volt outgoing line panels.



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—PLAN OF POWER-HOUSE, WESTVILLE, N. J.

It will be seen from the above that the present normal capacity of the generating station is 6,000 kilowatts. However, there is sufficient room provided in the layout of the building for an additional 2,000-kilowatt turbo-generator set together with the necessary auxiliaries. The foundation for the extra turbine is already built. In addition to this provision for extra power, one of the end walls of the station is of a temporary nature in order that increasing demands for power may be met with a minimum of expenditure in the future.

The most important items among the auxiliaries are as follows: Two exciter sets, consisting of horizontal Curtis steam turbines coupled to seventy-five-kilowatt, four-pole, direct-current generators running at 2,400 revolutions per minute, and delivering 600 amperes each at 125 volts pressure. The turbines of these sets work non-condensing, as the exhaust is used for heating the feed water.

Three barometric condensers, built by Williamson Brothers, in connection with Cramp & Company, of Philadelphia, who are also the subcontractors for the circulating and air pumps. These condensers are capable of maintaining a vacuum of twenty-eight inches and are designed to condense 60,000 pounds of steam per hour with circulating water at a temperature of seventy degrees Fahrenheit. The approximate ratio of condensing water to steam condensed is seventy-five to one.

Three dry air pumps built by the I. P. Morris Company, of sufficient capacity to fulfill the guarantees given with the condensers.

Three centrifugal circulating pumps built by the I. P. Morris Company, and driven by Reeves engines. The piping for these engines is so arranged that the exhaust may be discharged to either the feed-water heater or to the third stage of the turbines, the latter arrangement only being used when the exhaust from the other auxiliaries exceeds that required for the feed-water heater.

Two Cochrane feed-water heaters. Each heater has a capacity for heating 135,000 pounds of water per hour from seventy degrees Fahrenheit to 212 degrees Fahrenheit.

Two Worthington boiler-feed pumps, two Worthington make-up pumps, two Worthington step-bearing pumps, three Worthington step-bearing water-return pumps.

One accumulator for the step bearings with a capacity of 100 gallons of water at 800 pounds pressure per square inch. This accumulator was supplied by R. D. Wood & Company, of Philadelphia, Pa.

The area of the power-house is 17,069

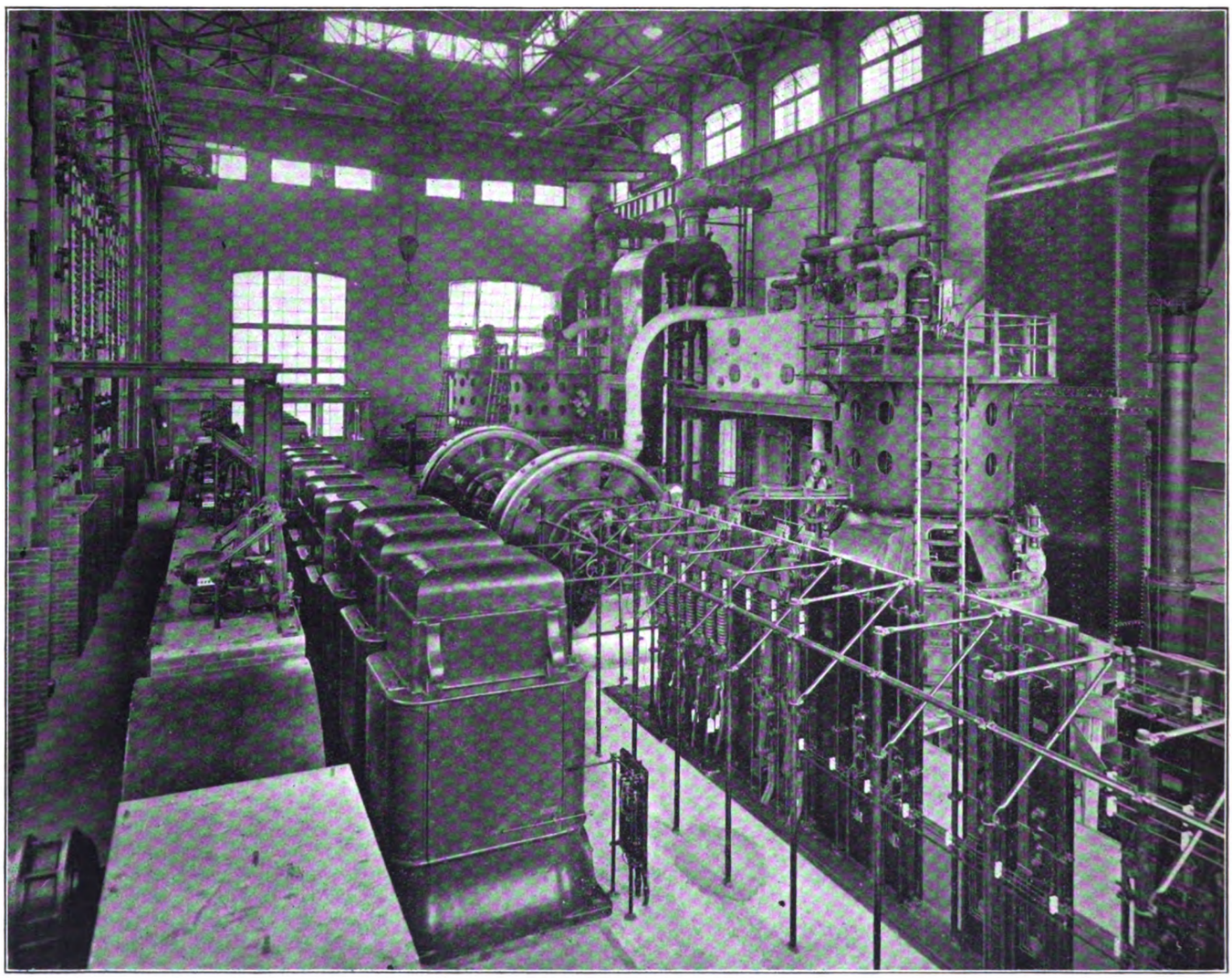
Digitized by Google

square feet, and the cubic contents amounts to 829,113 cubic feet, thus giving 2.13 square feet and 103.6 cubic feet per kilowatt as the unit output of the station, based on 8,000 kilowatts as the ultimate capacity of the present structure.

The layout of the steam piping in the power-house is of a neat design and allows ample operating space around all the machinery. W. K. Mitchell & Company, of Philadelphia, were the subcontractors for this work together with the steam valves, etc., and Keasby & Mattison furnished the pipe covering.

The boiler house is furnished with twelve Stirling water-tube boilers arranged in pairs forming six batteries. Each boiler is rated at 358 horse-power and is furnished with a superheater capable of delivering steam at 175 pounds pressure and at a temperature of 125 degrees Fahrenheit in excess of that of the saturated steam. The Stirling Boiler Company, of Barberton, Ohio, were subcontractors for both the boilers and boiler settings.

The coal and ash handling machinery is very complete. The coal is dumped from the railway cars into a receiving hopper over which the siding rails are laid. This hopper has a slanting bottom to feed the coal by gravity through a valve which is only opened when the skip is in the correct position for loading. The loaded skip is raised by means of the hoisting engine till it reaches the level of a deflector, when it is automatically tipped into a crushing hopper, the smaller coal passing through a screen and the larger coal being broken in the crusher in transit. From this hopper the coal is fed into a gravity return car by means of the valve at the bottom, when it is conveyed by the automatic railway over the coal bunkers into which it is tipped. From these bunkers it is fed to coal cars on the tracks on the boiler-room floor. The ashes are taken from the boiler house in cars and dumped into the receiving hopper, from where they are raised in a similar manner to the coal, but the deflector is thrown in the reverse direction from that used when handling coal. The ashes are conveyed from the ash chute to an ash storage bin placed above the siding, from whence they are conveyed by means of a chute to cars on the railway track.



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD - INTERIOR OF POWER-HOUSE, WESTVILLE, N. J.

SUBSTATIONS.

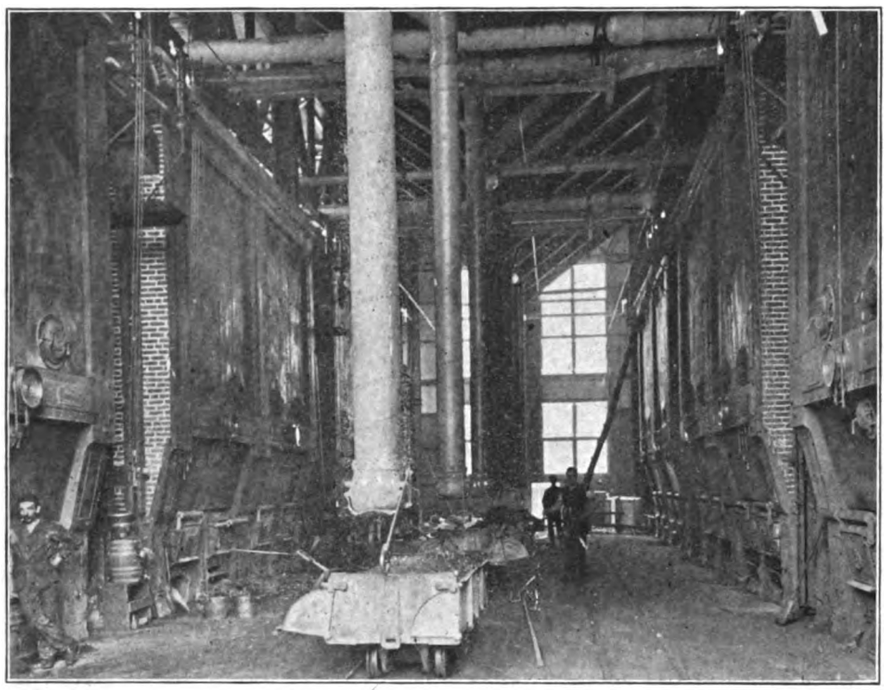
The high-tension three-phase current is reduced in pressure and converted to direct current at 650 volts in eight substations distributed along the line as follows:

One is located in the power-house at Westville; three terminal substations are situated respectively at South Camden, Clayville and Atlantic City, and four intermediate stations, one at Glassboro, one

Digitized by Google

at Mizpah, one at Newfield, and one at Reega.

The equipments in the several different substations vary according to the require-



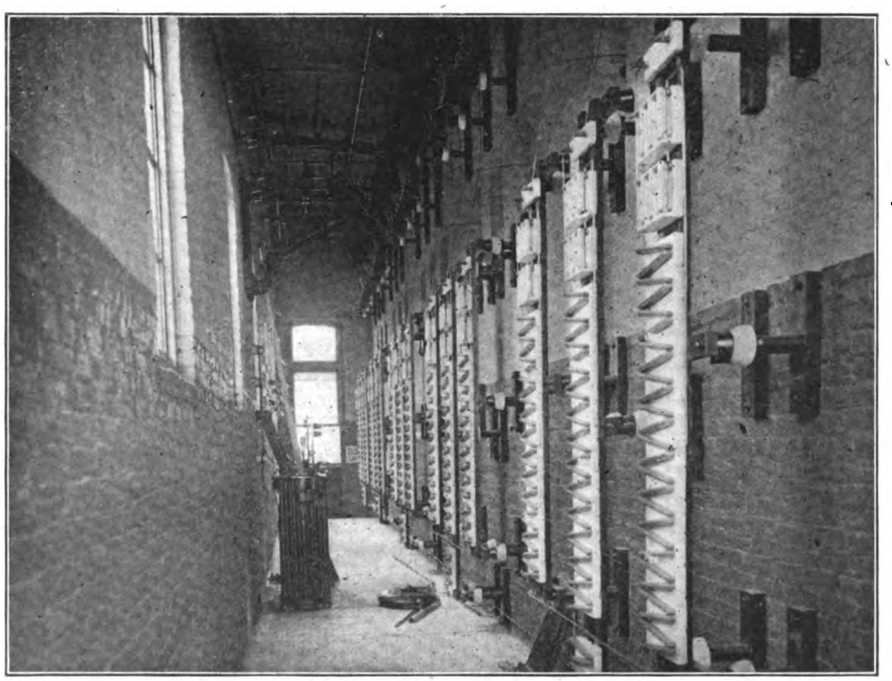
ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—BOILER ROOM, WESTFIELD, N. J.

ments of the portion of the road they supply. The South Camden, Westville, Glassboro, Newfield, and Reega stations have each two 750-kilowatt rotaries installed and provision is made for an additional one. The Clayville and Mizpah stations have each two 500-kilowatt rotaries installed with provision for an additional unit of 750 kilowatts and the Atlantic City station has two 750-kilowatt rotaries now in place with provision for two 1,000 units in addition.

The rotary converters are all of standard design, and are capable of running at fifty per cent overload for two hours with a temperature rise not exceeding fifty-five degrees. The transformers are all supplied with taps giving one-third and two-thirds of the working voltage to enable the converters to be started from the alternating-current side. This method of starting needs no synchronizing and should the direct-current polarity of the machine chance to come in the wrong direction it is readily changed by means of the field reversing switch provided for this purpose. By this method, any of the rotary converters can be started, run up to full speed, and be delivering power to the line within a minute.

Three air-cooled transformers of standard design are provided for operation in conjunction with each rotary, and these are located in each case with a view to the further extension of the substation.

The disconnecting switches and lightning arresters in each substation are located in a separate room. The high-tension circuits are of bare copper wires supported on insulators on a pipe framework,



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—LIGHTNING-ARRESTER ROOM, WESTFIELD, N. J.

and each pole of the oil switches is enclosed in a separate brick compartment. In the arrangement of the machinery every precaution has been taken to provide for the continuous operation of the road under all traffic and weather conditions.

The substation buildings are of red brick, trimmed with Indiana limestone facings, and the floors are of concrete. Each substation is furnished with a hand-operated crane, capable of handling any of the machinery installed.

It is a matter of interest that the substation buildings, including the foundations, were built in sixty working days, and that the installation of machinery was accomplished in thirty working days. The subcontractor for the substation buildings was Lynch Brothers, of Philadelphia.

INSPECTION SHEDS.

Inspection sheds have been built at the three terminals. The largest one is on the dock at Camden, just back of the new passenger terminal. This is a three-track shed 221 feet long by fifty-six feet wide, accommodating nine cars with room for office, storeroom and small machine shop at the end opposite to the entrance. All tracks have pits provided with steam heating, electric lights and compressed air outlets for cleaning. The third rail is not carried into the shed, overhead trolley being used instead. The centre track has an overhead hand-operated crane, with a runway extending into the machine shop. The building is of wood frame construction covered with corrugated galvanized iron, with four-ply slag roof and is supplied with large windows and skylights. Kinnear steel rolling doors are used at the main entrance.

At Atlantic City the shed is of the same

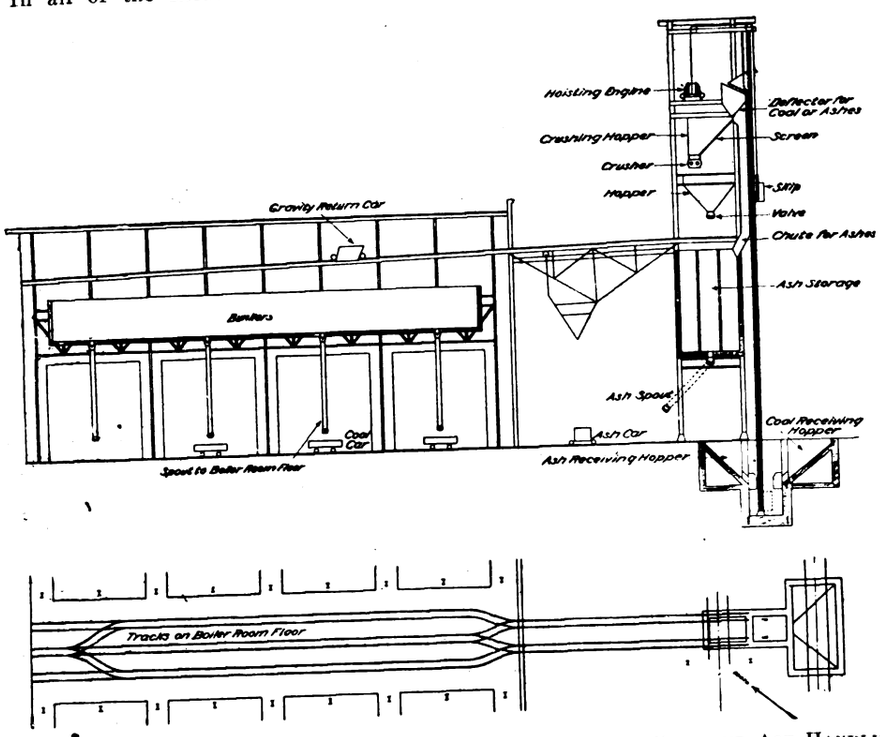
Digitized by Google

general arrangement, but smaller. It is a two-track shed eighty feet by forty-two feet, with doors at both ends, and so located that a train can be run through on either track and the cars inspected one at a time as they stand over the pits in the shed. This building is of wood frame covered on the outside with expanded metal plastered with cement.

The shed at Millville has one track and is of sufficient length for one car with space to work around a truck when run out at one end. The construction is generally similar to the shed at Atlantic City.

In all of the sheds the track rail is carried on a stringer which makes the top of the rail twelve inches above the floor level. All tracks in the sheds are provided with continuous pits three feet five inches deep from top of rail. This arrangement is laid out with special reference to the arrangement of control and brake apparatus on the underside of the car, and is very convenient for inspection.

(To be concluded.)



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—COAL AND ASH HANDLING MACHINERY.

The 1907 Question Box of the National Electric Light Association.

Paul Lüpke, editor of the question box of the National Electric Light Association for 1907, has hit upon a unique scheme for keeping before the members of the association the utility of the question box. A manilla folder has been issued, containing space for any questions which may from time to time occur to the busy man. These are to be jotted down and, in time, returned to the editor of the question box.

Convention of the American Street and Interurban Railway Claim Agents' Association.

The third annual meeting of the American Association of Street and Interurban Railway Claim Agents was called to order Monday, October 15, at 2 P.M., by President S. L. Rhoades, Philadelphia.

B. B. Davis, claim agent, Columbus Railway and Light Company, welcomed the association.

John I. Beggs, vice-president of the parent association, was introduced and addressed the meeting briefly.

The Hon. W. Caryl Ely, president of the parent association, spoke upon the work of reorganization and congratulated the claim agents upon the results which had been achieved.

The report of the executive committee was read and approved.

The secretary's report showed receipts of $800 and expenses of $766.76. The association now has 201 members.

The Tuesday morning session was called to order by the president at 10 o'clock. The first business was the reading of the paper by A. J. Farrell, claim agent, International Railway Company, Buffalo, N. Y., entitled, "Which Is the Better Policy, Quick or Delayed Settlement?" This paper was discussed at length, and the paper entitled "The Policy of the Claim Department Toward the Public," was presented by W. F. Weh, claim agent, Cleveland Electric Railway Company.

At the afternoon session the question box was taken up and after this was disposed of a paper was read by C. Willis Hare, of the United Gas Improvement Company, Philadelphia, entitled, "The Claim Agent's Work of the Future." This was followed by a paper by William De-Milt Hooper, entitled, "The Relation of Statistical Bureaus to the Claim Agent's Work."

On Wednesday afternoon the association met at 1 o'clock. H. C. Bradley, adjuster of the Chicago Union Traction Company, presented his paper, entitled "Methods of Management of the Claim Department."

Resolutions of regret at the death of Mr. Feeney were passed.

The following officers were then elected:

President—S. L. Rhoades, Philadelphia Rapid Transit Company.

First vice-president—Henry C. Bradley, Chicago Union Traction Company.

Second vice-president—Andrew J. Farrell, International Railway Company, Buffalo.

Third vice-president—W. F. Weh, Cleveland Electric Railway Company.

Secretary and treasurer—B. B. Davis, Columbus Railway and Light Company.

The convention was then adjourned.

Convention of the American Street and Interurban Railway Accountants' Association.

The tenth regular meeting of the American Street and Interurban Railway Accountants' Association was called to order by President W. B. Brockway at 10.20 o'clock Tuesday morning, October 16. P. V. Burington, auditor of the Columbus Railway and Light Company, extended the hospitality of Columbus to the convention in a brief address of welcome.

The Hon. W. Caryl Ely, president of the parent organization, addressed the convention at some length, dwelling particularly upon the subject of depreciation and endorsing the action of the executive committee in placing this subject upon the programme.

The annual address was then delivered by President Brockway.

Upon motion, H. C. Mackay, one of the ex-presidents of the association, was elected an honorary member in recognition of his long and faithful services in the interest of the association.

The report of the executive committee was then read.

The report of the secretary and treasurer showed the membership to be 263 at the present time, as compared with 152 last year. The receipts for the current year amounted to $1,522.13, and the balance on hand at the present time is $485.80.

Committees were appointed and the meeting then adjourned.

At the afternoon session, which was called to order by President Brockway at 2.20 o'clock, H. M. Edwards, auditor of the New York Edison Company, and chairman of the committee on "Electric Light Accounting" of the National Electric Light Association, was introduced and stated that he came to the convention rep-

Digitized by Google

resenting that association in search of information.

C. L. Judson, of the New York State Board of Railroad Commissioners, addressed the convention briefly.

P. S. Young, controller of the Public Service Corporation of New Jersey, read his paper entitled "The Accounting of Capital Expenditures."

H. H. Adams, president of the Engineering Association, addressed the convention briefly, and acknowledged the valuable assistance rendered by President Brockway in bringing about the co-operation of the engineering branch in the reorganization of the different associations.

The question box was then taken up and the nineteen questions therein contained discussed.

At the Wednesday afternoon session the paper entitled "The Use of Curves and statistics", was presented by A. Stuart Pratt, general auditor and treasurer of the Stone & Webster Company, of Boston.

The report of the Committee of Standard Classification of Accounts was read by W. F. Ham, chairman.

The report of the committee appointed to attend the convention of the National Association of Railroad Commissioners, held at Washington, D. C., April 2-5, 1906, was also read.

The following officers were then elected:

President—C. L. S. Tingley, Philadelphia.

First vice-president—J. H. Neal, Boston.

Second vice-president—E. F. Bryant, Bridgeport, Conn.

Third vice-president—C. L. Wight, Des Moines.

Secretary and treasurer—Elmer M. White, Birmingham, Ala.

Executive committee—W. B. Brockway, Yonkers, N. Y.; H. T. Bunn, Knoxville, Tenn.; A. Stuart Pratt, Boston; H. S. Swift, Toledo.

The convention was then adjourned.

The September Earnings of the Manila Electric Railroad and Lighting Corporation.

The earnings of the Manila Electric Railroad and Lighting Corporation for September are reported from Manila by J. G. White & Company, operating managers, as follows: Railway department—gross earnings, $37,500; net earnings, $14,100. Lighting department—gross earnings, $34,000; net earnings, $19,500. Total gross earnings, $71,500; total net earnings, $33,600.

The gradual increase in the ratio of net to gross earnings in the lighting department is a favorable feature. In six months this has been raised from fifty-one per cent to fifty-seven per cent through improved administration and the elimination of the old plant of La Electricista, the former lighting company.

Electric Developments in North Carolina.

The biggest deal in hydroelectricity ever consummated in the South, and one of the largest in the entire country, has recently been closed at Charlotte, N. C., with the agreement of the Southern Power Company to supply the well-known Cannon Mills, of Concord, with 5,000 electrical horse-power. Of this amount, 4,500 horse-power will be furnished the early part of next year and the remainder as demanded by the officials of the mills. In addition to this, the Odell mills of the same town have contracted with the Southern Power Company for 1,800 electrical horse-power which in itself is a magnificent contract. By the first of January, 1907, the power company expects to sell to lesser manufacturing enterprises an additional 1,000 horse-power, making a total approximating 8,000 electrical horse-power.

The amount of capital which will change hands under this contract aggregates a considerable sum. The outlay will figure between $125,000 and $150,000, the cost of the power furnished the Cannon Mills alone figuring within the range of $75,000 and $100,000.

The Southern Power Company is a corporation chartered under the laws of the State of New Jersey, with a capital stock of $7,500,000, authorized. The company owns 110 miles of water-rights along the Catawba river, fifteen miles from Charlotte, and holds under its control practically every power site on the water-course. There are eight of these in Piedmont Carolina.

The developments now in progress at Great Falls are well under way. When completed the power generated at that point will be transmitted to the station at Rock Hill and from there to Charlotte, Gastonia and other important manufacturing centres where the company has placed electrical power. The new contracts will call for the extension of the present transmission line to Charlotte to Concord, a distance of about eighteen miles. The cost of the new transmission line will reach $10,000 per mile. Concord is one of the most thriving of the several towns in this section. It is situated on the main line of the Southern and has a population of about 12,000. There are eight cotton mills in and around the city. J. W. Cannon is owner and operator of the following mills, which are among the largest in the Piedmont section of the South: the Cabarrus Cotton Mills, capital, $150,000; the Cannon Manufacturing Company, capital, $200,000; Franklin Cotton Mill, Gibson Manufacturing Company, capital, $375,000; Patterson Manufacturing Company, capital, $165,000.

The 5,000 electrical horse-power will be used in operating 3,511 looms and 118,436 spindles. At an early date the transmission lines will be extended to Statesville, where the company has recently closed a contract with the board of aldermen of that town to furnish 2,000 electrical horse-power. The company is spreading its lines in all directions from this point, and at an early date it is assured that practically every town of any size in the Piedmont section will be furnished with their power. It means a forging to the front of the varied industries of this great commercial centre. J. S. M.

Charlotte, N. C., October 30.

The Vaudeville Performance During Street Railway Week at Columbus, Ohio.

The vaudeville performance given at the Southern Theatre to the delegates to the American Street and Interurban Railway Manufacturers' Association and their guests was a decided success, a brilliant programme being presented.

The Third Rail Glee Club, composed of nearly fifty gentlemen of Columbus, was the opening number and was received with great applause.

The glee club was followed by Al Havens, of the Ohio Brass Company, in feats of legerdemain.

He was followed by R. M. Campbell, of the same company, who was styled on the programme as "The King of Black Face, with Apologies to Lew Dockstader." The audience demanded numerous encores.

Burton Holmes's monologue, "Behind a Curtain," was rendered by Mrs. Amory, of New York.

John Thomas was eminently pleasing in baritone solos, particularly that entitled "My Dear Old Pipe."

Thomas H. Bibber, of the American Circular Loom Company, was in fine fettle and kept the audience in a roar with stories hitting the various officers and members of the association. Mr. Bibber also rendered a number of up-to-date parodies, which were well received.

A comedietta entitled "A Game of Cards," was delightfully acted by E. J. Wendell, D. W. Dennett and Francis M. Verdi.

The hit of the evening was probably made by Clarence E. Billings, of the Colonial Steel Company, in a sketch entitled "An Inter-Reuben Trip from Portland, Me., to Columbus, Ohio."

The performance closed with selections by the Columbus Serenaders.

Digitized by Google

American Institute of Electrical Engineers.

The two hundred and tenth meeting of the American Institute of Electrical Engineers was held at the Edison Auditorium, New York city, Friday, October 26, with President Samuel Sheldon in the chair.

Secretary Pope announced that at a meeting of the board of directors held Friday afternoon, forty-one associates had been elected and the following associates had been transferred to the grade of member: Armin Henry Pikler, Ampere, N. J.; Otto Martin Rau, Milwaukee, Wis.; Warren Ray Thompson, Manchester, England; Arthur Bowers Stitzer, Philadelphia, Pa.; Arthur Thomas Cooper, Bombay, India; Thomas Hesketh, Folkstone, England; Allen Harwood Babcock, Oakland, Cal.; Herbert C. Work, Schenectady, N. Y.; Harry Guthrie Spain, British Guiana, South America; Theodore Hanamann Schoepf, London, England; Sebastian Ziana De Ferranti, London, England; John Francis Cleverton Snell, Sunderland, England; Alois John Joseph Pfeiffer, Calcutta, India; Harry Lepper Kirker, Pittsburg, Pa.; Robert Hammond, London, England; Arthur William Beresford, Milwaukee, Wis.

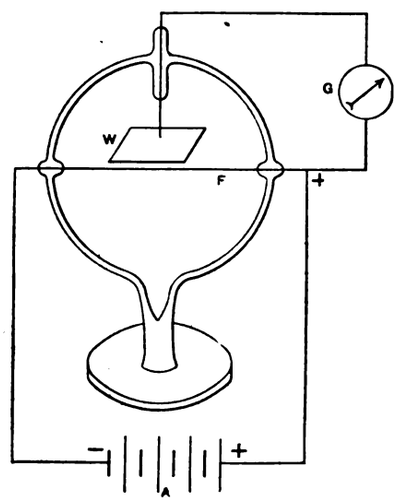


FIG. 1.—APPARATUS FOR STUDYING EFFECT OF HERTZIAN OSCILLATIONS UPON IONIZED GASES.

The secretary also reported that at the meeting of the board of directors the representatives of the Institute on the joint building committee of the Engineering Building reported that they had promises that the building would be practically ready for occupancy on December 1, and it would be in use by December 15, to be occupied by the officers and staff of the three societies. However, no meetings will be held there, and no opening of an official character, until April next, as it is the intention to make the opening rather an important event in the engineering history of the country.

The paper for the evening, entitled "The Audion; a New Receiver for Wireless Telegraphy," was read by Dr. Lee De Forest.

While making experiments in wireless telegraphy at night, during 1900, it was found that the Welsbach mantle was sensitive to the sound of the induction coil spark. This led to a search for a similar effect due to Hertzian waves and it was found that they would cause a variation in the current passing through a luminous flame, which could be detected by means of a telephone receiver. This effect was studied carefully. The best results are given by a Bunsen flame rendered luminous by potassium or sodium vapor. The sensitiveness of the detector, which has been called the "audion," is of the same order as that of the electrolytic detector. The same effect may be observed in the electric arc. The action is undoubtedly connected with the ionization of the gases and inasmuch as the gases ionize more readily at lower heats and are in their most mobile, delicate, and sensitive conditions in vacuum, it seemed certain, after experiments with the flame, that the attenuated and ionized gases around an incandescent filament would undergo very considerable changes when subjected to Hertzian oscillations. Fig. 1 shows an arrangement of apparatus for studying the effect. If the battery A brings the platinum wire F to incandescence and a leakage current will be set up between the wire F and the plate W, which may be detected by the galvanometer. The current passes mainly to that portion of the filament near its negative terminal. The current increases rapidly with the heating current through the filament, which increases the velocity of the negative ions, as does also an applied electromotive force between plate and filament.

In the form of "audion" illustrated in Fig. 2 two platinum wings are placed parallel to the plane of the bowed filament and about two millimetres on either side of it. These wings are soon coated with an iridescent deposit from the metal filament, especially at the portions opposite to the negative half of the filament. They become quite hot at this short distance, but not sufficiently hot to take part in the ionization of the gas.

When connected in the oscillation circuit as shown, properly attuned to the receiving electromagnetic impulse from the antenna, the "audion," under proper adjustment of heating current and battery B potential, is extremely sensitive, giving response in the receiving telephone several times as loud as any other form of wireless receiver when subjected to the same impulses. It is, however, less sensitive to atmospheric or static disturbances, which are strongly damped or a-periodic. Its operation seems to be dependent upon the sum total of the energy received from the complete wave-train rather than upon the maximum first impulse of the train. In other words, while instantaneous as far as our senses or instruments can perceive, its action is sufficiently sluggish to be determined by the additive effect of the entire received electroradiant energy through a short time-interval.

The "audion," to a greater extent than any other responder, is self-tuned. By regulating the heating current, the potential between wing and filament, or the distance between these, the "audion" can be made to a great extent selective *per se* to certain received impulses. And the determining factor here is not merely the frequency of the electrical oscillation; the spark frequency, or factors determining the total amount of energy received during a very brief unit of time, determine to an extent the amount of its response. Thus with twelve volts across it, it may give a loud response to a transmitter A; and with ten volts bring in another transmitter B to the almost complete exclusion of A, although A and B are of equal power and of approximately the same wave-length, but differing considerably in spark frequency. Similar discrimination can be produced by adjustments of the heat of the filament, which also governs the amount of flux through the gas.

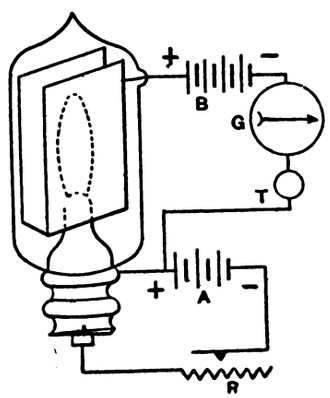


FIG. 2.—DIAGRAMMATIC REPRESENTATION OF "AUDION."

It is not necessary to connect the anode to a terminal of the oscillating circuit. One terminal may be attached to a metal sheath or ring surrounding the glass vessel, thus forming a condenser with the filament or the conducting gas within the

Digitized by Google

tube. In this condenser arrangement the sound heard in the telephone changes its quality to an extraordinary degree, being of a dull muffled nature rather than sharp and staccato. Signals of this quality are sometimes much more readily distinguished from the static disturbances which so frequently render wireless signals difficult to read. The operator has thus a ready means of changing the quality of the received signals to suit the conditions. This latter type of "audion" is the one found most serviceable in practice.

The "audion" may even be placed in the space between two plates of an air condenser in the oscillating circuit. A flat-walled type of tube is preferred for this arrangement. Again the electrical oscillation may be led through a coil of wire wound round the outside of the tube, and not through the "audion" at all, or through a flat coil brought up close to the tube, with its axis perpendicular to the filament. In this arrangement it is chiefly the electromagnetic component of the passing oscillation which affects the motion of the ions within the vessel. The ions are readily influenced by a magnetic field.

Dr. De Forest has arrived as yet at no completely satisfactory theory as to the

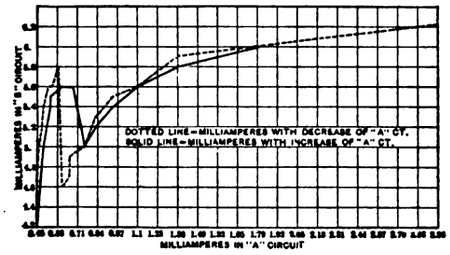


FIG. 3.—DIAGRAM SHOWING THE BEHAVIOR OF THE TWO-ELECTRODE "AUDION."

exact means by which the high-frequency oscillations affect so markedly the behavior of an ionized gas. Fleming points out that when the cold plate of the Elster-Geitel tube is connected to the positive end of the filament, and the two put in a high-frequency oscillation circuit, only the positive half of the oscillation can pass from the plate to the filament across the gas. He uses this principle to rectify the Hertzian oscillations, and applies the unidirectional currents of the oscillations themselves to operate a sensitive galvanometer, or direct-current instrument, for quantitative measurements over very short distances. When an independent external source of electromotive force is applied, in the manner described, the action becomes quite different. It then operates as a relay to the Hertzian energy instead of merely rectifying this energy so that it can be used directly to give the sense signal.

The "audion" therefore is tremendously more sensitive and available in practical wireless. A sensitive direct-current instrument in the B circuit shows a steady deflection varying not a whit, by increase or decrease, during the reception of strong wireless signals. An electrolytic receiver or "polariphone" under similar conditions would cause a great deviation in the deflection of a milliammeter, although the signals in the telephone with the electrolytic are not so loud as with the "audion."

When the anode consists of two parallel plates instead of a cylinder there will be a maximum of positive electric density along their vertical edges. The more intense parts of the electric field will involve the larger number of ions, and on the anode these will generally be located at the vertical edges of the parallel plates, provided these are not too far from the filament.

With this type of anode a peculiar and sudden inflection point in the current-flux diagram, as the heating current is gradually increased or decreased, is noticed. The flux goes on increasing, then suddenly drops back to a lesser value; at the same time a click is heard in the telephone in the B circuit. Then as the heating current is still further increased the B flux is again increased. These same cusp points in the curve are obtained if the A circuit be kept constant and the B voltage be increased instead.

Similarly a click is heard when the flux current is being reduced from a higher value, only the location of the cusp on the curve of decreasing current is not coincident with but lags behind that observed when B is being increased. This second cusp point shows a sudden increase in the flux current, when the critical point is reached, to a value previously passed through. The sharpness of these cusp points can be smoothed out or quite obliterated by putting impedance in the B circuit in series with the telephone.

The diagram (Fig. 3) shows the relative magnitude of these sudden alterations in the flux current obtained with a certain sample "audion," and Fig. 4 the decided hysteresis effect, showing how the actual B current lags behind the increasing or decreasing electric field which produces it.

These hysteresis curves are always obtained even though the anode is in the form of a cylinder or flattened cylinder without the vertical edges; but the reactive cusp points in the curves are never obtained save with the plane anodes.

In framing any theory of the action of electric oscillations in the "audion" a variety of complex, contradictory phenomena is met with, exceedingly puzzling to explain. An example is the fact that a continuous-current instrument in either the A or the B circuit shows absolutely no change of deflection, either of increase or decrease, when B is large and the "audion" in its most sensitive condition. If only the positive halves of the oscillations pass from anode to filament these should increase the reading of a milliammeter in the B circuit during the passage of a long series of wave-trains of sufficient intensity. Or else the negative halves of these oscillations might be expected to diminish to a greater degree the positive charge on the anode, and result

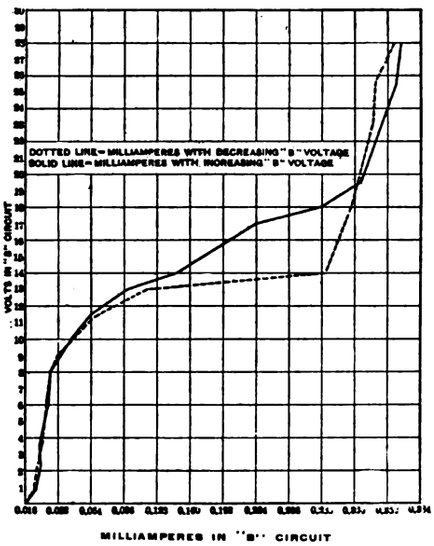

DOTTED LINE = MILLIAMPERES WITH DECREASING "B" VOLTAGE
SOLID LINE = MILLIAMPERES WITH INCREASING "B" VOLTAGE
VOLTS IN "B" CIRCUIT
MILLIAMPERES IN "B" CIRCUIT

FIG. 4.—DIAGRAM SHOWING THE HYSTERESIS OR CURRENT LAG IN THE "AUDION."

in a diminution of the B circuit. Or if both of these acted equally and oppositely no signal would be obtained at all, for the telephone diaphragm is utterly incapable of following such rapid increase and decrease in the B current, even if its impedance would allow these pulsations to pass through the circuit. Neither would the ear detect such vibrations.

If on the other hand the integrated effect of a complete Hertzian wave-train were either to increase or decrease the B flux, a long succession of such effects, all of which must be of the same sign, ought to cause a change in the needle's deflection, as when a long Morse dash is sent out from the transmitting station. We have no reason to suppose that one wave-train, the result of one spark, would produce a momentary decrease in the B flux, indicated by a click in the telephone,

Digitized by Google

and that the next succeeding wave-train from the next spark would cause an opposite increase in the B flux, and another similar click in the telephone. Such action would of course explain why a loud sound in the telephone might not be accompanied by any change in the sluggish ammeter reading, similar to the case of the magnetic detector.

The following explanation of the phenomena which seems to account for many of the peculiarities of this paradox has been suggested. It should be remembered that if the negative half of the electric oscillation can not pass through the gas from cold anode to the filament, the "audion" electrodes during that half-period will act merely as the two armatures of a condenser. Even when close together, their mutual capacity, when the gas is cold, is exceedingly small, and only a very small positive charge can be held bound on the filament; or if there are sufficient free positive ions in the hot gap the complimentary positive charge will be held just on the outside of the "variation layer" at the anode.

The falls of potential across the variation layers at anode and cathode are proportional to the squares of the velocities of the positive and negative ions; and the ionic velocities are proportional to the electric forces acting upon them. Supposing then that during the positive half of the electric oscillations the velocity of the positive ions is increased at the anode layer, and during the other half period the velocity of the negative ions is increased, due to the changes in the electric force acting upon them. Then, regardless of the sign of the change of the velocities, the potential drop across the variation layers (which varies with the square of these changes) will be increased during the entire passage of the oscillation train.

The layer will act during this interval like a condenser, the potential drop across which is momentarily increased, which momentary increase will disappear with the passage of the wave-train. It will be as if the plates of a charged air condenser were suddenly further separated and then brought suddenly back to their normal positions; or as if the specific inductive capacity of the dielectric were decreased and then increased. This operation being repeated for every spark at the transmitter, a listener in the telephone in the B circuit will hear a sound whose pitch is exactly that of the spark, while a milliammeter in that circuit will show no variation in its deflection.

As the fall of potential across the variation layers is proportional to the square of the current passing, and to that of the impelling electric force it is readily understood how, by regulating the heating current and the B voltage, an optimum value of the electrode drop may be obtained for which the effect from any given received impulses will be a maximum. Also how by varying the distance between the electrodes the sensitiveness of response may be regulated.

Thomson shows that at low gas pressures and high ionic velocities the ions, when placed in a strong magnetic field, will travel along the lines of strong magnetic force; but when the product of velocity and field is small the ion moves parallel to the electric force. In the "audion," if the lines of a strong magnetic field pass through the gas parallel to the plane of the anodes, a marked reduction in the flux is obtained, sometimes amounting to twenty per cent. When the magnetic lines pass perpendicular to the plane of the wings the negative ions which are traveling in the direction of the magnetic force, from filament to wing, will be accelerated, but those originally traveling out from the filament in the opposite direction will be bent around or deflected from their direct paths; so the resultant will be a decrease of the total current flux. When the field is intense, a marked frying or hissing sound in the telephone is heard, especially with the two-wing anode, and when the magnetic force is parallel to their plane and thus affecting mostly the ions which are streaming towards their vertical edges.

A very convenient form of "audion" for investigating the relations which the distance, area, etc., of the electrodes bear to its response is had by using a pool of mercury for the anode. This is conveniently held in one or more pockets blown in the walls of the glass vessel, and the filament so placed as to pass closer to some than to others.

A large number of experiments have been carried out with a view to reducing the filament heat necessary to give the enclosed type of the "audion" the extreme sensitiveness which now characterizes it. This is now attained at normal brilliancy of the filament, or a little below; never at excessive heats. Thus the life of an "audion" should be that of an incandescent lamp of the same class of filament and voltage.

Filaments have been coated with alkali metals or salts, or vapors of these introduced into the tubes. Experiments along these lines and with various dissociable gases are being pushed with gratifying promise of our soon being able to achieve the present marked sensitiveness even at red heats; or of still further multiplying the sensitiveness.

Radioactive compounds, applied for example between juxtaposed metal disks and heated, give little encouragement. At the low voltages used no increase of conductivity by their means has been observed. Spontaneous ionization; that is, the ionization independent of the electric field as for example that produced by the X-rays, does not increase the current flux. Only the ions produced by the electric field itself close to the cathode, and by the heat of the cathode, is effective.

It is required that the "audion" be made with scrupulous care; a trace of impurity in the gas may produce surprisingly large effects in the potential drop across the variation layers. The presence of a mere trace of moisture may cause great difference in the behavior of a tube.

Dr. M. I. Pupin, in opening the discussion, said the number of detectors of wireless waves seems to be increasing indefinitely. He objected to the plan of inventing a new name for each device and criticized the term "audion" as philologically incorrect. It is a Latin word with a Greek ending. Acouion might have been better, but more difficult to pronounce. Although the device forms a new wave detector, the physics of the thing is old. Hittorf, over fifty years ago, discovered that in a vacuum tube very high electric tensions would produce no perceptible discharge, but that the heating of the cathode facilitated the passage of electricity to such an extent that a small electromotive force, a few volts, would produce perceptible current. Dr. De Forest devotes some attention in the first part of his paper to a detector of the new type in which the gases are at ordinary pressures, but abandons this form because it is variable, and turns to the vacuum tube, as the same phenomenon should exist there and one would expect a very much greater steadiness and reliability, which is one of the highest desiderata in any technical work, particularly in wireless telegraph.

A complete physical explanation of the phenomena is difficult. (The current through the gas is steady as far as a milliammeter can tell. It is not steady as far as the telephone can tell. Therefore it can not be that the waves are rectified. The only other thing we can guess, as possibly happening, is that the oscillation passes through the whole circuit, but on account of some effect upon the gaseous part of the circuit, the resistance, or the

Digitized by Google

diminution or increase of some of the other reactions, the original current is strengthened very much at certain intervals during one-half of the waves, and weakened during the other half, or strengthened on each side of the wave. That, as Dr. De Forest points out, is also impossible to believe, because the oscillations being so rapid, could not very well pass through the winding of the telephone in the first place, and in the second place could not be expected to produce a very large magnetic effect upon the diaphragm. Dr. Pupin cautioned against placing too much reliance upon the telephone. He has used it for years for detecting faint sounds, faint differences of potential, and faint currents, and found it one of the most tricky instruments one can use.

Percy H. Thomas said apparently the new device is another illustration of the new theory in electrical science—an apparatus depending on corpuscles or ions. As Dr. Pupin has said, the way to make use of corpuscles, if you want to use them, is to get them into a vacuum where you can control them. But these corpuscles or electrons do not exist in a free state ordinarily, any more than sodium or chlorine, or other materials do. If you want to use them you must produce them, and there are many ways of producing them. In the "audion" we have such a means. In the first place we have a vacuum, which allows a more or less free movement, and we have a means of controlling and directing the ions, that is the additional battery electromotive force. And then we have, further, the waves which come in on the transmission circuit, which, in some way or other, which is not understood, so affect the action of the corpuscles as to make a sound in the telephone.

Sewall Cabot asked whether the statement that the device is self-tuning referred to the ability to alter the electrostatic capacity of the "audion," which would itself be in a tuning circuit, and thereby altering the tuning of the circuit, or does it simply refer to the tuning of the spark frequency, that is, by changing the battery potential, having the "audion" more or less responsive to relatively slow frequencies.

Dr. De Forest replied that both effects are present, but as the capacity is small, it has less effect.

E. P. Thompson thought the action of the "audion" might be due to electrostatic effects and described an electrostatic telephone receiver. Or the device may be nothing more than the old Hertzian receiver, consisting of two terminals forming a spark gap.

Frank J. Vreeland pointed out the similarity of action in the electrolytic detector, the "audion" and Fleming's vacuum valve, and said that as a telephone is certainly sensitive to a current of a millionth of an ampere, might it not be possible that there was a unidirectional polarized current sufficient to affect the telephone and not sufficient to affect the instrument used.

Dr. De Forest said it might have had that effect, but at the same time signals were obtained which could be described as tremendously loud in the telephone, but caused no change of deflection of the ammeter, and there was no reason to suppose that as these signals got weaker in the telephone they would become unidirectional, or if so there was no reason to suppose they should when they are weak give an effect entirely lacking when they are strong. He was inclined to believe the effect was due to alternating currents. As to the name "audion," when one uses a term 100 times a day, it is necessary to have something brief. Replying to a question asked by J. B. Taylor, the sound heard in the telephone represents the spark frequency. The currents causing the sound are undoubtedly alternating, rather than polarized. The intensity of the signals is at times so great that there is no doubt of their being caused by an electromagnetic current flowing through the telephone, and not electrostatic effects, although the latter undoubtedly exist, and under certain conditions may predominate.

The meeting was then adjourned.

The Irish International Exhibition.

The Irish International Exhibition will be held at Dublin, Ireland, from May to October, 1907. This will be the biggest undertaking of its kind ever organized by Irishmen, and it is expected that it will completely dwarf any of the exhibitions previously held. Subscriptions to the guarantee fund new exceed $900,000. Work on the exhibit buildings is going forward rapidly, and it is announced that they will be finished some months before the date set for opening, May 1, 1907.

The exhibits will be classified in nineteen sections, and in the transportation and machinery section a number of prominent companies will be represented. Among these are the Great Southwestern Railway Company, the Dublin, Wicklow & Wexford Railway Company, the Great Western Railway Company, Messrs. Harland & Wolff, the White Star Line, Royal Pacific Steam Packet Company, the Cunard Steamship Company, Babcock & Wilcox Company, Combe & Barbour, and the British Westinghouse Company.

The secretary of the exhibition is James Shanks, Ballsbridge, Dublin, Ireland.

An Important Movement for the Introduction of New Electric Lighting and Transit Systems in New York City.

Considerable interest has been aroused by the reorganization of the Long Acre Electric Light and Power Company, which recently obtained from Justice Dowling, of the Supreme Court, a peremptory mandamus directed to the Electrical Subway Company compelling the admission of its electric light wires to the conduits owned by the subway company. The Long Acre Electric Light and Power Company, it is understood, is preparing to begin work under its franchise to furnish electric light to the full extent of its capacity. The entire holdings of this company were recently purchased by John C. Sheehan and associates, and they also purchased from Joseph H. Hoadley the rights and equipment of the Manhattan Transit Company. In addition to the development of power-houses for the lighting system of the city it is the intention of the company to institute a line of auto buses, which, it is expected, will go a long way toward solving the problem of city traffic.

The power-stations of the Long Acre Electric Light and Power Company will very likely be equipped with oil-engine-driven units. This will afford an exceptional opportunity for the utilization of the American Diesel oil engines, the builders of these machines being closely connected with the interests controlling the Long Acre Electric Light and Power Company. It is understood that the new company is planning to sell current for light and power at rates considerably lower than those now charged in the city, and with the use of the internal-combustion motor as a prime mover it is expected that an almost ideal power-station system can be secured.

At a meeting of the directors of the Long Acre Electric Light and Power Company on Monday, October 22, Edgar Van Etten, William J. Clark and William H. Lamprecht were elected members of the board. Mr. Clark is general manager of the Foreign Department of the General Electric Company, Mr. Van Etten is second vice-president of the New York Central & Hudson River Railroad, in charge of the Boston & Albany division, and Mr. Lamprecht is a member of the banking house of Lamprecht Brothers, Cleveland, Ohio.

Digitized by Google

ELECTRIC RAILWAYS IN SPARSELY SETTLED COMMUNITIES—I.[1]

BY E. P. ROBERTS.

The special report of the United States Census Office relative to Street and Electric Railways, 1902, undoubtedly contains much information of value, but the data therein presented has frequently been misused. Average results for the United States or for individual states have been considered as applicable to a proposed road; whereas, in the writer's opinion, each proposition must be considered by itself, and only such statistics applied as are obtained from roads which are properly comparative, and as no two roads are identical, allowance must be made for the difference between the proposed road and such road or roads as are compared therewith. Even the fact that the proposed road has the same terminal city as the roads with which it is to be compared, and has the same population per mile of road, does not make the two propositions strictly comparative.

The writer has always felt very strongly that each case must be considered by itself, but in view of several inquiries recently received, asking how we figure probable earnings of interurban railways, and whether it is not possible to obtain an empirical formula which would have some value, we prepared several tables and attempted to obtain a curve which might have some value. Curiously enough, the first eight or ten roads tabulated gave such results as checked, with not an excessive variation, with the empirical formula suggested by one of our engineers; but even then there was such variation as would be sufficient to make the difference between profit and loss. This formula is based on allowing a certain annual income per capita from the population in the principal city, a greater amount in the towns, and a still greater amount in the country; but applying some additional data, we found that for many roads the suggested formula had no value at all. The population taken as being along the route is not based on that within a certain distance of the road, but is based on local conditions. To ascertain same necessitates more time and skill than when the latter method is followed, but it is the one which I consider proper.

We always consider the entire population directly on the route, and when one city greatly preponderates exclusive of such principal city, but noting the population of such city, and when there is no such greatly preponderating city we consider all the population. For sections a greater or less distance from the route we use a percentage based on local conditions, and take into account the character of the population, the reasons for travel, the comparative facilities, including accessibility, etc. For example: Near the principal city a person residing three miles or less from the corporation limits of the city, and three miles from the proposed road, would seldom if ever use same, whereas, if he were a considerable greater distance from the city, and three miles from the road, he would use it almost as much as if he lived directly on the route, provided that there was not another electric or a steam road nearer to him. If such road were a steam road consideration would be given to the service provided by it.

It is also evident that if the location of the proposed road is along a river, especially of considerable width, and having a few bridges, the population on the other side of the river from the road has lessened in value; it might not, geographically speaking, be a quarter of a mile distant, but from the standpoint of accessibility may actually be several miles away. In some cases, and because of connection with steam or electric railways, or river transportation, or existing stage routes, considerable value should be given to a population at a considerable distance from the route, whereas in other cases, and as above indicated, the population quite near the route may have little value.

The population so obtained is what we term the "equivalent" population, by which is meant the population which, if all of it were directly on the route, would equal in amount of travel the actual population as it is actually located. For example: a population of 1,000 may be considered as equal to 100 or 200 or more directly on the route.

Relative to the population, our custom is to take the 1890 and 1900 census and note the rate of growth, and also to give due consideration to the school and voting population, etc., and checking any statements as to unusual growth, or growth at a more rapid rate than between 1890 and 1900.

Relative to the population which should be considered, we give separate value to the principal terminal city when it is much larger than any other city along the route. The writer's present opinion is that usually it makes little difference to the interurban road whether the principal city has 100,000 or 500,000 population, provided that it is the principal city in that general section of the country, and therefore the one to which all business tends.

The receipts per capita depend upon the reasons for travel, comparative facilities, habits of the people, character of population, comparative costs of travel, etc., and to apply any statistics requires not only a careful study of the conditions relative to the proposed road, but also a full knowledge of the conditions relative to the roads from which the statistics are taken and a careful differentiation and application of such statistics.

An examination relative to an operating or proposed electric railroad necessitates the application of personal judgment and, to a greater or less degree, the application of statistics—and, before giving detailed consideration to such examination, it may be well to state the object of such examinations.

The examination of an operating plant is generally in order to ascertain its existing income, gross and net, the past rate of increase of same, and the probability as to the future, its physical value and whether it is economically advisable to make additions and improvements. An examination is also made of the franchises and of other matters outside of the construction and operating features.

The examination of the income and expenses is, as nearly as possible, in accordance with the standard classification of accounts prepared by the American Street and Interurban Railway Accountants' Association, and statistics obtained from other roads are compared therewith in order to note any considerable variations from what may be considered as normal, and the reasons for any such variation are investigated. Sometimes actual statistics obtained from other roads are not referred to, because the investigator has such knowledge as enables him to apply results he has elsewhere obtained to the case under consideration, and he may do so unconsciously. But whether consciously or unconsciously he uses statistics is immaterial, the principal point being that he does use and compares them with local conditions and applies personal judgment.

If the examination is relative to a proposed road it must include a predetermination of all the factors entering into total cost, both first cost and operating, also income, both gross and net, and evidently requires not only a wide experience, but also excellent judgment in the application of statistics.

The object of an investigation as to the

[1] Abstracted from a paper read at the convention of the American Street and Interurban Railway Association, Columbus, October 18

Digitized by Google

advisability of constructing a proposed interurban electric road is evidently to ascertain the probable resulting net earnings per dollar invested. In order to arrive at such conclusion it is necessary to ascertain the probable gross income, the total first cost and the consequent resulting financial charge and the operating expense. Logically, these matters should be taken up in the order above stated, but in many respects they are inter-dependent, and are considered simultaneously.

The probable income. This may be from several sources—passenger, express, carload freight, mail, advertising and, in some cases, the sale of electric energy for light and power. The last three sources will be disregarded and consideration merely given to the income from passengers, express and freight.

Having obtained the equivalent population in the manner previously described, the next and most important step is to determine the probable income per capita. Consideration must be given to the reasons for travel, comparative existing facilities, including railway time-tables and rates, and possibilities or probabilities of existing, or of other proposed, roads furnishing increased facilities. The habits of the people must be studied, the existing trend of traffic and every factor which may influence the situation. Some of these factors can be given an approximately definite value, and others are largely a matter of experience. To each must be applied personal judgment and the actual or unconscious application of statistics obtained from other roads having conditions more or less analogous to those of the projected road, and upon the ability to ascertain the conditions and properly apply the results elsewhere obtained depends the accuracy of the predetermination.

The above refers more especially to passenger travel, but practically the same method is followed in connection with freight, both package and box freight, including milk, garden truck, etc., also mail, although the latter is not generally of great financial value, but policy may make it desirable.

Express matter and so-called package freight can usually be carried either in a special compartment of a regular car or in a special express car similar in general makeup to the passenger car used on the road, and, in either case, can be handled without interfering with the regular schedule and without any extraordinary demands for power. Bulk freight, on the other hand, to be profitable must be handled in fairly large quantities, and this requires the operation of train units of several cars. If such trains are run in the daytime when the regular passenger traffic is on the road, it necessarily interferes more or less with the regularity of the passenger schedule, as such trains move at slower speeds than the passenger trains.

Having predeterminated the obtainable traffic, the next step is to decide as to the traffic facilities which must be furnished for the anticipated business. Undoubtedly, a map has been available from the start, and the general location of the proposed road has been marked thereon, from which distances between the principal points have been ascertained. The specialist also has gone over the route and is fairly well informed as to the physical conditions, and, in a general way, the most desirable locations, both in the country and in the cities and towns, also the practicability of obtaining such locations. In fact, he is quite well informed, not only as to the general situation, but also as to the business situation, probable character of franchises obtainable, legal conditions, etc. If the country is reasonably level, he is able to approximate the cost of the grade, has ascertained the probable length of bridges required, and, from the maps obtained distances with sufficient accuracy for a preliminary study. If the country is rather rough, a topographical survey is exceedingly helpful, and quite frequently can be obtained from the United States Geological Survey. In some cases it is desirable to make at least a preliminary survey before the proposition has proceeded very far, but in many cases this is not only unnecessary but actually inadvisable, as it necessarily indicates the most probable route and frequently increases the cost of right of way. A time must arrive when the location becomes evident, but there are methods of procedure which minimize the tendency to increase the cost of the right of way which practically always follows such publicity.

Having a preliminary map and possibly a profile of the route, train schedules and train sheets are prepared in order to ascertain the approximate time of the runs of the various classes of trains (each of which may consist of one or more cars), and which are of importance in determining the number of cars required, the motor equipment for each car, the amount of power required, the location of substations and other matters. Of course, at this time such schedules and train sheets are of a preliminary character, and are liable to modification after a final map and profile have been obtained, and also numerous other matters have been definitely decided, but a competent man will prepare the preliminary schedule with a very close approximation to the final ones.

Some of the questions which will arise at this point are as follows:

With a preliminary map which shows the length of the road, and the length of the run in cities, towns and country, including the length in the principal terminal cities, and knowing that it is desirable that passenger cars should be operated at regular intervals, starting from terminal points, preferably on the hour, half hour or quarter hours; also knowing that the cost of train crews is one of the principal expenses, and consequently that the layovers at the ends of the route should not be greater than necessary for unloading and loading the cars, with sufficient allowance for delays in reaching such terminal points, and not forgetting that increased speed necessitates, for any given size and weight of car, greater capacity of motors, and also increased cost of the power equipment, including motors, substation and power-house machinery; also knowing that the runs in the cities and towns are under city regulation as to speed and, therefore, can not be increased by higher-speed motors; also realizing that increased stops in the country materially decrease schedule speed, the proposition is to so combine all these factors as to obtain the best *net* result.

In such study, consideration must also be given to grades, grade crossings with other railways, and, to some extent, of highways; also, in some cases, the service given by competing roads, either steam or electric. It is a fact that the income per capita in the country will generally be greater than from that in towns, but an effort to obtain every dollar possible from the country may be exceedingly poor economy. It might be considered that this is a matter of policy to be determined by the management, but it is of vital importance in connection with the design, if the design is to be such as will give the best returns per dollar invested.

The consideration of the route may start with the principal terminal city, and it is of great importance to have the terminal station in such city well located relative to the retail district, which is generally also the amusement centre.

(To be concluded.)

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Railway Coach Electrification.

The adoption of electric traction on the Metropolitan Railway, London, left the company with nine trains, each consisting of seven cars, which had formerly been hauled by steam locomotives. These cars were built in 1900, and it was decided to fit them up for electric traction rather than discard them. The work was undertaken by the British Thomson-Houston Company, and two trains fitted up, which have been in operation for some time satisfactorily. Each train consists of seven cars, and is made up of two motor cars and five trailers, although it is planned to add an extra trailer after the station platforms have been lengthened. Each motor car is equipped with four 200-horse-power motors, thus giving a total of 1,600 horse-power per train. It is capable of driving it at a maximum schedule speed of forty-five miles an hour on the level, when making a schedule speed of sixteen miles per hour. The trains are controlled by the Sprague-Thomson-Houston multiple unit control system. The motor cars weigh, complete, about thirty-eight tons, and the trail cars nineteen tons. A complete train weighs about 172 tons. In converting these cars the trail cars were not altered in any way except by the addition of the necessary wiring for lighting, heating and motor control. In the motor cars longitudinal channels have been substituted for the diagonals in the under frames over the centre of the trucks, in order to facilitate inspection of the motors, and to allow of better arrangement of the wiring. All wires and cables are enclosed in cold-drawn solid steel tubing with standard thread and fittings. The entire under sides of the floors of the motor cars are sheeted over with one-half-inch Uralite, while the upper surface is provided with a three-quarter-inch layer of Paris cement. The surfaces of the floors of the trailers are similarly treated, and that portion of the under side directly above the wiring is also protected by Uralite.—*Abstracted from the Tramway and Railway World (London), October* 4.

Radium and Geology.

Recent papers dealing with the idea that the earth's internal heat is due to the content of radium within its crust have led O. Fisher to examine the matter from the geological standpoint. Strutt has shown that if the temperature of the gradient expresses the outflow of heat due to radium in the earth, the radium must be confined to a comparatively thin crust, because his laboratory experiments proved that the smallest radium content existing in the rocks examined would give a much higher gradient than the one observed if the radium were distributed throughout the entire earth. The author examined this suggestion more closely. Defining first the earth's crust by the depth beyond which no heat is caused by radium, and by adopting a certain temperature gradient at the surface, there is left only one value of the radium content which will correspond to any assumed thickness of the crust, and there will also be one corresponding temperature at the bottom of the crust and throughout the interior. The author has calculated these at intervals of five miles for Prestwich's estimate of the gradient, which is one degree Fahrenheit for each 42.2 feet descent; and also for the more commonly accepted one of one degree Fahrenheit for sixty feet. The results are given in tabular form. With the first gradient he finds that with a thickness of fifteen miles the radium content is 15.39×10^{-12} grammes per cubic centimetre and the temperature at the bottom of the crust is 966 degrees Fahrenheit. At a depth of thirty miles the figures are 7.7×10^{-12} and 1,900 degrees, and at forty-five miles they are 5.13×10^{-12} and 2,834 degrees respectively. Assuming the lower gradient, the temperature at a depth of fifteen miles is 676 degrees Fahrenheit, and the radium content 10.27×10^{-12} grammes per cubic centimetre. At thirty miles the figures are 1,330 and 5.09×10^{-12}, and at forty-five miles, 1,984 degrees and 3.59×10^{-12} grammes respectively. From these figures it appears that the radium contents corresponding to such values as are usually assigned to the thickness of the earth's crust by geologists and seismologists are well within the amounts contained in the rocks examined by Strutt, and that consequently the surface gradient can be fairly accounted for by the theory. But there are also indications of internal temperature from volcanic products, as Bartoli found the temperature of lava issuing from Ætna to be 1,060 degrees centigrade. If this came up from beneath the crust it would correspond to a thickness of thirty to forty miles, according to the rate of increase which is attributed to the gradient. Since any reasonable assumption for the mean radium content of the crust would supply sufficient heat to maintain the observed gradient, it follows that no heat can pass up from the interior. The conclusion would be that the earth is not a cooling body, but is in a state of thermal stability; and a fundamental belief of geologists is thus shattered at a blow.—*Abstracted from Nature (London), October* 11.

Electricity in Steel Works.

The severe conditions to be met by the motive power employed in steel works make it necessary, when electric motors are employed, to use special designs or to adopt some load-balancing scheme. A recent installation of this kind has been made for the McKenna Process Company, of Birkenhead, England. The plant consists of three turbine-driven, three-phase, twenty-five-cycle generators, each rated at 750 kilowatts. These supply current at 450 volts to 500-horse-power motors for driving a series of rolling mills, and to other motor-driven apparatus. For driving the live rolls special Siemens motors have been installed. They are three-phase motors designed with special end plates so as to give rigid support to the bearing. The electrical characteristics of these motors are specially designed to enable them to withstand heavy rushes of current which occur at starting and reversing. The motors are controlled by resistance introduced into the secondary. The controllers are fitted with contact fingers having massive carbon tips and magnetic blowouts, mechanical resistances being employed. Another type of controller which is used for these motors is of the liquid type. The electrodes are fixed and the resistance is varied by changing the height of the electrolyte. A serious question in steel plants is the large variation in load due to the rolls. To neutralize these peaks the most frequent plan is to

Digitized by Google

place a flywheel on the motor, care being taken to design the characteristics of the motor so as to permit a considerable drop in speed, in order to get the benefit of the flywheel. There are cases, however, in which the peak loads are either so high or of so large duration that, in order to neutralize them completely, the weight of the flywheel would be prohibitive. In such cases the demand on the generating station may be supplied by a storage battery or by a plan which is a modification of the Ilgner system of mine hoisting. A motor-generator set is installed, consisting of a three-phase induction motor of suitable characteristics, and a direct-current generator. The latter is connected directly to a motor coupled to the rolls. An exciter is coupled to the generator shaft as is also a heavy flywheel suitably mounted. During the periods of light load the motor-generator speeds up, storing up energy in the flywheel, which later is used in starting the rolls or in overcoming resistance. To reverse the machine the generator field is reversed and the motor, acting as a generator, is brought to rest, storing up its kinetic energy in the flywheel, which is then used to bring it up to speed in the opposite direction. This system is being used with excellent results, load diagrams showing how the sudden and intermittent loads on the motor are converted into a very smooth load on the generating plant.—*Abstracted from the Electrical Review (London), October* 12.

The Duration of the After-Glow Produced by the Electrodeless Ring Discharge.

An investigation of the duration of the after-glow produced by the electrodeless ring discharge—that is to say, by an induced current set up within an exhausted tube by a coil placed outside of it—has been made by C. C. Trowbridge. A brief resumé is given of previous investigations of this phenomenon, none of which, however, has dealt with the duration of the glow. The first attempt to study it was made by setting up an electrical oscillation in a coil surrounding a tube which could be exhausted to any desired degree. But the discharge caused phosphorescence of the glass, which masked the phosphorescence of the gas. To get around this difficulty a second tube was attached to the one in which the discharge was caused to take place. After the discharge had taken place the phosphorescent gas was allowed to diffuse into the second tube, and its behavior watched. The duration of the after-glow is taken as the time between the instant of the secession of the electrodeless discharge and that when the after-glow becomes invisible, the time being registered by a stop-watch, which gave concordant results provided that any one series of experiments was carried out continuously, for it was found that if the gas were allowed to stand in the tube for some days the results did not agree. The author concludes that the visible duration of the after-glow can be measured with considerable precision if the eyes of the observer are protected from strong light, so as to secure constant sensitiveness of the retina. With an electrical system remaining the same, similar duration curves showing the change of duration and change of pressure can be formed, giving the same characteristic points of inflection, maxima and minima. But variation in duration in some curves may occur, owing to changes which take place in the gas. The after-glows thus far observed appear over a range from 2.4 to 0.002 millimetres pressure. The maximum of intensity of the after-glow and the maximum of duration are nearly coincident only at low electrical intensities. There is a critical point on the duration curve where the after-glow is only occasionally formed, and, when obtained, varies greatly in duration and intensity. This point corresponds closely to the pressure at which the white discharge begins. The position of the maximum of the curve, giving a change of duration with change of pressure, varies with the frequency of oscillation of the discharge, a greater frequency moving the maximum of duration toward higher pressure. When the discharge is caused to take place in gas at the temperature of liquid air, the intensity and duration of the after-glow are both greatly diminished. This investigation was undertaken to seek for any points of resemblance between this after-glow and the persistent meteor trains. These trains are masses of meteoric smoke left in the path of meteors, and are self-luminous, sometimes glowing for over thirty minutes. The luminosity appears to be electrical in origin. The height at which these trains occur is between fifty and sixty-five miles, and the after-glow bears a strong resemblance to them in a number of respects. The glow appears to be produced between definite gas pressures, which at the heights mentioned, were between 0.5 and 0.05 millimetre. The rate of diffusion of the after-glow at certain pressures is of the same order as the outward diffusion of the glowing particles of the meteor train, at the rate of several hundred per minute. The spectrum of both appear to be composed of a few lines or narrow bands. Under certain conditions the after-glow dies out first where it is formed, and observations have shown that many meteor trains fade first in the centre. The fact that the after-glow can occur at low temperatures shows that it is possible for such an effect to be produced at those temperatures which must exist at fifty or sixty miles above the earth's surface.—*Abstracted from the Physical Review (Lancaster), October.*

Some Observations on Alternating-Current Rectifiers.

An investigation of mechanical and electrolytic rectifiers has been made by A. C. Jolley. A machine of the permutator type, in which the rectified current is collected from a stationary commutator by synchronously rotated brushes, was first tested. This was rated at ten kilowatts and gave disappointing results. To obtain a charging current of twenty mean amperes the effective current indicated by an alternating instrument in the charging leads read fifty-one amperes, indicating a form factor of 2.55. The efficiency of the machine under these conditions was fifty-four per cent. This is five per cent lower than the efficiency which the machine gives on non-inductive load. To improve the performance, various inductances were placed in series with the battery. In this way the form factor was reduced until it was brought down eventually to 1.1, when the behavior of the machine was as good as on non-inductive load. An electrolytic rectifier of the Nodon type, designed to give an output of 500 watts, was found on test to give an efficiency at full load of seventy-three per cent. This was at 100 volts direct current, five amperes. The alternating voltage was about 136. The machine was capable of considerable overloads without a great reduction in efficiency; in fact, the efficiency curve represents that of a large generator. The efficiency is but little affected by heating until the temperature of the electrolyte has reached forty degrees centigrade, which, with this device, took place after a full-load run of two hours. At this point the primary current rises rapidly and the efficiency falls off correspondingly. By varying the voltage of the supply it is found that the efficiency of the device increased until it reached sixty-eight per cent at 135 volts, the direct-current load during the test being maintained constant at 500 watts. Changes in frequency had but little effect between the limits of forty and 200 cycles per second. The tendency is to lower the efficiency as the frequency rises. The whole effect at the highest frequency mentioned is about three per cent. The introduction of inductance does not influence the form factor when charging storage batteries.—*Abstracted from the Electrician (London), October* 12.

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

ORGANIZATION AND CONDUCT OF A NEW-BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.[1]

BY CHARLES NATHAN JACKSON.

I have always lived in the small city of "C," a town of about 30,000 inhabitants, in central Ohio. I have been in the banking business for several years and was interested, to a certain extent, in our local electric light plant. In course of time, however, I purchased the entire property. The former officers of the company had always been satisfied to let well enough alone and, as the plant was paying a small dividend, they were not very aggressive. I determined to see if, by increasing the business, I could increase the net earnings of the property.

We had a total generating capacity of 600 kilowatts and did not do the municipal lighting. The revenue was about $30,000 per year, and the plant was loaded to its utmost capacity about five o'clock in the December afternoons. The manager in charge was a very capable operating man and had several years of experience at operating plants. He was drawing a salary of $2,000 per year, but did not seem to know much about hustling for business. When I asked him what we had better do to increase the revenue, he said: "Hire a solicitor and install more machinery." We finally secured a young man who had sold electricity in another town, and started him to work and then began to make plans for increasing the capacity of the plant. We were charging ten cents per kilowatt-hour and the young man had not been at work very long before he secured a contract for a wholesale house that would use about twenty-five arc lamps. He also got contracts for several factories, and I began to think that there was a good prospect of his building up quite a business. However, I did not see any increase in the receipts, but the manager told me to wait until next winter and all these new customers would then be using the light. Of course, we could not expect much in the summer, as they did not need it. Gas was selling at a dollar a thousand cubic feet, and a walk through the business district at night showed all the saloons, drug stores, restaurants and hotels using gas. Upon enquiry I found that the price of electric light to such consumers was about three times the cost of gas, and of course they could not afford to pay the difference. The solicitor's business soon began to drop off and in a few months his orders were very few and far between. He merely said that he had secured every customer that he could and could not possibly get any more.

In other cities I have seen the electric light company light all the saloons, drug stores and the like, and wondered why we could not do it. So I began to look around and see if I could not find a man who could get the business. One day, in answer to one of my letters, Mr. Johnson, a man of about thirty-five years, called to see me, and in answer to my question as to what he could do, he replied that he did not know, but that if I would give him a guide and a right to ask a few questions, he could soon tell me. I did so, and the next day he returned and said: "I find that you have loaded your plant down with 'short burners.' About the only revenue you get is on the peak in the winter. You asked me how I could increase your net profits, and I will say that I can increase your net profits from twenty to thirty thousand dollars per year and you need not purchase any more machinery." I replied that I did not see how that was possible, as we could not raise our prices. He said that he would *cut* them to some customers and *raise* undesirable ones; for example, "you have a commercial light and power load of 600 kilowatts on the peak, or a revenue of $50 per year per kilowatt demanded on the peak. Now there are a great many concerns, such as saloons, drug stores, restaurants, hotels and other 'long burners' that you ask to pay at your present ten-cent rate, $200 per year, per kilowatt demanded, which is much too high; imagine a drug store having forty sixteen-candle-power lamps, paying you $400 per year—their gas bills are not over $150 per year—but you will let a wholesale store, that closes at 5.30, burn forty sixteen-candle-power lamps and only pay you $50 per year, and they cost you nearly as much as the drug store. All of your fixed expenses are the same for both, but the drug store uses about 4,000 kilowatt-hours and the wholesale store 500 kilowatt-hours. As your coal bill is not over one-half cent per kilowatt-hour, you can see the drug store would cost for coal $20, the wholesale house $2.50. So you are either making a very large profit on one or losing a lot on the other."

I could readily see that this argument was correct, and asked him how he would go about it to produce results. He replied that the town was not large enough for him to spend his entire time with us, but that he had in training several bright salesmen, any one of whom was capable of going into the town and working up the business under his supervision. Of course, it would oftentimes be necessary for him to help the solicitor on some big contract, and that he would charge me $1,800 per year for the services of the solicitor and for his own services he would ask twenty-five per cent of the increased profits during the first two years. After that he would probably not be needed, as things would be running so nicely that the solicitor would be able to go it alone.

His desire to back up his ability with such a proposition made me feel safe in accepting it at once. He at once came on the ground to give us a start and first got a friend of our company to agitate a rate ordinance, which was passed. It prohibited a charge in excess of fifty cents per month per sixteen-candle-power lamp to customers using light not over ten hours per day. The "long burners," of course, were pleased and boosted it along. The "short burners," never dreaming that it would affect them, said nothing. He then sent for the solicitor, who was instructed to charge a flat rate of $5 per month per kilowatt demanded, and an extra charge of two cents per kilowatt to all light customers, except residences, who were to pay ten cents per kilowatt-hour, $1 minimum. Lodge rooms, churches and hotels were to receive a special rate. The solicitor had no trouble in securing contracts with all the "long burners," and at the same time kept an eye open for unprofitable "short burners" and raised their price to the new rate. The whole-

[1] This paper received an honorable mention in the contest inaugurated by the Cooperative Electrical Development Association, Cleveland, Ohio.

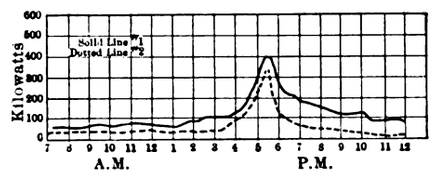
Digitized by Google

sale house, when asked to pay $10 per month plus two cents per kilowatt-hour, threw up their hands in horror and said that they would not stand for any such "holdup," so they put in gas.

In October the load curve of the station looked like Fig. 1. The load curve before looked like Fig. 2. He said, "You will notice that the load drops off a little after six, and if we don't do something we will have a curve like Fig. 3 in December. You will notice on Fig. 3 that it will begin to drop off at 5 P. M. I am going to start a strong campaign on residence lighting, churches and lodge rooms, which commence to burn at five o'clock and get heavier as the other load goes off."

He engaged two bright young fellows and started them after residence contracts at the old price of ten cents per kilowatt-hour. They would turn the names of all prospective customers over to a stenographer, who would mail them a series of letters and advertising matter on electricity for home use. In that manner they would get from two to four contracts per day. All that time the solicitor was getting all the churches and lodge rooms he could at a six-cent rate. It was not long before I could see a change in the load curve. It began to fill out after six, and by Christmas it looked like Fig. 4. He was not satisfied with that, but said he wanted one to look like Fig. 5, and that he would get it with power business. I replied that factories did not stop work until 5.30, so their load would be on the peak. He said that large factories are on the peak but small shops are not. He had studied their load and found that a load curve from a power circuit handling a great many large and small customers showed a load curve during December that began to drop off at four o'clock and reached zero at six, and at five o'clock it was only fifty per cent of the total load and that there were several large factories which he knew were on at five o'clock, consequently it must have been the small shops that began to quit at four o'clock and were practically all through at five.

He began to push power business at three cents to large and small customers alike. As there was no firm in town that handled motors, we sold them to our customers at cost. Such a low price on power secured a great many small power customers and a few large ones. He was gradually filling up the "valley" in the load curve, and our receipts in March were $5,000, which made me feel pretty good. About that time a big cold-storage plant was being built, and Johnson went after the business, quoting a two-cent rate. He told me that they would require 100 horse-power about 600 hours per year, which at two cents per kilowatt-hour would give us a revenue of $9,000, of which about seventy-five per cent was clear profit. I had so much confidence in Johnson that I knew he was right, but I had



FIGS. 1 AND 2.—LOAD CURVE.

to ask how the profit could be so much and how he could carry the increased load. "Nothing easier," he said. "They agree not to use power after 4 P. M. in November, December and January, so the only time they come near our full load is Saturday night in the summer time, and then our load is never more than 400 kilowatts. Regarding the seventy-five per cent profit, I am going to let you answer

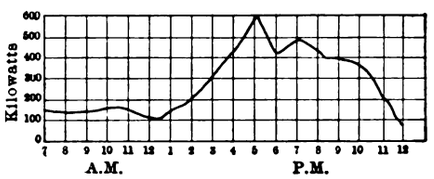


FIG. 3.—LOAD CURVE.

that. Do you have to put in any more machinery to carry the load?" I replied "No." "Do you require any more men to run your plant?" I said, "No." "Then isn't coal the only added expense, and does it cost you over one-half cent per kilowatt-hour?" I took off my hat to him. I could see his seventy-five per cent profit.

When summer came, our receipts held

FIGS. 4 AND 5.—LOAD CURVE.

up to about $4,000 per month. All the stores were paying their "flat rate." The power customers were paying more than they did in the winter, the refrigerating plant was paying us nearly $1,000 per month, and I began to see visions of a good paying property.

Johnson had an office system that was very thorough and yet very simple. He first bought one section (two drawers) of a vertical filing cabinet. The folders were numbered from "one" up. He had another drawer in which he kept his three-by-five-inch index cards. When a new contract came in, a work order was issued in quadruplicate (two heavy copies and two tissues), one tissue was put in the customer's folder, and the two heavy copies and the other tissue went to the operating manager, who kept the tissue and passed the two heavy copies to the line foreman and the meter foreman. The operating manager's tissue was kept on his desk so that he could see what orders were in the hands of the men. When the men returned their copies marked "completed," he destroyed his tissue and passed the orders back to Johnson, who passed them with the contract to the bookkeeper, who would enter the customer's name and rate on the ledger and then would pass them back to Johnson, who filed them in the customer's folder. He issued work orders for meter tests, complaints on service, etc., to the operating department in the same way, always filing his tissues at once, so at any time a glance in the folder would tell what the last move was. All prospective customers had a folder. After a visit, where anything of importance was said or done, he would dictate a "report" and file it. He also had a small desk tray, which he called the "tickler." One set of guides were for the twelve months and one set for thirty-one days. I have seen him dictate a report on a prospective customer, saying that "if Jones & Company renewed their lease December 1 they would be glad to accept our proposition of April 15." He would then drop a three-by-five-inch tickler card in the tickler for about December 1, calling attention to report of April 15 on Jones & Company. He never tried to remember the slightest thing regarding any deal. If it were "up to to the other party" he paid no attention to it and never gave it another thought. If it were "up to him" he would put in a tickler that would come up, say in ten days, asking if "Davis & Company had answered June 12," or, "had P. C. Stewart sent him plans as per May 29."

One day I asked him how a certain big power deal was progressing. He looked in the folder and found that the last thing done was a letter confirming a verbal quotation. It was signed by the solicitor, and we, to test the solicitor's system, looked in the tickler to see if he was taking care of it. We found a tickler

Digitized by Google

dated eight days from the date on the letter, asking if the Iron Works have answered May 17. He taught his solicitors never to use their memory, but to keep the system in first-class shape. He said that a good man could solicit at one time fifty large deals, whose business would run from $3,000 to $20,000 per year, and could tell any detail of any one of them in a very few minutes. After a call on a prospective customer, he should decide when he would call again, make his notes and then forget that such a deal is on.

There were about fifteen deals which he gave his personal attention in our town. I have seen him come into the office after a week's absence, look at a small memorandum book and say, "I must see Brown & Company this trip." I would ask him, "How about the others?" He knew no "others." He only knew those that turned up for that trip, and under no circumstances would he go near any other deal.

He trained his men *never* to say anything while on a deal until they got all the information they could, then to go away and "form a plan of campaign," and when they got a plan that looked good to them, "go ahead and work it."

At the end of the second year the results showed that our revenue was $62,000 per year, and about the only increase in operating expenses was for coal. I was very glad to pay him according to our agreement and insisted on retaining him at a salary of $1,200 per year in an advisory capacity only.

Our two largest hotels looked as dark and gloomy as they could, and the owners would not install any more lamps. The solicitor, by making a special rate for a few months, lighted one hotel until it made the other look like a dungeon. That made the owner of the "dungeon" sit up and take notice. As soon as the dungeon was well lighted and a contract was secured, the solicitor had no trouble in securing a contract with the other.

We made a special rate of three cents per kilowatt-hour, with a minimum of five cents per month per two-candle-power lamp, on signs, the customers agreeing not to light them before 5.30 P. M. As they came on after our five o'clock peak, our cost was only one-half cent per kilowatt. As the sign load would give us a revenue of nearly $60 per year per kilowatt, we considered it the best kind of business. Johnson showed me that if we charged six cents for sign lighting we would, as a rule, not get over $60 per kilowatt per year, and as they would light them at 4.30 P. M. during the holidays, and be on our peak, there would be no profit to speak of, while at the three-cent rate with the 5.30 P. M. start, it was nearly all profit.

The gas company, seeing their "long burners" leaving them, and in return getting our outcasts ("short-burners"), began a very aggressive campaign and offered all sorts of cut-rate propositions. Johnson told me to call upon their manager and tell him that if he did not quit that kind of warfare we would give him a "dig" that would hurt. You can imagine what that manager said to me. After I reported the result of my talk with the gas manager to Johnson, he said that we would advertise complete electric cooking outfits for $80 on time payments, and would sell current for them at two cents per kilowatt-hour. By advertising, we had no trouble in assuring the public that it was cheaper, cooler, cleaner and more healthful than gas, and we put out fifty sets in two weeks. The gas manager

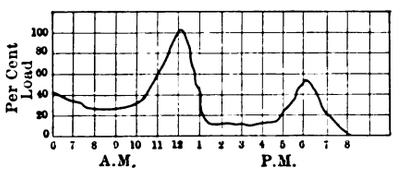


FIG. 6.—LOAD CURVE.

came to me and asked me how much longer we were going to run that offer. I replied "forever," and he went away declaring that we would go into bankruptcy if we continued at such a price. Johnson contended that we were making a good profit on it at two cents, as you see the cooking load runs like Fig 6. It is an all-day load until people begin to get their supper. The load at 5 P. M. is not worth considering, and it gradually gets heavier until after six. After we put in our new 500-kilowatt generator, we can not get enough residences to fill our load curve out from five to six, so the cooking load will fill in there very nicely and only increase our expenses a little for coal. The gas manager intimated that if we would put the price up to three cents, that he would quit cutting prices in the business district. But we were so strongly intrenched there that we thought we had better let the price remain at two cents as it was a great "ad" for us.

You asked me how to organize and conduct a commercial department, and, after my experience, can safely say, hire the best commercial man in the country and let him do the rest. Electrical engineers and mechanical engineers are absolutely necessary in building and operating your plant, but don't expect them to be commercial men any more than you would expect your architect to manage your factory, office, bank or department store if he should build it. So far the electric lighting industry has paid the high salaries to the engineers and has employed young inexperienced solicitors at salaries from forty to one hundred dollars per month, to market the product from an investment of sometimes millions. For that reason "good salesmen" have never cared to go into the electric business, and consequently to-day, when there is millions of business to be sold, there are very few men capable of selling it. Let me show you the difference between a "good man" and a "cheap man." You wish to develop a certain very thriving factory district, where you have to make a long run to reach it, and you must secure a certain amount of business to warrant the extension. Your "good man" secures seventy-five per cent of the business that he goes after; your "cheap man" thirty per cent. Your "good man" therefore makes it possible to make the run and thereby gives a big revenue from that district, while you get none from the "cheap man's" effort. Every man that you go after and "land" is an advertisement, because he, to show his good judgment, tells every one how nice and cheap electricity is, while the man that was solicited but not "landed" by the "cheap man" tells how *he* would not use it, as the price was too high.

I know of one case where a "cheap man," in talking to the manager of a foundry that was under construction, let the manager calculate that one crane, one cupola blower, three rattlers, one emery wheel and one small air-compressor for chipping, would, at a five-cent rate, cost him $8,000 per year. The manager proved to the "cheap man" that it would cost that much, and the manager was about to order his steam plant, when a "good man" heard of it and called to see him. When he heard the manager's story he merely said, "I know of a foundry where the conditions are identical, and, at a five-cent rate, they only pay about $3,000 per year. You put in your motors, but let the central station handle you for a few months, then, if your bills exceed that amount, and you still think you can save money by installing your own plant, do so." He got the business and kept it.

Digitized by Google

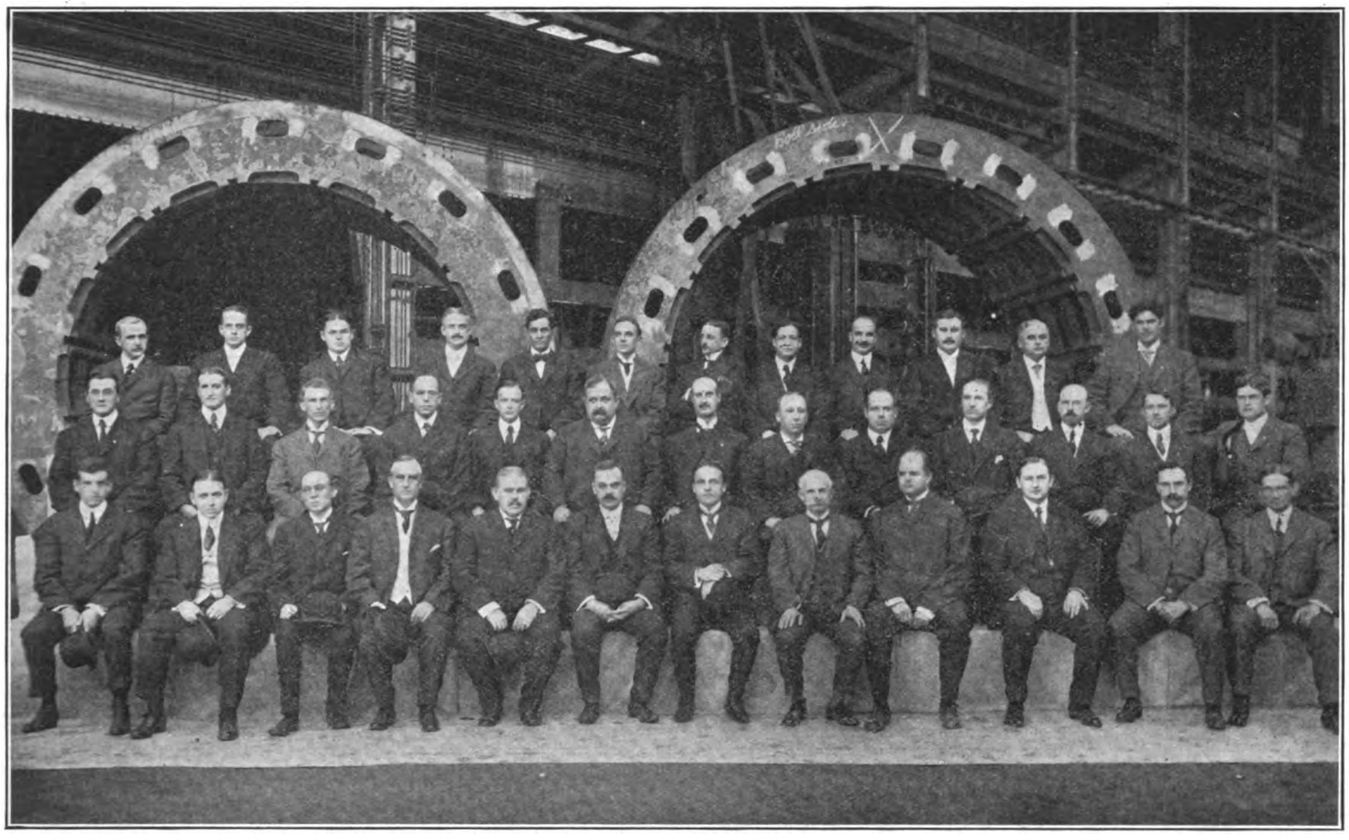
INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Westinghouse Managers' Meeting.

The annual convention of the sales managers of the Westinghouse Electric and Manufacturing Company was held at the East Pittsburg works during the week ending October 27. The meetings were conducted by E. M. Herr, first vice-president, and L. A. Osborne, second vice-president, assisted by C. S. Cook, manager of the railway and lighting department; S. L. Nicholson, manager of the industrial and power department; C. B. Humphrey, manager of the detail and supply department, and Walter Cary, general manager of the Sawyer-Man Electric Company. On Wednesday evening, October 24, the officials of the company gave a banquet to the visiting managers at the Hotel Schenley, at which there were present, in addition to the officials and managers of the electric company, prominent officials of associated interests, including Colonel H. G. Prout, vice-president of the Union Switch and Signal Company; John F. Miller, fourth vice-president of the Westinghouse Air Brake Company, and E. H. Sniffin, third vice-president of the Westinghouse Machine Company.

These annual meetings of the Westinghouse company were inaugurated a number of years ago and give an opportunity for the mingling of ideas of the managers from all parts of the country, working under almost every known commercial condition. The convention closed on Saturday, when the managers returned to their respective territories.



GROUP OF WESTINGHOUSE SALES MANAGERS, EAST PITTSBURG, PA., MEETING, OCTOBER 22-27, 1906.

The Manufacture of Water-Wheel Governors.

The Lombard Governor Company, Ashland, Mass., has over an acre of machine-shop floor devoted to the manufacture of water-wheel governors. This company is now engaged in turning out a very large proportion of all the larger water-wheel governors used in this country. It has been increasing its factory from year to year, but at the present time it has about $60,000 worth of unfilled orders in the shops, and every effort is being made to make a gain in shipments each month.

From time to time it has been feared that the present era of activity in water-power plant construction would cease, but the prospects at the present time indicate even an increase in the rate of construction.

The president of the Lombard Governor Company is Homer Loring, of the banking firm of S. D. Loring & Son, Boston. Henry E. Warren is superintendent, and Allan V. Garratt is chief engineer and general sales agent, G. G. Beals acting as treasurer.

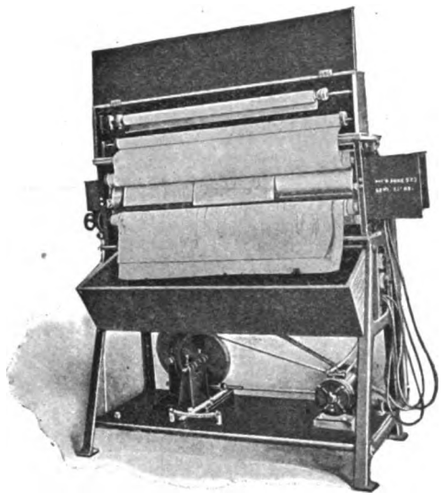
The company has well-organized offices in San Francisco, Seattle and Los Angeles, on the Pacific coast, and in Japan, and announces that Scandinavian Europe is also calling for a considerable supply of its apparatus.

Digitized by Google

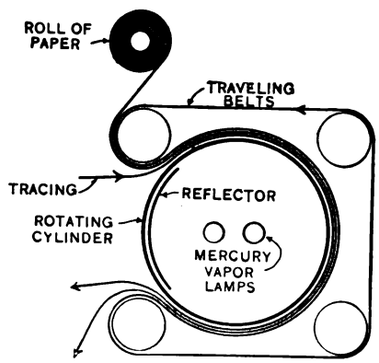
A New Form of Electric Blue-Printing Machine.

The accompanying illustrations show a new form of electric blue-printing machine placed on the market by the Revolute Machine Company, 523 West Forty-fifth street, New York city. This is designated as the Everett-McAdam continuous electric blue-printing machine.

This machine consists of a rotating glass cylinder which lies in a series of narrow belts. Within the cylinder are placed two Cooper Hewitt mercury-vapor electric lamps. The roll of paper to be printed is placed in a box on top of the machine and feeds in continuously between the belts and the cylinder; or, if only a few prints are wanted, previously cut sheets of paper may be fed in directly with the tracings. The tracings are inserted between the paper and the cylinder, and after passing around three-quarters of the circumference of the cylinder, are deposited with the paper in a box in the front of the machine, the printing being done from the inside of the cylinder as the paper and tracings travel around it.



HORIZONTAL ELECTRIC BLUE-PRINTING MACHINE.



ARRANGEMENT OF PARTS, ELECTRIC BLUE-PRINTING MACHINE.

With this machine it is possible to make prints five feet wide and of any length whatever. The device is particularly adapted to making numbers of small prints on one long sheet of paper, or blue-print paper cut to the proper size to accommodate a number of small tracings can be fed in continuously. A feature of the machine is the facility with which the tracings may be fed in one at a time, small ones being fed in side by side, while the paper is fed automatically from a continuous roll. The tracings go in and come out on the same side of the machine, so that the leading edge of a tracing may be started into the machine again before the trailing edge comes out, saving considerable time where more than one print is wanted from a single tracing.

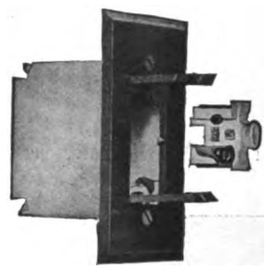
With the use of a number of one and one-half-inch belts, instead of a single broad contact belt, a uniform pressure is obtained, which is said to be decidedly advantageous.

Behind the lamps, and covering a section equivalent to about one-quarter of the circumference of the cylinder, is a reflector, which increases the printing power of the light furnished by the mercury-vapor tubes.

The machine is compact, requiring a space of two feet by five feet, and is entirely self-contained. The printing cylinder is driven by a motor, and the speed may be changed according to the time of printing desired for different qualities of paper.

New Type Flush Receptacle.

The Marshall Electric Manufacturing Company, Boston, Mass., has recently perfected and put upon the market a new plug and receptacle, known as its No. 971. This receptacle has the plug entirely enclosed in the receptacle, so that the finished article, whether with or without the plug, is flush with the plate, the two doors opening out each way permitting the withdrawal or insertion of the plug.



The contacts for wiring the receptacle are easy of access, yet well protected from the metal frames or boxes. The receptacle is arranged with the special Marshall lugs so that it is adapted for use in all standard conduit boxes or frames without any alteration or fitting. The receptacle is rated at ten amperes but carries safely a load of thirty amperes and the plug will take the reenforced cord.

These receptacles are carried in stock at the New York office, 227 Fulton street, and the Chicago office, 169 Adams street, of the Marshall Electric Manufacturing Company, as well as at the Boston works.

The Opening of the New Plant of the Wagner Electric Manufacturing Company.

On October 20 the Wagner Electric Manufacturing Company, St. Louis, Mo., formally introduced its new plant on Plymouth avenue, St. Louis, to its employés of all classes. Special cars were placed at the disposal of the working organization, and after luncheon was served at the plant the members of the party inspected the buildings and grounds at their leisure. In order that the arrangement of the new works might be easily understood, a descriptive pamphlet was provided, and the affair passed off very pleasantly, as every effort was made to indicate to the employés that in planning the development of the company the directors were not overlooking the general welfare of its working organization.

Digitized by Google

"G. I." Flush Receptacle and Attaching Plug.

The accompanying illustrations show the new form of flush receptacle and attaching plug placed on the market by the Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass. Fig. 1 shows the front view of the receptacle with attaching plug inserted, and Fig. 2 the flush receptacle and attaching plug. The body of both receptacle and plug is made of porcelain proportioned to withstand severe usage. The face plate is made of heavy brass equipped with doors which close flush whether the plug is in or out of the receptacle. The doors are held either open or closed under tension by flat springs. The receptacle has flexible contacts of phosphor bronze, which adjust themselves to the fixed contacts on the plug and ensure good contact. The surfaces are kept clean by the rubbing of the contacts as the plug is inserted or withdrawn.

This receptacle will fit standard boxes, and is designed with ample space for the wires. The plug is fuseless and the hole is seven-sixteenths of an inch in diameter, to take reenforced cord, and space for tying a knot is provided.

The plug contacts are copper and are kept in alignment by ribs formed on the plug. This eliminates the possibility of short-circuiting or grounding through the plate when inserting or withdrawing the plug, because the length of the plug contacts is less than the distance between the plate and the fixed contacts.

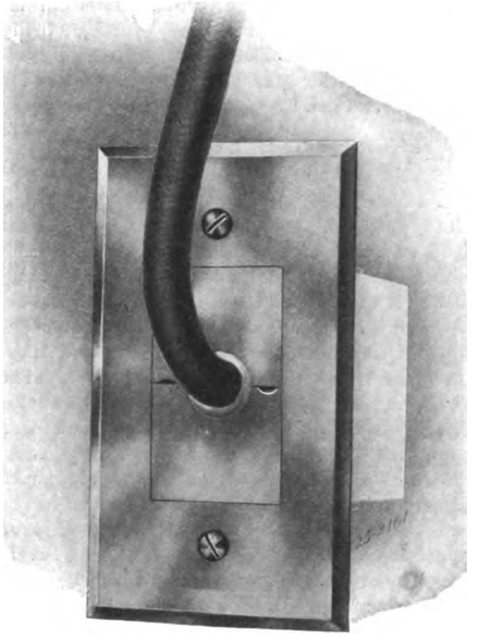


FIG. 1.—FRONT VIEW OF "G. I." FLUSH RECEPTACLE WITH ATTACHING PLUG INSERTED.

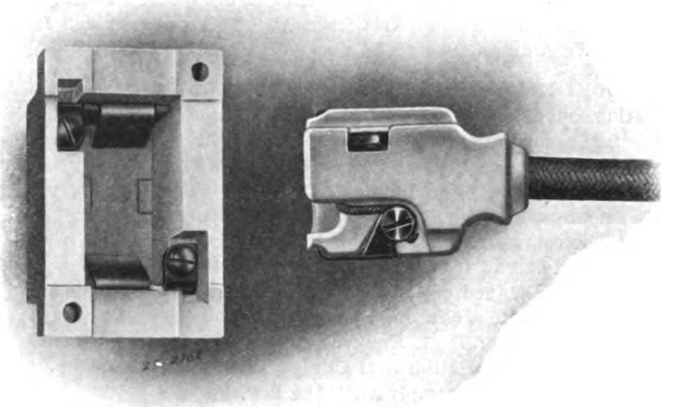


FIG. 2.—"G. I." FLUSH RECEPTACLE AND ATTACHING PLUG.

The Fifth National Business Show Held in New York City.

The Fifth National Business Show was held at Madison Square Garden, New York city, October 27 to November 3. Among the large number of companies making a specialty of office appliances there were some who are well known in the electrical field. The latter made exhibits of a smaller line of apparatus than is usually seen at an electrical show. The interest in these devices, however, was keen, and the companies report many profitable enquiries.

The companies enumerated below made exhibits and were represented as follows:

Advertising Mirrorgraph Company, Brooklyn, N. Y.—Motorless flashing electric signs, flashers, glass signs, paper cut-out signs. Represented by W. D. V. Kelly, manager.

Crouse-Hinds Company, Syracuse, N.Y. —This company made an elaborate exhibit of the "Hawley" time-registering clock. By means of a very ingenious system of marking up time sheets a complete weekly register is obtained. Represented by W. D. Hawley, W. C. Blanding and H. B. Crouse.

Holtzer-Cabot Electric Company, Brookline, Mass.—Interior telephone apparatus and annunciators; small motors for special applications. Represented by E. F. McCobb and A. P. Waterman.

Oliver Manufacturing Company, Philadelphia, Pa.—Telephone specialties, including the "Equipoise" telephone bracket. Represented by Scofield & Company, New York city.

New York Beck Lamp Company, New York city—Flaming arc lamps. Represented by George R. Berger.

The Schmidt-Wilckes Electric Company, New York city. Intercommunicating telephones, latest type; two complete intercommunicating sets coupled up; four private-line telephones of both the receiver and bell-call types. Represented by F. L. Benzon.

Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Private-exchange telephone systems; intercommunicating systems for hotels, factories, etc., and a regular line of central energy telephones, all connected up, showing the apparatus in actual service. Represented by James O. Oliver, H. A. Jones and F. W. King.

The New York Telephone Company had a very attractive booth, which also served as a main exchange for the exhibitors in the Garden.

The Bates Machine Company, Brooklyn, N. Y., made an exhibit of automatic numbering and dating machines. Represented by B. B. Conard, M. W. Phillips, Walter Grobe and G. J. Soulsby.

Illuminating Engineering Society.

The November meeting of the Illuminating Engineering Society will be held at the Edison Auditorium, 44 West Twenty-seventh street, New York, at 8.15 P. M. on Friday, November 9. Papers will be read on: "Fixture Location in Residence Lighting," by F. N. Olcott; "Fixture Design and Location," by Major E. L. Zalinski; "Location of Lamps and Illuminating Efficiency," by Preston S. Millar.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

MEXICAN LIGHT PLANTS SOLD—The Mexican Light and Power Company, a Canadian concern, which already owns the electric light plants and street railway system in Mexico City and Pueblo, has purchased the two electric light plants and street railway systems of the city of Guadalajara. The price paid for the property was more than $7,000,000.

LAKE CHELAN (WASH.) POWER COMPANY—The Lake Chelan Water Power Company, organized under Arizona laws, with $3,000,000 capital, has filed articles of incorporation. Its objects are to engage in general transportation, irrigation and mercantile business. The incorporators and officers are: James McMillan, of Minneapolis, president; Junius Bebee, of Wakefield, Mass., vice-president; Albert F. Helliwell, of Minneapolis, secretary and treasurer; Carrie E. McMillan and Charles F. Linnmayer, of Minneapolis. The chief place of business is Phœnix, Ariz. Branch offices are provided for at Chelan, Washington, Boston, Minneapolis and New York.

MISSOURI INTERURBAN LINE CHARTERED—Articles of incorporation have been filed with the secretary of state of South Dakota for a new railway company which will build a line in western Missouri. It is known as the Western Missouri Interurban Railway Company, with a capital of $3,000,000. The headquarters of the company will be at Sioux Falls, S. D., with an office at Clinton, Mo. The company's line will be operated by electricity or other power, and will extend from Odessa, Lafayette county, to Greenfield, Dade county, a distance of 125 miles, the line to pass through the counties of Lafayette, Johnson, Henry, St. Clair, Cedar and Dade. The incorporators are: D. J. Haugeberg, Allie W. Campbell, Frank S. Gray and George S. Halliday, of Clinton, Mo., with enough South Dakota incorporators to comply with the law.

TELEPHONE CONSOLIDATION—The United States Telephone Company, which is part of the Brailey syndicate, has taken over nine of the largest independent telephone companies in Ohio, besides securing the controlling interest in the Huron county telephone syndicate. The acquisition was effected through an exchange of securities. The following companies have been operating as subsidiary companies since June 1: the Columbiana Telephone Company, Findlay Home Telephone Company, Citizens' Telephone and Message Company, of Fostoria; the Lancaster Home Telephone Company, the Massillon, Mansfield, Youngstown, Zanesville & Stark County Telephone Company. The transaction involves an exchange of $1,461,800 of United States Telephone Company stock divided into $1,100,000 common and $361,800 preferred, besides numerous other securities.

NEW ELECTRIC LINE—The Madison & Fond du Lac Electric Railway Company has been incorporated to build a third-rail electric line between Madison and Fond du Lac. It is stated that eastern capital is behind the enterprise. A survey has been completed and the right of way is being sought. The road will be finished by October 1, 1907. The direct route between Madison and Fond du Lac will include Windsor, Columbus, Beaver Dam and Waupun. A line will also be built from Watertown and Fox Lake, crossing the main line at Beaver Dam, where the power-house will be located. The present capital is $150,000, which will eventually be increased to $3,000,000. The new road will shorten the distance between the two cities twenty-three miles. It will carry both passengers and freight, and through trains will maintain a speed of seventy miles an hour.

PLANS OF THE BOSTON-NEW YORK INTERURBAN—Details of the project for a new interurban line between Boston and Providence, to constitute a part of a Boston-Providence-New York line, have been filed with the railroad commissioners by the Boston & New York Electric Railroad Company, the company for which articles of association were advertised a few weeks ago. They show that the proposed line would be about thirty-five miles long, with its Boston terminus at Forest Hills. The company asks that the commissioners certify that public exigency requires the construction and operation of the proposed line, and a date for a hearing on the petition will be announced later. Charles C. Blaney is counsel for the new company, and the directors are: Stephen W. Reynolds, John F. Crocker, L. S. Brown, Daniel W. Howland and A. B. Leach. The company has filed a schedule of cost of building and equipment of its proposed line, of which the total is $7,115,250. The proposed route would involve forty overhead bridges, sixteen under bridges, four railroad bridges, sixty farm bridges and forty-one culverts, items in the preparation of a private right of way devoid of grade crossings.

ENGINEERING SOCIETY NOTE.

SCHENECTADY BRANCH OF AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The third meeting of the season of the Schenectady branch, American Institute of Electrical Engineers was held on Saturday evening, October 20. Dr. Rossiter W. Raymond was the speaker of the evening and presented an address on "Professional Ethics," a subject of great interest at present to all electrical engineers on account of President Wheeler's address at the Milwaukee convention of the Institute and the present activity on the part of the Institute's special committee recently appointed to formulate a code applicable to the electrical profession. Dr. Raymond was greeted by an enthusiastic audience of some seven hundred and the value of his remarks amply justified the large attendance. As president of the American Institute of Mining Engineers for several years, as the efficient secretary of that body for some twenty years and as editor for years of the *Engineering and Mining Journal*, which he founded, Dr. Raymond is particularly well equipped to speak with authority on the subject he chose. He addressed his remarks to the young engineers and students, speaking for loyalty to one's employer and to one's self, with a fund of anecdote and wit that seemed inexhaustible and kept the room in laughter between the serious portions of his talk. He gave much good advice and summed up with the following general rule of engineering ethics: "Do not do what you can not tell, or if there be a good reason for not telling the details, do not do what you can not tell without shame." The speakers were introduced by Chairman Rushmore, and among the others were Dr. George R. Lunn, of the First Reformed Church; Dr. W. R. Whitney, of the research laboratory, General Electric Company, and Professor Hoffman, of Union University. The branch meetings are held in the auditorium of the Schenectady High School, and the officers of the branch are greatly gratified by the continual increase in the size of the audience. Although the admission was by ticket only at this meeting, the attendance was the largest in the history of the branch. An interesting feature of the meeting was the large number of men who came prepared to join the branch. The membership committee has succeeded in building up a branch membership which already is more than three times the number of regular members and associates of the national body residing in Schenectady. At the same time, however, the local membership of the parent organization has been greatly increased on account of the activity of Institute work at Schenectady. Weekly meetings are being held through the winter. On Friday, October 5, the branch was addressed by T. Commerford Martin on "Technical Journalism," and on October 12 by E. G. Acheson on "Inventions and Discoveries."

DATES AHEAD.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.

Northwestern Electrical Association. Milwaukee, Wis., January 16, 1907.

American Society of Mechanical Engineers. New York city, December 4-7.

Digitized by Google

NEW INCORPORATIONS.

AUSTIN, TEX.—Jacksonville Ice and Electric Company, Jacksonville. $75,000. Incorporators: Charles A. Zilker, William Watkin and L. H. Vanderwerf.

COLUMBUS, OHIO—Massillon Northern Railway Company, Massillon. $10,000. Incorporators: W. O. Schuster, H. W. Loeffler, C. F. Dow, L. A. Koons and G. W. Kratsch.

AUSTIN, TEX.—Citizens' Light and Power Company, Texarkana. $50,000. Incorporators: C. C. Taylor, Robert E. Miller, John B. King, Claude L. Shepherd and R. W. Rodgers, all of Texarkana, Tex.

WICHITA FALLS, TEX.—Citizens' Light and Power Company, Wichita Falls. $10,000. Incorporators: E. P. Walsh, G. W. Wigham, J. D. Davis, W. E. Skeen, A. Kahn, Edward Howard and T. F. Taylor, all of Wichita Falls.

DES MOINES, IOWA—American Electric Railway Company. To build an electric road from Omaha to Chicago, to pass through Winterset and Des Moines. $20,000. C. W. Baker, president; J. D. Pollard, vice-president, and Charles F. Castleman, secretary.

AUGUSTA, ME.—Gennessee County Niagara Power Company, organized at Portland, for the purpose of promoting or carrying on the business of an electric light and power company. $250,000. Officers: president, W. F. Crummett, of Portland; treasurer, Charles D. Fullerton, of Portland.

LANCASTER, PA.—Leland Electric Light Company; to supply electric light and power to the residents of Manheim borough; $5,000; directors: J. Hector McNeal, H. C. Case, George R. Heisey, E. L. Baker and L. M. Endebrock. Stover Electric Light Company; $5,000; same directors as above; incorporated to furnish electric light and power to Mount Joy borough.

HARRISBURG, PA.—Sylvan Avenue Street Railway Company, Pittsburg; $21,000. Haight's Street Railway Company, Pittsburg; $15,000. Winebiddle Street Railway Company, Pittsburg; $6,000. Halkett Street Railway Company, Pittsburg; $3,000. Coral Street Railway Company, Pittsburg; $6,000. Greenwood Street Railway Company, Pittsburg; $7,500. Frankstown Avenue Street Railway Company, Pittsburg; $3,000. Glenwood Avenue Street Railway Company, Pittsburg; $6,000. Hale Street Railway Company, Pittsburg; $6,000. Johnstown Avenue Street Railway Company, Pittsburg; $6,000. Portland Street Railway Company, Pittsburg; $13,500. Harriett Street Railway Company, Pittsburg; $6,000. Moulton J. Hosack, Pittsburg, is president of all these companies.

NEW MANUFACTURING COMPANIES.

DOVER, DEL.—Articles of incorporation have been filed for the Electric Supply Company, of Maryland, to transact a business of wholesale and retail electric supplies, etc. The incorporators are: George M. Upshur, Franklin Upshur, Sherwood R. Murphy and John M. Newverth, Jr. The capital stock is $5,000.

ATLANTA, GA.—E. F. Peckham, H. E. Tolman, A. Madison, W. J. Fletcher and J. H. Tolman have filed an application for a charter for the Current Motor Company, of Georgia. The company will be capitalized at $1,000,000, with the privilege of increasing the amount. It is proposed to deal in electrical appliances and to equip and operate power and light plants.

PASSAIC, N. J.—Articles of incorporation have been filed of the R. B. Anderson Company, electrical contractor and engineer, of Passaic. The incorporators are: Reginald B. Anderson and H. Anderson, Zabriskie A. Van Houten and A. G. Van Houten. The capital of the concern is $15,000, and the business will be conducted from Mr. Anderson's present quarters in the People's Bank Building.

NEW PUBLICATIONS.

A NEW POTENTIOMETER—A recent paper on "A New Potentiometer for the Measurement of Electromotive Force and Current," contributed to the *Bulletin of the Bureau of Standards* by H. B. Brooks, has been reprinted in pamphlet form. This describes a new design of potentiometer which is thought to have some useful advantages for certain kinds of work.

THE ELECTRICAL PLANT OF THE ONTARIO POWER COMPANY—The Ontario Power Company, Niagara Falls, Ontario, has published, in handsome pamphlet form, the paper entitled "The Electrical Plant of the Ontario Power Company," by V. G. Converse, which was presented at the sixteenth annual convention of the Canadian Electrical Association at Niagara Falls, Ontario, June 19, 1906.

ELECTRICAL SECURITIES.

As compared with a week ago the active list of industrials shows an improvement, with considerable advances in some cases. Despite this advance, however, traders generally are viewing things from a bearish standpoint, and it is expected that until after the general elections there will be but little change either way. It is hoped that by that time there will also be a loosening of money, so that a number of important deals which are about to be launched may have the assistance of an easier money market.

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 27.

New York:	*Closing.*
Allis-Chalmers common	17⅛
Allis-Chalmers preferred	44¾
Brooklyn Rapid Transit	78⅝
Consolidated Gas	138½
General Electric	173½
Interborough-Metropolitan common	36⅝
Interborough-Metropolitan preferred	76¼
Kings County Electric	155
Mackay Companies (Postal Telegraph and Cables) common	70
Mackay Companies (Postal Telegraph and Cables) preferred	69
Manhattan Elevated	142
Metropolitan Street Railway	104
New York & New Jersey Telephone	124
Western Union	86
Westinghouse Manufacturing Company	156

Directors of the Consolidated Gas Company have declared the regular dividend of 1 per cent. The dividend is payable December 15. Books close November 26 and reopen December 17.

Notwithstanding the entrance into its comparatively dull season, earnings of the Brooklyn Rapid Transit system continue to show substantial gains over those of last year.

Boston:	*Closing.*
American Telephone and Telegraph	137½
Edison Electric Illuminating	233
Massachusetts Electric	69
New England Telephone	129
Western Telephone and Telegraph preferred.	80

Directors of the New England Telephone and Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable November 15. Books closed October 31 and will reopen November 15.

Coupons from the five-per-cent three-year gold coupon notes of the American Telephone and Telegraph Company, by their terms payable on November 1, 1906, at the office of the treasurer in the city of New York, or, at the holder's option, at the office of the treasurer in the city of Boston, will be paid in New York by the Manhattan Trust Company, 20 Wall street, or in Boston by the National Bank of Commerce, Sears Building.

Philadelphia:	*Closing.*
Electric Company of America	11¾
Electric Storage Battery common	71
Electric Storage Battery preferred	71
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	27⅞
United Gas Improvement	91⅛

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	148
Metropolitan Elevated preferred	66½
National Carbon common	87
National Carbon preferred	119
Union Traction common	—
Union Traction preferred	—

Digitized by Google

PERSONAL MENTION.

MR. F. BISSELL, president of the F. Bissell Company, Toledo, Ohio, was a New York visitor last week.

MR. F. M. HENCKEL, of the Bryan-Marsh Company, Chicago, Ill., reports a new heir to the "House of Henckel."

MR. L. P. SAWYER, manager of the Buckeye Electric Company, Cleveland, Ohio, was a New York visitor last week.

MR. CHARLES PHILLIPS HILL, of the Doubleday-Hill Electric Company, Pittsburg, Pa., was a New York visitor last week.

MR. R. K. MICKEY, president of the Novelty Incandescent Lamp Company, Emporium, Pa., spent several days at the Imperial Hotel, New York city, during the last week. Mr. Mickey was accompanied by Mrs. Mickey.

MR. JAMES JARDINE, of Sacramento, Cal., has been appointed master mechanic of the Northern Electric Railroad Company, with headquarters at Chico, Cal. Mr. Jardine was formerly government inspector at the Union Iron Works, San Francisco.

MR. JOHN E. McGIVNEY, purchasing agent of the New Orleans Railway and Light Company, who attended the street railway convention at Columbus, Ohio, spent several days in New York and Boston before returning to New Orleans. His new friends in both cities were very glad to welcome him.

AMONG other New York visitors last week were John W. Brooks, sales manager of Pass & Seymour, Syracuse, New York; William Robertson, president of the Robertson Electric Company, Buffalo, N. Y., accompanied by Mrs. Robertson, and J. M. S. Fullman, manager Steel City Electric Company, of Pittsburg, Pa.

MR. E. J. KULAS, secretary and manager of the Brilliant Electric Company, and vice-president of the A. & W. Electric Sign Company, was a visitor to New York city last week. Mr. Kulas reports a very heavy demand for the new high-efficiency lamps which this company is making and expects the busy season to last for some time.

MR. F. R. M. EVANS has been appointed special representative on tantalum, "Gem Meridian," "Gem" high-efficiency and "Gem" standard lamps for the Buckeye Electric Company, Cleveland, Ohio. Mr. Evans has had a unique technical experience in laboratory and research work on these lamps, and his engineering ability will be of great value to him in the sales organization of this company.

MR. MARSDEN J. PERRY, president and general manager of the Narragansett Electric Lighting Company, Providence, R. I., and past-president of the National Electric Light Association and one of the most prominent central station managers in the country, was a visitor to New York city last week. Mr. Perry was in his usual good spirits and was kept busy looking up old acquaintances.

MR. R. C. MARDEN has been appointed district superintendent of the Fitchburg (Mass.) district of the New England Telephone and Telegraph Company. Mr. Marden entered the New England Company's service as night operator at Claremont, N. H., in 1894. The three years following he was engaged in operating, inspection and line work and then became chief clerk and cashier of the company's northern division, with headquarters at Burlington, Vt. From Burlington Mr. Marden was transferred to Lowell, Mass., where for the past six years he has been chief clerk.

MR. JOHN W. DAVIS, who has been manager of the offices of the Western Union Telegraph Company and the Pacific Express Company at Independence, Mo., for about twenty-seven years, and also of the Bell Telephone Company since its establishment in Independence, has sent in his resignation to the telegraph and express companies. He does this in order to devote his entire time to the Missouri & Kansas telephone system. Mr. Davis has charge of the business of this company between Kansas City and Odessa. Mr. Davis first came to Independence in 1879 as night operator for the Chicago & Alton Railway, which had just been built through the city.

MR. C. W. HUTTON, formerly superintendent of the electric department of the Sacramento Electric, Gas and Railway Company, has been made superintendent of the Sacramento division of the California Gas and Electric Corporation, with headquarters at Sacramento, Cal. He will have jurisdiction over the Alta, Auburn and Newcastle power-houses and the substations and transmission lines of the Central California Electric Company, the Folsom power-house, the transmission lines and the Sacramento substation of the Sacramento Electric, Gas and Railway Company, and a portion of the Bay Counties Power Companies' transmission lines and substations between Davis and Lincoln. C. R. Gill, formerly Mr. Hutton's assistant in the handling of the Sacramento electric department, is promoted to the position of superintendent of electric distribution, and will have charge of all of the distributing lines of the company in the city of Sacramento. Mr. Hutton will act in an advisory capacity in connection with the distribution.

MR. C. A. S. HOWLETT, formerly a contracting engineer for the Western Electric Company, Chicago, Ill., has been appointed manager of the power-apparatus sales department of the Chicago office, succeeding Alfred McEwen, resigned. Mr. Howlett is well-known in the electrical engineering field in the Middle West. His technical training was obtained at the Lawrence Scientific School, Harvard University. After graduation he obtained a practical experience in the Lynn shops of the General Electric Company, later entering actively into commercial engineering work. He is a member of the American Institute of Electrical Engineers, the Western Society of Engineers, the Illuminating Engineering Society, is chairman of the General Advancement Committee of the Electrical Salesmen's Association, and secretary of the Chicago division of the Rejuvenated Sons of Jove.

MR. JOSEPH B. BAKER has been appointed technical editor of the government fuel testing plant, with headquarters at St. Louis, Mo. Mr. Baker for the past two and one-half years has been a technical writer under M. P. Rice, manager of the publication bureau of the General Electric Company, at Schenectady, N. Y. He may be considered as one of the best endowed of technical writers, as his skill is the result of fifteen years of practical engineering work, the contributing of numerous articles to the technical and daily press, as well as the teaching of classes in electricity and delivering lectures on special subjects at the Massachusetts Institute of Technology and at Harvard and Union Universities. His engineering training has been a broad one, comprising experience in the installation of electric light plants, experimental work, general telephone engineering, machine design and consulting engineering. This training, crowned by the technical publicity work which Mr. Baker has been doing for the General Electric Company, thoroughly equips him for similar work for the United States government.

TELEPHONE AND TELEGRAPH.

SPRINGFIELD, MASS.—A telephone line has been completed in Cheshire.

LINDSAY, ONTARIO—The Lindsay town council has passed a by-law granting a twenty-one-year franchise to the Canadian Machine Telephone Company, of Toronto.

NEW LONDON, CT.—Considerable new conduit work for the underground cables of the Southern New England Telephone Company will be undertaken in New London this fall. A new exchange has been opened in Colchester. This will give the Southern New England a total of 534 exchanges in Connecticut.

TRAVERSE CITY, MICH.—The farmers on the peninsula have organized a telephone company and already have five miles of line in service. The whole of the peninsula is included in the territory, and the line is connected with the Michigan State Telephone Company. The officers are as follows: president, H. E. DeGraw; secretary and treasurer, P. F. Lardie.

AUGUSTA, ME.—The Maine Telephone Company, which recently purchased the Crosby lines, has rebuilt many of the old lines and has also built new ones in this vicinity. The long-distance service now furnished is excellent. The Mount Vernon Telephone Company, a local company which was organized last year, has also been extending its lines, and now has 230 subscribers in Mount Vernon and vicinity.

LOS ANGELES, CAL.—Extensive local improvements are being planned by the Sunset Telephone Company. Arrangements are being made to string many miles of new wire and increase the switchboard capacity at both the central and branch offices. Work on the enlargement of the system will probably begin in the near future. Although no figures have been mentioned it is thought fully $1,000,000 will be expended. The company now has about 29,000 subscribers. A new fireproof building is being erected on Boyle Heights in which a switchboard will be placed to facilitate the service to that part of the city.

Digitized by Google

ELECTRIC RAILWAYS.

PROVIDENCE, R. I.—The Old Colony Street Railway Company's new through service between Providence and Boston has been inaugurated.

DANBURY, CT.—The Danbury & Bethel Street Railway Company has begun the work of laying tracks for a two-mile extension of the local street railway system.

TAYLORVILLE, ILL.—The city council of Taylorville has decided to grant the Springfield-Pana Interurban Company a franchise through the city, with concessions which are to be arranged later.

ALBANY, N. Y.—It is stated that the deal for the transfer of the control of the United Traction Company, of Albany, to the Delaware & Hudson Company has been closed by the turning over of forty shares of stock to the latter.

COLUMBUS, IND.—Negotiations have been closed by the Columbus Street Railway and Light Company for the building of a new power plant south of the city, which, with its equipment, will cost $100,000.

EAST DOUGLAS, MASS. — The selectmen of Douglas have signed the grant that gives the Worcester & Providence Street Railway Company the right to build a double-track road in the village of East Douglas.

SAN FRANCISCO, CAL.—The Peninsula Railway Company has begun the work of constructing its line from Mayfield to Los Gatos, and it is believed that the road will be ready for business within eight months.

DETROIT, MICH.—Work on the Windsor & Tecumseh electric railway, the franchises and rights of way of which recently passed into the hands of the Detroit United Railways, will be commenced in a short time by the new owner.

BEAUMONT, TEX. — The construction of an electric railway between Beaumont and Port Arthur *via* Spindle Top, Port Neches and Nederland is now assured, a franchise having been granted the promoters of the road by the county commissioners' court.

HOLLIDAYSBURG, PA.—Arrangements have been made for building the Johnstown, Ebensburg & Northern Electric Railway. The first division from Johnstown to Ebensburg, twenty-five miles long, will be built at a cost of $500,000 by the Endelbel Construction Company, of New York. The road, it is reported, will later be extended to Hollidaysburg and Altoona.

DOYLESTOWN, PA.—The Newtown Electric Street Railway Company, which controls the road between Doylestown and Newtown, reorganized by electing Thomas P. Chambers president, and Alexander Chambers, A. W. Watson, George C. Worstall, T. S. Enderdine, E. H. Buckman, all of Newtown, and H. E. Woodman, of Philadelphia, directors.

SYRACUSE, N. Y.—Announcement is made that the contract for grading the proposed extension of the Syracuse, Lake Shore & Northern Electric road from Baldwinsville to Fulton, a distance of fifteen miles, including the foundations for the bridges, has been awarded by the Beebe syndicate of electric roads to the firm of C. E. & J. S. Kaulbach, of Phœnix.

WATERBURY, CT.—At a recent meeting of the directors of the Woodbury & Waterbury Street Railway Company it was decided to build the new trolley line to Lake Quassapaug as soon as possible. At the same meeting it was decided to merge the Woodbury & Waterbury company and the Seymour & Woodbury company and to operate them under one management.

MONMOUTH, ILL.—At a meeting of the Rock Island Southern interurban officials and St. Louis and New York capitalists, one and a quarter million dollars was secured to extend the line from Monmouth to Rock Island. Surveying parties will commence work at once and the route be determined. Contracts for construction also will be let and the line completed within a year.

FARMINGTON, MO. — The St. Francois County Court has granted franchises to two electric railroads, which propose to give the lead belt an outlet to St. Louis. The railway companies are the St. Louis, Montesano & Southern, of which Charles A. Gutke, of St. Louis, is president, and the St. Louis & Southeastern, of which O. M. Munroe, of De Soto, is president. The former company is capitalized at $4,000,000, and the Southeastern at $250,000.

ALBANY, N. Y.—Paul Smith's Electric Light and Power and Railroad Company has asked the state commission on gas and electricity for permission to issue $5,000 of bonds and to increase its capital from $75,000 to $100,000. The funds are needed to complete the company's railroad. The Saranac Lake Light, Heat and Power Company has requested permission to sell its property and franchise to the Paul Smith's company.

WAYNESVILLE, MO.—J. J. Burns, of St. Louis, is organizing a stock company to build an electric road connecting Waynesville with the 'Frisco system at Crocker. He proposes to organize, with a capital stock of $15,000 per mile, the citizens to purchase $20,000 stock; the remainder will be bought by eastern capitalists. This road will eventually be built from Eldon to Mountain Grove, Mo., and will furnish transportation facilities for the most fertile region of the Ozarks.

ROMNEY, W. VA.—The Petersburg district in Grant county and the South Fork and Moorefield districts in Hardy county will vote at the regular election in November on the proposition to subscribe for $20,000 worth of the bonds of the proposed Hampshire Southern Railway Company, which proposes to build a line from Romney to Petersburg, the line for which has already been laid out. It is also proposed to exempt the bonds from interest payment for a period of ten years, in order to encourage the new road.

NEW HAVEN, CT.—The Connecticut Railway and Lighting Company will at once begin the work of connecting its trolley line, which is now being built down the eastern side of the Naugatuck river, from Naugatuck to Seymour, with the present tracks of the Connecticut Railway and Lighting Company at the south. When this work is completed, which will be in good season next year, the Connecticut Railway and Lighting Company will have uninterrupted trolley lines from Waterbury to Bridgeport and thence to beyond Stamford on the southwest, paralleling the steam lines of the New York, New Haven & Hartford Railroad Company.

WILKESBARRE, PA.—At a meeting of the officials of the Wilkesbarre & Wyoming Valley Traction Company it was decided to apply to the court for the privilege to construct two new lines. One of the lines will be known as the Pittston & Avoca Street Railway Company and will operate between the two towns, passing through Hughestown. The other road will start from the present terminus of the East End line and will extend through Parsons, Miners Mills and Hudson, connecting with the present Plains line at Miners Mills. This will be known as the Wilkesbarre & Plains Railway Company. An extension will also be made to the Sugar Notch and Georgetown lines as soon as the new road is completed. The new improvements will cost over $500,000.

LIMA, OHIO—The building of the trolley link between Sandusky and Fremont is being rapidly pushed forward by the Lake Shore Electric, and the Western Ohio has entered into contracts for the construction, early in the spring, of the connecting link between Fremont and Fostoria, which, when completed, will parallel the Lake Erie & Western road from Celina to Sandusky. The Schoepf-Morgan branch, known as the Indiana Union Traction Company, has made complete surveys for the building of a link between Celina and Portland, Ind., in the spring. By this road this city will have an air line by trolley to Indianapolis, also Toledo and Detroit. With the Fremont-Fostoria link, Cleveland and Lima will be given through trolley service, there being no direct steam line from Lima or northwestern Ohio.

TOLEDO, OHIO—Arrangements have been completed by the Toledo & Indiana Railway Company for the extension of its lines westward from Bryan, which will fill the last gap in the continuous system of trolley lines between Chicago and Erie, Pa. It is expected the gap, which extends from Bryan to Waterloo, a distance of twenty-five miles, will be closed by the new trolley by the end of 1907, making a continuous line from Toledo to Chicago. From Toledo eastward there is a chain of trolley roads, including the Lake Shore Electric to Cleveland, and the Cleveland, Painesville & Eastern, from Cleveland to Erie, Pa. A new line is now being constructed from Erie to Buffalo. When this line and the line between Bryan and Waterloo are completed, a continuous trolley system will exist between Buffalo and Chicago.

Digitized by Google

ELECTRIC LIGHTING.

OTSEGO, N. Y.—A franchise has been granted for an electric lighting system.

PROVO, UTAH—The citizens of Provo have voted against the proposition to buy the electric light plant.

ST. CHARLES, MO.—It has been decided by the city council to buy new equipment for the electric light system.

ST. JOHNSVILLE, N. Y.—At a meeting of the village board a franchise was granted to the Hudson River Electric Power Company.

ST. AUGUSTINE, FLA.—The South Beach Bridge and Railway plant has been transferred to the St. Johns Light and Power Company.

NIAGARA FALLS, N. Y.—The Niagara, Lockport & Ontario Power Company has been granted a power franchise to do business in Lancaster.

LOS ANGELES, CAL.—Los Angeles capitalists are said to be behind a new scheme for a power plant in Fresno county, on which they propose to expend $200,000.

GUTHRIE, OKLA.—Reynolds & Tucker, of Tulsa, have been granted a franchise to put in a $20,000 electric light plant at Sapulpa, and work on it will begin soon.

LOS ANGELES, CAL.—The city council and the board of public works have agreed to install 200 new street lights, one-half that number in January next and the balance during the spring months.

PORTLAND, ME.—The Portland General Electric Company is completing its new power and distributing station on Knott street. It is 100 by 50 feet, and with its machinery will cost upward of $40,000.

GREELEY, COL.—Tax payers have voted by a large majority in favor of granting the Greeley Gas and Electric Company a franchise. The company will now issue bonds, enlarge its plant and build a new power-house. About $40,000 will be expended.

ELYRIA, OHIO—The city council has granted to the Elyria Milling and Power Company a franchise to use the streets and alleys of the city for the purpose of erecting poles, stringing wires and the operation of an electric lighting plant in Greater Elyria.

FREDERICKSBURG, VA.—The Fredericksburg Water Power Company, owned by Joseph F. Swift, of Wilmington, Del., has been sold to a party of capitalists, represented by W. C. Whitney, of Rock Hill, S. C. The price is said to have been $125,000.

BOSTON, MASS.—The Pittsfield Electric Company has petitioned the gas commissioners to increase its capital stock from $150,000 to $225,000 and its bonded debt from $100,000 to $150,000. The proceeds are to be applied to the completion of a new power-plant and other additions.

BLACKSBURG, VA.—The Blacksburg Power and Supply Company has placed an order for the first instalment of machinery for its plant. This company was organized in September, with D. H. Keister, president; J. F. Evans, vice-president; M. F. Slusser, secretary and treasurer.

COBOURG, ONTARIO—A special meeting of shareholders for reorganization of the Northumberland-Durham Power Company was held recently. Twenty-one directors were elected from Cobourg, Port Hope, Colbourne, Campbellford and Belleville. J. A. Culverwell was elected president.

SALEM, OHIO—The Ford Lighting Company, now located in Elyria, has been purchased by a newly incorporated company of local business men and will be transferred to Salem in the near future. The new company is incorporated with a capital of $30,000, all the stock being held in Salem.

PEABODY, MASS.—The lighting committee appointed to investigate the municipal electric lighting plant problem has returned its report, which will be brought before the town at its next meeting. The committee comes to no definite conclusion, but rather favors the purchasing of current in preference to rebuilding the town plant. The committee fully endorses the report of the Electrical Auditing Company, Boston, Mass., which suggests the alternative proposition of either manufacturing or purchasing current. This report made a close analysis of the situation and pointed out the conditions under which the town might profitably purchase its current from a private corporation.

BRIDGEHAMPTON, N. Y.—The Babylon Electric Light Company is contemplating installing an all-day service, having facilities for power as well as lights. The capital stock of the company will be increased from $15,000 to $75,000. A modern fireproof building is to be erected to accommodate the new plant.

ASHTABULA, OHIO—The Merchants' Lighting Company has been incorporated for the purpose of establishing in this city a new electric light plant. The project is due to the inability of the present municipal plant to supply the demand for lighting, and to the refusal of the council to make needed additions. The movement is supported by the merchants of the city, and has ample financial backing.

SYRACUSE, N. Y.—The Niagara, Lockport & Ontario Power Company, which furnishes electricity for the running of the cars of the Syracuse Rapid Transit Company, has completed its duplicate line nearly to Rochester, and will continue work until it reaches the city line at Syracuse. This system, it is expected, will enable the company to deliver power without interruption, which it has not been able to do up to the present time.

WILKESBARRE, PA.—A meeting of the stockholders of the American Electric Light Company and the American Gas Light Company, of Bloomsburg, has been held and the companies merged into one. Officers were then elected as follows: president, E. B. Tustin; vice-president, J. B. Russell; secretary and treasurer, A. W. Duy. The above and P. R. Bevan and G. W. Reynolds, of Wilkesbarre, and H. S. Barton, of Bloomsburg, were elected as directors. A name for the new company will be decided on later.

ESSEX JUNCTION, VT.—A deal has been closed whereby the extensive water power on the Winooski river at Essex Junction has been sold to the Consolidated Electric Company, of which F. H. Parker, of Burlington, is superintendent. This deal includes the Hunter, Shiland and Johnson dam, the water power owned by C. W. and S. A. Brownell, the grist mill and creamery owned by W. B. Johnson & Company and the sawmill owned by S. A. Brownell. This power will be developed at an estimated cost of $250,000.

WESTERVILLE, OHIO—After defeating municipal ownership last year, Westerville has reconsidered it, and by a majority vote passed a proposition to issue $12,000 in bonds for the purpose of purchasing the franchise and plant of the Westerville Electric Company. The plant will be enlarged and improved for the purpose of supplying electric lights to the corporation and inhabitants. The question of municipal ownership has been agitated for some time, and prior to the voting, a mass meeting was held, at which the matter was thoroughly discussed.

SUMAS, WASH.—Representatives of the Stave River Power Company have been looking over the country with a view of extending a power line at Sumas and to Kendall to furnish power for the cement plant to be started by the Coleman-Evans interests. The plant of the company has a capacity of 45,000 horse-power, and lines are being extended all over British Columbia for the purpose of furnishing power and light. The company also proposes to build an electric line from Vancouver to Sumas Prairie and Chilliwack, and will touch the boundary line at Sumas.

ONEIDA, N. Y.—It is said that a deal has been consummated whereby the stock of the Madison County Gas and Electric Company, of Oneida, has become the property of the Hudson River Electric Power Company, one of whose interests is the Empire State Power Company, which has the contract for lighting the city of Oneida for a term of five years from January 1. By the terms of the sale it is understood that the Empire State Power Company assumes and will use the lines and lamps of the Madison county company, so far as is practicable, in the fulfillment of the contract. The franchise for commercial business, owned by the Madison County Gas and Electric Company, also becomes the property of the Hudson River Electric Power Company, and under its provisions the Empire State Power Company will do a commercial business in the city.

Digitized by Google

INDUSTRIAL ITEMS.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., has ready for distribution discount sheet No. 848. This sheet will be sent to any one interested upon request.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING COMPANY, Yonkers, N. Y., has ready for distribution a new discount sheet on Habirshaw wires and cables.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, is mailing a striking folder entitled "A Pair of Crooks." This calls attention to the perfect alignment of "Columbia" carbons.

THE SARCO COMPANY, 906 Sixth avenue, New York city, has designed a neat little booklet calling attention to the Sarco Key arm-switch. This booklet will be sent to any one interested upon request.

THE A. & W. ELECTRIC SIGN COMPANY, Cleveland, Ohio, has been incorporated under the laws of the state of Ohio for $25,000. The following officers have been elected: H. J. Walzer, president and treasurer; E. J. Kulas, vice-president, and William Knapp, secretary.

THE AMERICAN INSTRUMENT COMPANY, Philadelphia, Pa., has arranged for a representation in Chicago, Ill., with A. B. Weeks in charge. Arrangements for representation on the Pacific coast have also been made with the Holabird-Reynolds Electric Company, San Francisco and Los Angeles.

M. W. DUNTON & COMPANY, Providence, R. I., are mailing to those interested a folder containing samples of "Red Rope" paper, showing the sizes which are carried in stock for insulating purposes. The firm carries a large stock of this paper constantly on hand in different widths and thicknesses.

THE GERMANIA ELECTRIC LAMP COMPANY, Harrison, N. J., owing to the great increase in orders, removed on November 1 to larger quarters at 420-422 Ogden avenue, Newark, N. J. The company manufactures Germania standard and reflector lamps. It will retain its New York office at 120 Liberty street.

THE SOLAR ELECTRIC COMPANY, Chicago, Ill., entertained Sir Thomas Lipton at the recent advertising show at Chicago, Ill. Sir Thomas expressed himself as very much impressed by the decorative advertising lamps made by this company, and gave an order for a large number of the Canteen globes to advertise Lipton's tea in all parts of the world.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has ready for distribution bulletins No. 1,082, No. 1,083, No. 1,084 and No. 1,085, describing and illustrating, respectively, multiple alternating-current street arc-lighting system, types MA and M induction motors, standard switchboard panels for multiphase generators, and integrating switchboard wattmeters.

THE GOULD STORAGE BATTERY COMPANY, New York city, made an interesting exhibit at the recent appliance exhibition of the American Street and Interurban Railway Manufacturers' Association at Columbus, Ohio. Several single cells for railroad and lighting work were shown, as well as a number of very interesting photographs of Gould installations. The company was represented by R. H. Watson, Chicago; T. Milton, Chicago; H. W. Powers and John Eipper.

THE DETROIT INSULATED WIRE COMPANY, Detroit, Mich., has well under construction a large building which will be equipped as rapidly as possible for the manufacture of rubber-covered wire and cables, lead-covered cables, weatherproof wire and flexible cords. The officers of the company are E. E. Keller, president of the Westinghouse Machine Company, president; J. H. Hunter, of the National Cable and Wire Company, vice-president, and Arthur Hartwell, secretary and treasurer.

THE NATIONAL METAL MOLDING COMPANY, Pittsburg, Pa., has purchased the entire assets, good will, etc., of the Osburn Flexible Conduit Company, and will hereafter control the manufacture and sale of "Flexduct." In order to better serve the interests of customers, all business pertaining to "Flexduct," flexible conduit and "Economy" rigid conduit will be conducted from the headquarters of the company at Pittsburg. C. E. Corrigan, vice-president of the company, will hereafter be located at the general offices in the Fulton Building, Pittsburg, Pa.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is calling attention to its universal portable. This portable combines the desirable features of an adjustable portable, and is light in weight, strong, durable and ornamental. When not in use it may be folded into a small space. There are no screws nor nuts used to tighten the apparatus, and the solid cast base, weighing five and one-half pounds, is heavy enough to keep the portable from being easily overturned. The bottom of the base is felt-covered, so that it will not mar nor injure a polished desk.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has published the tenth edition of "Graphite as a Lubricant." The subject of lubrication in general, and graphite lubrication in particular, are exhaustively treated. In addition to the good features of the previous editions the latest information, both scientific and practical, that has to do with the subject, is added, making the booklet very valuable. This work is arranged and indexed so as to readily enable the reader to find the information he is most interested in. The company will be pleased to send copies of the booklet upon request.

THE GREEN FUEL ECONOMIZER COMPANY, Watteawan, N. Y., is building two induced draught fans of exceptional dimensions for the power station of the East St. Louis & Suburban Railway Company. The wheels of the fan, which are overhung, measure nineteen feet six inches in diameter, and are seven feet wide at the tips of the blades. These are believed to be the largest overhung induced draught wheels ever built. They will be driven by Corliss engines, and will be carried on ten-inch steel shafts. They have specially designed two-part spool hubs, which occupy comparatively little space on the shaft, and permit the bearings to be set in close to the centres of gravity of the wheels. Each water-cooled bearing weighs over a ton.

Record of Electrical Patents.

Week of October 16.

833,733. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed December 23, 1902. Makes use of a consequent-pole, electromagnet device for controlling the call bells.

833,741. ELECTROMAGNET. Hans H. Hansen, Chicago, Ill. Filed May 1, 1905. A magnet suitable for call bells provided with two circuits for carrying dephased currents.

833,745. TELEPHONE TRANSMITTER-ARMS. John A. Loff, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed December 6, 1901. A method of constructing a pivoted arm.

833,760. REGULATING APPARATUS. Elmer A. Sperry, Cleveland, Ohio, assignor to the Safety Car Heating and Lighting Company. Filed June 6, 1905. A dynamo provided with two commutators, two sets of brushes and means for automatically bringing into action either set.

833,765. SIGNAL SYSTEM FOR RAILWAYS. Maximillian G. Voigtlander, Harrison, Ohio, assignor of one-third to Owen W. Grubbs, Harrison, Ohio, and one-third to Abraham L. Weeks, Harrison, Ind. Filed November 14, 1904. An automatic block system, one rail being continuous.

833,778. FASTENING DEVICE FOR SWITCHBOARD CONNECTING-CORDS. Edward B. Craft, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. Filed December 7, 1904. Provides hooks for supporting the telephone-cord terminals.

833,781. SIGHTING-MACHINE. Bradley A. Fiske, U. S. Navy. Filed January 2, 1904. A target device for training gunners.

Digitized by Google

833,805. ELECTRICAL SELECTING APPLIANCE. Charles E. Scribner, Jericho, Vt., assignor to Western Electric Company, Chicago, Ill. Filed December 18, 1905. A spring-actuated calling device.

833,816. TELEPHONE-CIRCUIT SIGNALING APPARATUS. James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill., assignors to American Telephone and Telegraph Company. Filed July 3, 1905. Employs an electromagnetic pole-changing switch for actuating the signals.

833,817. TELEPHONE SWITCHING AND SIGNALING APPARATUS. James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill., assignors to American Telephone and Telegraph Company. Original application filed July 3, 1905. Divided and this application filed March 12, 1906. A four-party-line system employing plus and minus bells.

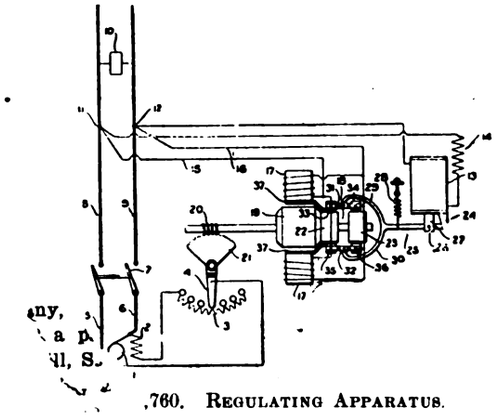
833,866. TELEPHONE SYSTEM. Charles V. Beaver, Anita, Iowa. Filed August 19, 1904. An intercommunicating telephone system which operates by various groupings of a limited number of wires.

833,870. UNDERGROUND CONDUIT. Horace B. Camp, Akron, Ohio. Filed October 3, 1905. A number of hollow members are surrounded by a reenforced cement body.

833,877. INSULATOR. Francis J. Grant, Chicago, Ill. Filed August 12, 1905. Has two arms set at an angle with each other.

833,906. TELEPHONE SWITCHING AND BUSY-TEST APPARATUS. James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill., assignors to American Telephone and Telegraph Company. Filed July 3, 1905. Makes use of a series of relays connecting for two central stations together.

833,907. SIGNALING APPARATUS FOR TELEPHONE TOLL LINES. James G. Wray, Chicago; Herbert T. Gardner, Maywood, and William G. Kinton, Chicago, Ill., assignors to American Telephone and Telegraph Company. Filed July 3, 1905. Provides a supervisory signal at the called central station.



,760. REGULATING APPARATUS.

833,929. HU NG APPARATUS. Charles W. Hunt, New York, N. Y. Filed February 7, 1906. Two drums are driven by independent motors.

833,968. ALTERNATING-CURRENT CONTROLLER. David Larson, Yonkers, N. Y. Filed September 28, 1905. Controls automatically the acceleration of the motor by means of two actuators placed one in series and one in shunt.

834,010. ELECTRICAL CONTROLLER. David Larson, Yonkers, N. Y. Filed November 4, 1905. A current controller for a constant voltage system, the controller being a motor with two opposed windings.

834,054. SPARK-GAP AND MUFFLER THEREFOR. Aaron E. Harrison, New York, N. Y., and Crowell M. Haslett, Jersey City, N. J. Filed September 26, 1905. The spark-gap is enclosed in a chamber provided with an outlet to a second muffling chamber.

834,084. HIGH-POTENTIAL INSULATOR. Louis Steinberger, New York, N. Y. Filed March 24, 1905. The insulator, consisting of a number of hoods engaging each other, is supported on a soft rubber bushing.

834,098. ALTERNATING-CURRENT MOTOR. Charles A. Ablett, Schenectady, N. Y., assignor to General Electric Company. Filed July 30, 1903. A motor of the induction commutator type.

834,100. OVERHEAD TROLLEY SYSTEM. Charles E. Barry, Schenectady, N. Y., assignor to General Electric Company. Filed May 1, 1905. The overhead conductors are supported at the side of the road, means being provided for changing automatically from one side to the other.

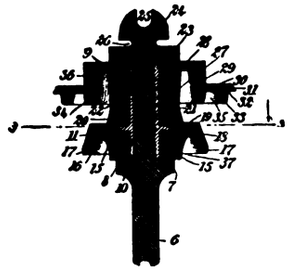
834,104. TELEPHONE BRACKET. Charles H. Borden, Stamford, Ct. Filed August 29, 1905. An adjustable bracket having a parallel movement.

834,128. ELECTRIC SWITCH. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Company. Filed February 1, 1906. A number of independently movable switches are employed, and means for automatically breaking the circuit if they be closed out of a predetermined order.

834,129. BLOCK SIGNAL SYSTEM. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Company. Filed April 7, 1906. A train-actuated block signal system.

834,134. TROLLEY BASE. Henry Holland, Cleveland, Ohio. Filed August 5, 1905. The socket is provided with a double fulcrum rest.

834,147. AUTOMATIC MOTOR CONTROL. Sam H. Libby, East Orange, N. J., assignor to Sprague Electric Company. Filed May 21, 1904. The controlling resistance is cut out by a pilot motor.



834,084. HIGH-POTENTIAL INSULATOR.

834,148. TRANSFORMER. Charles E. Lord, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. Filed October 19, 1905. The air, after being forced through ventilating passageways in the core and coils, is passed through a cooler.

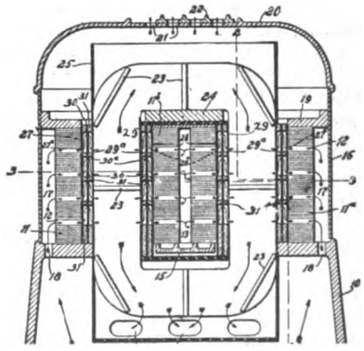
834,160. TRANSFORMER. Louis C. Nichols, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company Filed October 19, 1905. Passageways are arranged so that air passes through the coils in two different directions.

834,162. ELECTRICAL RESISTANCE PYROMETRY. Edwin F. Northrup, Philadelphia, Pa., assignor to the Leeds & Northrup Company, Philadelphia, Pa. Filed June 16, 1906. Employs a low-resistance element.

834,172. VAPOR ELECTRIC APPARATUS. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. Filed July 1, 1904. One of the electrodes is of vaporizable material.

834,175. MAGNETIC ORE SEPARATOR AND CLASSIFIER. Guy H. Waring, Webb City, Mo. Filed November 16, 1905. A series of electromagnets is placed over an inclined trough of non-magnetizable material.

834,208. TELEPHONE SYSTEM. Charles Kenney and Robert H. Leather, Philadelphia, Pa. Filed April 25, 1904. An indicator is provided with means for connecting it in circuit with any one of the instruments.



834,160. TRANSFORMER.

834,220. METHOD OF MAKING COILS FOR ELECTRICAL APPARATUS. Edward L. Aiken, Schenectady, N. Y., assignor to General Electric Company. Original application filed December 5, 1898, patented February 10, 1903, No. 720,092. Divided and application filed January 31, 1901. Again divided and this application filed August 13, 1902. Flat helixes are wound and the turns separated by a spreader.

834,235. ELECTRIC SIGN. Anatole C. Heiny, New York, N. Y., assignor, by direct and mesne assignments, to Heiny Electric Company. Filed December 15, 1904. A plurality of panels is provided, each having incandescent lamps arranged in fixed groups.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 19. NEW YORK, SATURDAY, NOVEMBER 10, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW
CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING
BOSTON
NEW ENGLAND OFFICE, ... 95 MILK STREET
LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
Domestic Electricity 745
A New Method of Regulating Alternators 746
Useful or Useless Races 747
The Radio-Telegraphic Conference 747
Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw. 748
Second Annual Electrical Show at Chicago 751
Changes in the Personnel of the Engineering Staff of the New York Central & Hudson River Railroad 751
Adaptations of Electrically Driven Conveyers, by Day Allen Willey 752
Electric Lighting by Wind Power 753
The Rejuvenated Sons of Jove 753
English Electrical Notes 754
New York State Telephone Developments 755
A Combined Heating and Lighting System at Canton, Ohio, by R. W. Hutchinson, Jr 756
A Prayer to the Wiremen 758
Annual Report of the Western Union Telegraph Company 758
The Growth of the Westinghouse Interests 759
English Experiment of Shipping by Electric Wagons 760
Cooperative Electrical Development Association 760
Electrification of the West Jersey & Seashore Railroad—II 761
The Production of Platinum in 1905 765
Electric Railways in Sparsely Settled Communities (Concluded), by E. P. Roberts 766
Electrical Machinery Breakdowns 768
Berlin Street Lighting 769
The New Muspratt Laboratory of Physical and Electrochemistry at Liverpool University, by John B. C. Kershaw 770
The Alaskan-Yukon-Pacific Exposition of 1909 770
Handling Public Complaints, by John A. Beeler 771
An Electric Car Brake 773
New York Electrical Society 773
Exposition of Safety Devices 773
REVIEW OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 774
Report of the Alameda (Cal.) Municipal Light Plant 776
Results by Telephone 776
Electrically Lighted Railway Mail Cars 776
METHODS OF GETTING NEW BUSINESS 777
The Lighting of Railway Cars by Electricity 778
INDUSTRIAL SECTION:
Mechanical Time Recorders 779
Hydroelectric Contract for J. G. White & Company 779
A New Electric Blue-Printing Machine 779
American Ball Engines and Generators 780
The New Holophane Reflecting Arcs 780
Western Electric Belted Alternator 780
Allis-Chalmers Oil-Insulated Transformers 781
Electrical Equipment of a Modern Steam Laundry 783
Window Lighting 783
Illustrated Lectures on Illumination 783
CURRENT ELECTRICAL NEWS 784
DIRECTORY OF ELECTRICAL AND ALLIED ENGINEERING AND SCIENTIFIC SOCIETIES 790
RECORD OF ELECTRICAL PATENTS 791

Copyright, 1906, by Electrical Review Publishing Co.

DOMESTIC ELECTRICITY.

A valuable feature of the electrical appliances which have been devised to bring comfort to the housekeeper has been the convenience of the apparatus. The chafing-dish and the broiler are always ready for service, the electric iron is always hot and maintains a constant temperature, and, in fact, to bring any one of these little devices into service requires merely the turning of a switch. There is no doubt that this feature is a most important one. This readiness to serve, if it went with no other advantage, would be sufficient to overbalance a considerable disadvantage in the matter of first cost and cost of operation, if such exist.

But there is a feature of these electrical devices which, while recognized in a way, does not seem to have been given sufficient emphasis. This feature is very strikingly brought out by Mr. H. W. Hillman in the current issue of *Cassier's Magazine*. Mr. Hillman not only calls attention to the readiness-to-serve feature, but shows how this feature brings with it other and important advantages. An electric egg-boiler, for example, when supplied with a small quantity of water, produces steam in forty-five seconds, which, added to the three minutes required to boil the eggs, gives three minutes and forty-five seconds as the entire time in which the device is in use. When the eggs are boiled in the old way, it is customary to put on a quart or so of water over a gas burner or a coal stove and to allow five or ten minutes or more in order to bring the water to the proper temperature, so that the total operation requires three or four times as long as the new method, and at the same time is much more wasteful because of the large amount of water heated. The same system—that is, cooking by steam generated in an electric heater—may be applied in preparing other foods, for which purpose it is just as economical. Nearly all the heat developed by the electric heater is taken up by the water, and nearly all of this is utilized in preparing the food. There is almost no waste. This is a feature which is worthy of being dwelt upon more at length.

There is no doubt that a feeling exists among possible users of electrical household appliances that with all their advantages and conveniences they are too expensive for ordinary use because of the relatively high cost of a unit of heat when produced in this way. It is true, of course, that electrical energy is energy in an exalted form, which has been obtained only at considerable sacrifice and it must, therefore, be sold at figures which, per unit of heat produced, seem high. But the point brought out by Mr. Hillman leads one to wonder whether, after all, the system is not really a cheap and economical one. In the

Digitized by Google

ordinary operations of a kitchen range or gas stove the heat losses are enormous; in fact, they amount to nearly all of the heat developed, at least in the case of the coal stove. The matter seems to be a small one for each individual householder, but when it is remembered that the same wasteful method is going on in every house it is evident that the aggregate loss is considerable, and one well worthy of avoiding. The loss is due, of course, to the intermittent character of the work and to the badly designed apparatus for utilizing the heat. It would be interesting to compare, on a heat-efficiency basis, the performance of the coal stove, the gas range and the electric heater, starting, of course, with the coal pile and finishing with the heat actually delivered to the prepared food. It might be found that the electrical system, although it seems to be a roundabout way, is, after all, the least wasteful.

This feature is found also in other electrical appliances. They are always ready to work and are remarkably efficient. And it might even be found that for such purposes as heating a room for a short time in the morning and evening that an electric heater, even with energy at a few cents per kilowatt-hour, would cost less and give more comfort than a good type of coal furnace, for, in order to obtain heat from the latter for a short time in the morning and at night requires that it be kept going continuously. Mr. Hillman seems to think that this feature of electrical appliances—that is to say, the thermal efficiency with which they perform their operations—goes a long way towards making that operation no more expensive than if performed in any of the older ways; and the fact that he uses many electrical appliances throughout his house for cooking, lighting and even heating the rooms in spring and fall, and that his average monthly bill for electrical energy for the past two years has been only $6.69 at a price of five cents per kilowatt-hour, lends considerable force to his arguments.

So far the problem has been looked at from the point of the consumer only, but the desirableness of the load from the standpoint of the central station would doubtless lead the latter to make some inducement, and in this way build up a very economical load curve. One can not look for any startling development in this field, but it is a fact that the use of these appliances has increased during the past year or so much more rapidly than was anticipated, and there is every likelihood that it will go on increasing at a greater rate.

A NEW METHOD OF REGULATING ALTERNATORS.

A great many ways have been devised for controlling the performance of alternating-current generators so as to give either a constant voltage or one rising with an increase in the load. Practically all plans that have been tried for accomplishing the same purpose in direct-current design have been applied to alternators. With an alternating machine, however, the problem is, no doubt, more difficult, because the demagnetizing action of the armature depends upon two factors which are not necessarily related. An increase in the armature current sets up an increased demagnetizing force as does also an increase in the angular lag of the current with respect to the electromotive-force. Any perfect system of compounding or compensating an alternator for all loads must therefore provide for these two actions, and it is the difficulty of doing this that caused so many attempts at compounding alternators to fail.

The first plan of compounding an alternator which was naturally suggested was simply to add series turns to the alternator fields and supply these with rectified currents from the armature. The plan worked satisfactorily for purely lighting loads, but when alternating-current motors began to be used it no longer met the requirements. This led to various devices for meeting the new difficulty. The use of condensers and of over-excited synchronous motors to correct the power-factors of an inductive load was suggested and even tried, but never met with encouragement. One of the prettiest solutions is that due to Rice, in which advantage is taken of the shifting of the phase of the armature reaction of the alternator to compound an exciter mounted on the same shaft. Another plan was proposed by A. Heyland, which really developed from his method of winding induction motors so as to increase the power-factor.

Now Heyland has come forward with another plan which is very pretty in theory and which attacks the problem in a new way. Frequently it has been found, particularly in electrical engineering, that certain reactions which give a great deal of trouble at first can be so utilized as to correct the very trouble they cause. This is the case with the new method; as the increasing armature reaction, due either to an increase in the armature current or a change in its phase, is made to compound the exciter field, and thus avoid the decrease in electromotive-force which would otherwise result. This method is described in *L'Éclairage Électrique* (Paris) for October 20, and a brief abstract of the article appears on another page of this issue.

In brief, Mr. Heyland recognizes the two components of armature reaction, the cross-magnetizing and demagnetizing effects, and he utilizes the latter. This is done by turning off alternate pole faces of the alternator field so as to increase the air gaps and thus unbalance the magnetic system. The effect of the demagnetizing component of the armature reaction will then be to set up magnetic leakage, which, under these conditions, would tend to pass through the shaft of the alternator. If, upon this same shaft, the armature of the exciter be mounted, the leakage flux will tend to complete the circuit through the armature and field cores of the exciter and the frame of the alternator, provided no other path be offered. This would weaken one-half of the exciter poles as much as it strengthened the other, unless special provision were made to utilize it, which is done by turning off, as in the case of the alternator, the alternate poles of the exciter field, leaving a smaller air gap at those poles, which would be strengthened by the leakage flux. To prevent this difference in the air gap producing unbalanced electromotive-forces in the alternator, those poles having the longer air gap are provided with more turns in their exciting coils, so that when there is no armature reaction the flux through the different air gaps will be equal. The action of this arrangement is as follows: With the machine running unloaded the armature, of

Digitized by Google

course, has no effect, but as the load goes on the leakage flux set up by the reaction passes through the shaft and the exciter armature and fields in such a way as to strengthen them. This effect increases not only with the armature current, but with the angle of lag of an inductive load on the generator, since the demagnetizing components of such currents are greater. Some control over the amount of regulation can be made by controlling the field strength of the exciter, but the inventor of the method believes that when once adjusted it will take care of all load variations.

The method is not only very simple in that it calls for no additional circuits on either machine, but, as well, because it makes direct use of the very reaction which affects the regulation of the machine. Moreover, since it utilizes the magnetic forces it is applicable to generators and exciters having different numbers of poles; a feature which makes direct electrical compensation difficult. In the article referred to no account is given of any practical test of the system, so it is yet a question just how perfect the compounding will be; but since there are various methods of changing the degree of the effect, either by varying the relative lengths of the air gaps or by changing the relative magnetizations of the alternator and exciter, there seems to be no reason why a small cause at the alternator armature should not produce a considerable effect at the exciter fields. In fact, Heyland proposes adjusting the apparatus for half load, so that the variation in magnetization will be both up and down, and he expects to be able in this way, with a small total leakage flux, to over-compound his alternator to any desired extent.

USEFUL OR USELESS RACES.

Two recent events attracted world-wide interest. One was the Vanderbilt cup automobile race on Long Island, and the other was the balloon race starting from Paris and finishing in England. The contestants in both of these races were men of means or men well paid for doing what they did, and therefore no one should complain at what seems to be a waste of time and a useless risk of life. With respect to the automobile races, it may be said by the manufacturers that they assist in eliminating weak features and suggest means of improvement; yet the type of car best suited to an average speed of sixty miles an hour is not one that is best suited for ordinary conditions. It is probable that the advertising feature of the race is the one given the greatest consideration by those companies whose cars took part.

Regarding the balloon race, on the other hand, there is still less to recommend it. Few, if any, believe that the gas bag offers a solution of the problem of aerial navigation, and certainly there is little to be learned by casting oneself upon the mercy of the winds in such a contrivance. This much may be said for this great race, that those who took part in it did so as a matter of choice, and for the excitement which it furnished, and if they chose to take the risk of being dropped from the clouds or blown out to sea, they were free to do so. But it seems rather a pity that these contestants, and, in fact, most of those daring persons who are undertaking balloon flights, should waste their time and their efforts and their money in such useless ways. Why do they not turn their skill—such as it is—and their means, as well as their courage, into more useful channels? If they wish to go up in balloons why do they not seek some useful end at the same time? We know too little about the air to-day. Studies could very properly be made of air currents, air temperatures and electrical conditions which, if carefully carried out, would be of great scientific and practical importance. Such data as we have in this field have been gathered from a few isolated balloon ascensions and by means of a few kites, while if all those who now have balloons would turn their energies towards increasing this knowledge there is no doubt that they could very shortly increase our information greatly; and the satisfaction of knowing that they were conducting useful experiments would probably, in the end, be greater than that of being the lucky man whose balloon was blown the farthest.

THE RADIO-TELEGRAPHIC CONFERENCE.

The result of the recent international conference which met in Berlin to straighten out some of the tangles that have arisen from the growing use of wireless telegraphy—or, rather, radio-telegraphy, as we suppose we should say now, since this new designation was adopted by the conference—was, on the whole, rather successful. Although the rules adopted by the conference do not settle definitely the one question which has given rise to so much friction, they seem to indicate that there will be less trouble in this matter than heretofore, and that probably it will be settled satisfactorily within a few years. The matter which caused all this irritation was the practice of the Marconi Company of refusing to accept messages sent out from a station or vessel equipped with another company's system. The British post-office and admiralty are so bound up by their contracts with the Marconi Company that the British delegates were forced to make a strong fight against all rules looking to a general exchange of messages. In this they were backed by the Italian delegates, who were in the same position, as well as by those from France and Japan for a time. The final agreement was the adoption of a rule making inter-communication compulsory, but this was limited by making the rule a separate article, so that it becomes binding only upon those powers whose delegates sign it. It is interesting to note that during this conference the position taken by the British delegates was not in accord with the feelings expressed in the English technical papers, and although it was recognized that the contracts made between the British government departments and the Marconi Company have, no doubt, done a great deal in advancing the art, as, by means of them, stations were erected which, from a commercial standpoint, could not be expected to be profitable, still such expenditures must always be made in introducing any new art. Ordinarily this expense is borne by the company which originated the art, but in this case the importance of the new method of communication from a strategic point of view, and the little prospect of its becoming a profitable system within a few years, led to the arrangement which has caused so much ill feeling.

Digitized by Google

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW.

IX—The Chemical and Physical Characteristics of the Waste Gases —Sampling the Gases.

1. Chemical Characteristics—The burning of ordinary bituminous fuel in the furnaces of steam boilers is in reality a chemical oxidation of the hydrogen and carbon of the fuel, this oxidation being sufficiently intense to produce light and heat. When this oxidation or combustion of the fuel has been properly carried out, one obtains as products of the chemical changes only carbon dioxide and aqueous vapor; these two being diluted, however, with the nitrogen and unconsumed oxygen of the air. Sulphur dioxide gas is also generally present as an impurity derived from the sulphur in the coal. As already pointed out, it is this ingredient of the waste gases, and not the soot, which destroys vegetation and damages stonework in all great industrial centres where coal is burned on a large scale.

The chemical products of the perfect combustion of bituminous fuel in air are therefore: carbon dioxide, aqueous vapor and sulphur dioxide; with oxygen and nitrogen as diluent gases, derived from the air.

Should the combustion process have been improperly carried out, particles of unconsumed carbon and carbon monoxide gas will be present in the exit gases from the furnace of the boilers; while with very bad management, entirely unconsumed hydrocarbon gases may be found, in addition to those already named.

Semi-anthracite and anthracite fuels contain less hydrogen and, when heated, produce less hydrocarbon gases than bituminous coal. The waste gases from boiler furnaces fired with these classes of fuel as a rule therefore contain little soot or undecomposed hydrocarbons; but, on the other hand, the proportion of carbon monoxide may be high, owing to insufficiency of the air supply.

Coke also is a fuel which may produce large amounts of carbon monoxide when the management of the furnace and of the air supply is at fault. Sulphur dioxide is generally present in large amounts in the waste gases from furnaces fired by coke manufactured from cheap classes of fuel.

It may be pointed out here that, with coke and anthracite, the appearance of the waste gases gives no indication of the composition of the gas, and a clear and apparently satisfactory waste gas may contain large amounts of carbon monoxide and be associated with very bad conditions of combustion in the furnaces of the boiler.

Chemical tests of the exit gas are therefore required to discriminate between good and bad work with coke and anthracite.

When semi-anthracite or bituminous fuels are employed, insufficiency of air supply will cause, as before, carbon monoxide to be present in the exit gases, but in this case, owing to the larger amount of hydrocarbons liberated on heating the coal, smoke will be produced and will serve as a signal that the combustion of the fuel is incomplete.

With these cheaper and more generally employed classes of fuel a chemical examination of the waste gases therefore is not required to prove the existence of bad management of the furnaces and incomplete combustion. The freedom from smoke of the gases issuing from the chimney top is sufficient to indicate whether good or bad conditions exist within the furnaces.[1] It is somewhat depressing to have to state that although bituminous coal of all grades can be burned entirely without smoke production in the furnaces of steam boilers, in nine cases out of ten the correct conditions for perfect combustion are absent, with the result that soot and carbon monoxide, with unconsumed hydrocarbon gases, are allowed to escape in large quantities into the atmosphere.

2. Physical Characteristics—Temperature.—The temperature of the waste gases depends very largely upon the amount of excess air allowed to pass into the boiler furnaces, and upon the cleanliness of the boiler. A large excess of air causes a low initial temperature in the furnace, and a low heat transmission to the water in the boiler. With badly scaled boiler plates the heat of the furnace gases will not be transmitted so rapidly to the water on the other side of the plates, and the gases will consequently carry a larger proportion of their heat into the economizers and flues.

The temperature of the gases is therefore no indication of good or bad work, for it depends upon causes which operate in different directions. An excess of air lowers the temperature of the furnace and of the exit gas, while dirty and scaled plates increases it.

Good work and a high evaporative efficiency of the boiler demand a minimum of air and a high initial temperature within the furnace, combined with a rapid transfer of heat through the plates to the water. The temperature of the exit gases may thus be exactly the same in a boiler which is converting eighty per cent of the heat value of the fuel into steam and in one which is converting only sixty per cent and is allowing over thirty per cent to escape into the flues and chimney. The temperature of the gases issuing from the boiler flues is therefore not a safe guide to the working efficiency of the boiler, though as a general rule the lower the temperature of the exit gases the higher is the evaporative efficiency of the boiler.

Specific Heat—The specific heat of the exit gas varies with the chemical composition and can be calculated when this is known by the aid of the following figures:

Carbonic acid.....	(CO_2)	0.158	At constant volume; with water=1.000.
Carbonic oxide....	(CO)	0.175	
Nitrogen.....	(N_2)	0.173	
Oxygen.....	(O_2)	0.154	
Aqueous vapor...	(H_2O)	0.333	

It is evident that the amount of heat carried away by the exit gases will depend very largely upon the percentage of aqueous vapor present. This, however, varies with the amount of hydrogen present in the fuel and with the wetness or dryness of the fuel when charged into the furnace. The specific heat of the exit gases from furnaces using ordinary bituminous fuel may therefore lie between 0.240 and 0.300. Toole, in his work on "The Calorific Power of Fuels," gives a series of specific heats ranging from 0.312 for five per cent of CO_2 to 0.323 for fifteen per cent of CO_2; but the writer considers that these values are too high unless a very excessive amount of aqueous vapor be present in the exit gases. The importance of specific heat is recognized when calculating the heat lost with the exit gases. Article XII will deal with this subject, and in the calculations there given a constant value of 0.240 for the specific heat of the exit gases will be employed.

Specific Gravity—The specific gravity varies like the specific heat, with the chemical composition of the exit gases, and can be calculated when this is known. The following are the figures for the specific gravity of the gases likely to be present:

Carbonic acid...	(CO_2)	1.529	Experimental figures with air = 1.000.
Carbonic oxide..	(CO)	0.967	
Nitrogen.....	(N_2)	0.971	
Oxygen.....	(O_2)	1.105	
Aqueous vapor.	(H_2O)	0.615	
Sulphur dioxide.	(SO_2)	2.21	

A large percentage of carbonic acid or of sulphur dioxide in the exit gases is therefore accompanied by a high specific

[1]All rights of reproduction and translation are reserved. Copyright, 1906, by John B. C. Kershaw.

[1] Excess of air may produce a "clean chimney top," but will not lead to fuel economy.

Digitized by Google

gravity. The variations in specific gravity are used in one form of CO_2 testing apparatus, to indicate the percentage of CO_2. Further details of this instrument will be given in Article XI.

Refractive Index—The refractive index of furnace gases has not until lately been regarded as of any value as a guide to their chemical composition. An apparatus based on accurate observations of variations in the refractive index has now, however, been designed by F. Haber and has quite recently been placed upon the market by Carl Zeiss, of Jena. This instrument allows percentage variations down to 0.10 per cent of CO_2 to be easily detected, the refractive index of the furnace gas being compared with that of air, or some other standard gaseous mixture. A difference of one per cent of carbon dioxide makes a difference of 0.0000015 in the refraction coefficient, and this corresponds to 1.1 divisions upon the scale of the instrument.

Further details of this instrument will be given in Article XI.

Color—The color of the gases passing away from the furnace or combustion chamber of a boiler is some guide to the completeness of the combustion process. Gases in which all the carbon has been burnt to CO_2 and the hydrogen to H_2O are colorless and transparent, while incandescent particles of carbon produce yellow tongues of flame, and unconsumed hydrocarbon gases appear as dark streaks upon the bright background of the furnace walls.

It is advisable to use a dark blue glass when examining the furnace gases in this way, and to study first the various phases of combustion, with a bunsen burner-flame held against a cherry-red background of card or paper. By varying the amount of air admission at the base of the burner, all degrees of combustion can be obtained with the hydrocarbon gases supplied to the burner; and in this way an artificial reproduction of the conditions prevailing in a boiler furnace may be obtained. It is unfortunate that the combustion process in the furnaces of the ordinary internally fired Lancashire boilers can not be studied in this way, and that the method is only applicable to the furnace gases from water-tube boilers. In these latter, and in externally fired Lancashire boilers, sight holes closed with sheet mica can easily be made at suitable points in the brickwork setting, and a valuable check upon the combustion process can be exercised by observations made through blue glass, in the manner already described. The observations should be made as far from the boiler furnace as possible, but before the gases come into contact with the water-cooled plates or tubes of the boiler.

3. Sampling the Waste Gases—For regular and systematic control of the work of the boiler plant, it is necessary that frequent tests should be made of the exit gases from each boiler, both for temperature and for chemical composition.

The best place for taking the sample of the gases is at a point about eighteen inches or two feet on the boiler side of the damper which is used to cut off the boiler from the main flue to the economizers or chimney. If Lancashire boilers are installed and a separate damper be provided for each side flue, two sampling holes will be required. The holes should be made large enough to take a thirty-inch length of one-and-three-quarter-inch wrought-iron pipe, provided with a flanged top which can be closed with a bolt or plug when the pipe is not in use. This pipe is set with fireclay in the brickwork setting of the boiler, and is always ready for use when required. When fixing new boilers in position it will save time and trouble if a number of these sampling holes be provided in the brickwork setting at points suitable for testing purposes. Similar holes ought to be provided at one or more places in the main flue, and in the breast of the chimney; since the chemical composition of the waste gases at these points serves to indicate the amount of air leakage through faulty brickwork that is occurring between the boiler and the chimney. The sampling hole on the chimney breast must be made at a height of at least fifteen feet from the ground, as baffle walls are generally provided at the chimney base to direct the gases from opposite flues in an upward direction, and a sample of the mixed gases can not therefore be obtained at a lower level.

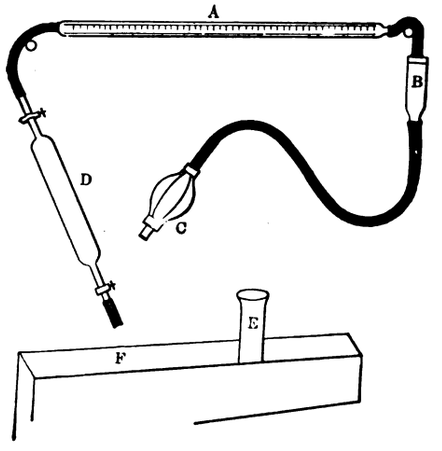


FIG. 33.—HONIGMAN GAS-TESTING APPARATUS.

For withdrawing the sample of gas from the flues, tubes of hard (potash) glass must be employed in three-foot lengths, and of three-eighths-inch external diameter. Arrangements for attempting to sample the gases across the whole width of the flue, by use of a perforated or split wrought-iron tube, are of little use, and it is best to simply insert the hard-glass tube, so that its far end projects about eighteen inches into the flue. A large bung, one and three-quarters inches in diameter, is fixed upon the glass-sampling tube, so that it is firmly held in position in the flanged end of the wrought-iron pipe, and no air leakage into the flue occurs at this point. A second or third length of hard-glass tube is now joined to the first by thick red-rubber tubing of good quality (black rubber is not suited for work with hot gases), and the sampling apparatus is then connected to the free end of the sampling tube or tubes. No filtering arrangement for retaining soot is used at this stage of the sampling, since it is better to have the freest possible passage between the flue and the sampling vessel. Soot and moisture will collect upon the inner walls of the glass tubes, and these must be well washed after each sampling operation, and allowed to drain and dry before use again.

Three methods for collecting the sample will now be described:

(a) *Snap-Samples of the Waste Gases Taken by Aid of the Dry Method and Honigman's Gas-Burette*—Honigman's original gas-burette was designed for testing the amount of carbonic acid present in gas mixtures containing a large percentage of this gas; it has been largely used in the manufacture of sodium bicarbonate and other chemicals. In its earlier form the burette was not well adapted for boiler work, and the form of burette and sampling apparatus has been modified by the writer to render it more suitable for use in testing the waste gases from boiler plants, and also more accurate in its results. This improved form of the Honigman apparatus is shown in Fig. 33. A is the special gas-burette holding about 110 cubic centimetres of gas, and graduated in fifths of a centimetre for the first twenty-five cubic centimetres of its contents. A space of ten cubic centimetres between the zero mark and the end of the burette is essential. C is a rubber finger-pump provided with valves, so that the gases pass through it only in one direction. It passes thirty-five cubic centimetres of

Digitized by Google

gas at each compression and is employed for "drawing" the sample of waste gases into A from the flue. B is a small rubber stop-valve which is inserted between A and C, to prevent all possibility of air leakage through C back into A. By drawing 600 cubic centimetres of gas through

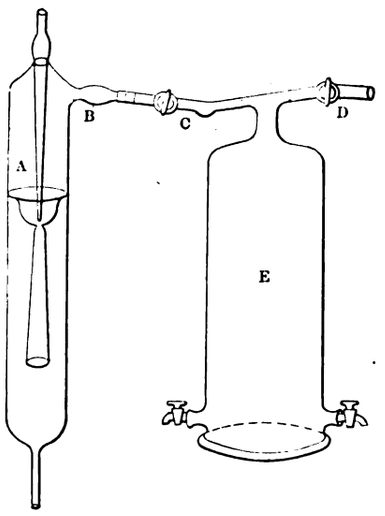


FIG. 34.—SAMPLING APPARATUS FOR AVERAGE SAMPLES.

A all the original air will be displaced by flue-gas. With a finger-pump of the above dimensions this can be effected in seventeen compressions, occupying less than one minute. If a check sample of gas for more complete analysis be collected at the same time in the gas sample tube D, the amount of gas drawn through the apparatus must be increased correspondingly to allow for the increased volume of air requiring displacement.

The glass stop-cocks on D are then closed, the spring clips are placed on the rubber at each end of A, and the sampling apparatus can then be disconnected and the sample taken away for analysis.

Since no liquid is used in this method of collecting gas samples, no absorption of carbonic acid gas can occur before testing. As a general rule the soot will be removed by deposition upon the inner walls of the sampling tubes before the gas arrives in D or A. With very smoke-laden gases, a little glass-wool must be inserted in the rubber tube connecting D to the tubes that pass to the flue to filter out the particles of unconsumed carbon.

(b) *Average Samples Extending Over One Hour*—When an average sample of the waste-gases over a period less than one hour is required, the apparatus shown in Fig. 34 is employed. A is a water-jet air pump which works upon the injector principle, and draws air through the arm B at a rate dependent upon the pressure of the water supply. The arm B is connected to the limb marked C of a Stead gas-sampling bottle, and the other limb of this, D, is connected to the glass tube or tubes leading to the flue. The sampling vessel E is filled up to the point where it joins the horizontal limb with mercury. The pump is now set to work and gas is drawn from the flue at a constant rate through the horizontal limbs, C, D, of the gas sampler. One of the lower cocks of this is now opened to allow a slow trickle of mercury to pass out. A mercury bottle provided with a funnel is placed below, to receive this and store it for the next sampling operation. The rate of flow of the mercury must be arranged so that the sampling bottle will still contain some of the metal at the end of the period over which the sampling is to extend. During this time, gas drawn from the flues will have been passing continuously through C, D, and a small proportion of this gas will have been continuously passing into E to replace the mercury which has flowed away. At the end of the period, therefore, E will contain a fair average sample of the flue-gases, and on closing all the cocks the apparatus can be disconnected and the vessel E containing the gas sample can be taken to the laboratory for chemical examination.

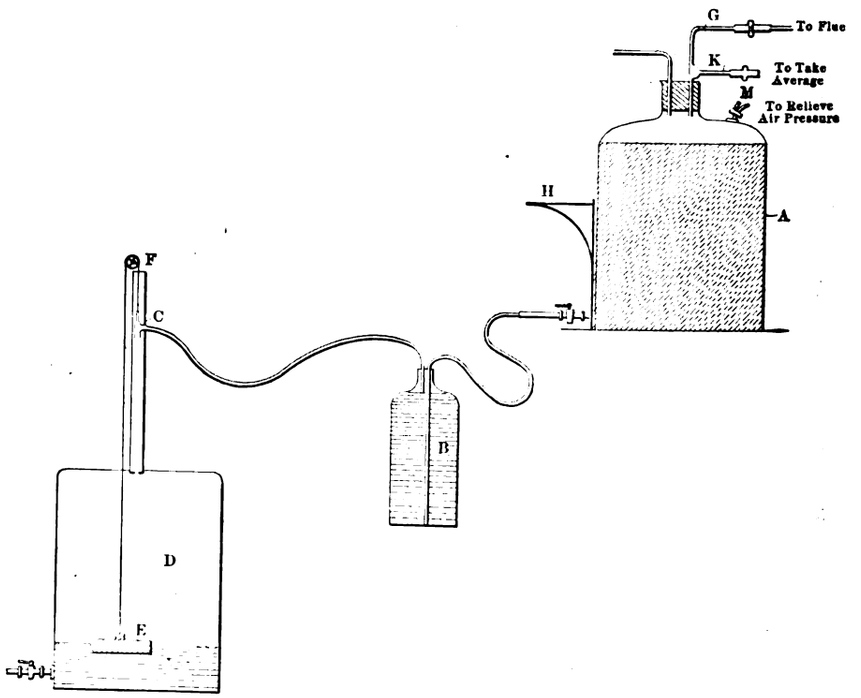


FIG. 35.—CROSFIELD'S PATENT GAS-SAMPLING APPARATUS.

If the waste-gases are very smoky, a small bottle containing glass-wool must be used to filter out the soot, this being inserted between D and the first length of sampling tube. The wool must be renewed for each test, as owing to the large volume of gas passing through the apparatus, a large quantity of soot will soon be collected. The mercury also will require frequent cleaning. This is best carried out by filtering through a large dry filter paper having a pin-hole in the apex, and by then washing the mercury with tap water and drying with filter paper or blotting paper. When quite clean no reaction occurs between the dry flue-gases and the mercury, and the sample can be kept for some hours in the vessel E without change.

(c) *Average Sample Extending Over Twelve Hours*—When an average sample of the flue gases extending over a period longer than one hour is required, the apparatus shown in Fig. 34 can not be employed, for the weight and cost of the mercury required would be prohibitive.

It is then necessary to use an apparatus depending upon the flow of water from one vessel to another and a difficulty arises due to the variation in the head of water at different stages of the sampling operation. The head being greatest when the sampling vessel is quite full of liquid, the outflow of water and inflow of gas will start at a maximum and gradually become reduced as the water is displaced by gas. The sample of gas obtained in this way can not, therefore, be regarded as a true average of the waste gases in the flue during the twelve hours over which it has been collected.

Fig. 35 shows a gas-collecting apparatus in use at Messrs. Crosfield's soap works at Warrington which is free from this defect, the rate of flow from the upper to

Digitized by Google

the lower vessel being constant for all variations in the water level.

The water from the upper gas collecting vessel A passes through the intermediate water-sealed bottle B, and then into the lower reservoir D by the delivery tube C. This delivery tube falls as the water level in D rises on account of its attachment to the float E by a cord passing over the pulley F.

The head of water is thus seen to depend upon the vertical distance between the level of water in the vessel A and the position of the delivery tube C, and a study of Fig. 35 will show that this is constant for all positions of the water level in A. The gases will thus be drawn into A at a constant rate during the whole of the twelve hours; and the sample, therefore, may be regarded as a true average of the flue gases during this period.

Two precautions must be observed in using this apparatus. The water in A must be covered with a film of oil to prevent CO absorption; and the tube G, leading to the flue, must be connected, not direct to the flue, but to a T-piece as in Fig. 34, through which the gases are being drawn at a rapid rate by the water pump. Otherwise the sample of gases collected in A will hardly be representative of the flue-gases. If only one sampling apparatus be in use, the top vessel is filled by hand when empty. If one apparatus be provided for each boiler of a large battery, a small pump is used for discharging the water from the lower storage vessels into the top vessels, all of these being connected to one water main. It is, of course, necessary that each vessel should be quite filled with water before starting the sampling. For this purpose the air cock at M is opened to allow the imprisoned gas to escape when the vessel is being filled with water.

The apparatus described above has been patented by Messrs. Crosfield, in the name of Crosfield & Dale, English Patent No. 9099, of 1906.

W. H. Blood, Jr., Retained as Insurance Expert by the National Electric Light Association.

W. C. L. Eglin, secretary of the National Electric Light Association, announces that W. H. Blood, Jr., of 84 State street, Boston, Mass., has been retained by the association as insurance expert in the interest of the members. Any member companies having insurance troubles would do well to call upon Mr. Blood for services that will undoubtedly be of great assistance and which will be promptly rendered.

Second Annual Electrical Show at Chicago.

Announcement is made that the second annual show of the Electrical Trades Exposition Company, which will be held at the Coliseum, Chicago, Ill., January 14 to 26, will, according to present indications, far surpass last year's success. Managing Director Homer E. Niesz states that space already sold is greater than that disposed of for the 1906 exhibition, and that a number of the exhibitors have doubled their show space.

The complete list of exhibitors to date is as follows:

Aetna Electric and Stage Lighting Company, Allis-Chalmers Company, American Steel and Wire Company, American Telephone Journal, Armour Institute, Brilliant Electric Company, Bryant Zinc Company, W. J. Burns, Central Electric Company, Central Electric Manufacturing Company, Chicago Battery Company, Chicago Edison Company, Chicago Lamp and Reflector Company, Chicago Pneumatic Tool Company, Chicago Telephone and Telegraph Company, Commonwealth Company, Frank B. Cook, Crane Company, W. P. Crockett Company, Diehl Manufacturing Company, Dixon Crucible Company, Duncan Electric Manufacturing Company, Edwards Electric Headlight Company, ELECTRICAL REVIEW, *Electrical World,* Electric Appliance Company, Electric Rotary Floor Polisher Company, Electric Service Supplies Company, Electric Storage Battery Company, Electrocraft Publishing Company, *Engineer* Publishing Company, Erwin & Company, Federal Electric Company, Fort Wayne Electric Works, General Electric Company, Gould Storage Battery Company, Emil Grubbe, M.D., Guarantee Electric Company, J. Allen Haines, Haller Machine Company, Holcombe & Company, Holtzer-Cabot Company, H. W. Johns-Manville Company, Kellogg Switchboard and Supply Company, J. Lang Electric Company, Mathews & Company, Metropolitan Electric Supply Company, Monarch Electric and Wire Company, National Battery Company, National Carbon Company, Niagara Tachometer and Instrument Company, Oliver Manufacturing Company, Ohio Brass Company, Peabody Coal Company, Peterson Manufacturing Company, Phoenix Glass Company, Reynolds-Dull Flasher Company, Rock Island Battery Company, Roth Brothers & Company, W. H. Schott, J. S. Schureman, Shelton Electric Company, Simplex Electric Heating Company, Stanley-G. I. Electric Manufacturing Company, Sterling Electric Company, Stolz Electrophone Company, Stromberg-Carlson Telephone Manufacturing Company, Swedish-American Telephone Company, Telephony Publishing Company, The Consumers' Company, Universal Electric Storage Battery Company, Vesta Accumulator Company, Vim Company, Vulcan Electric Heating Company, Wagner Electric Manufacturing Company, Western Electric Company, *Western Electrician,* Westinghouse Electric and Manufacturing Company.

Changes in the Personnel of the Engineering Staff of the New York Central & Hudson River Railroad.

The following announcement of changes in the engineering staff of the New York Central & Hudson River Railroad has been made by W. J. Wilgus, vice-president:

Edwin B. Katte is appointed chief engineer of electric traction. George A. Harwood is appointed chief engineer of electric-zone improvements, exclusive of electric traction and signals. George A. Berry, having resigned to accept another position, the department of company forces will hereafter report to the chief engineer of electric-zone improvements. John D. Keiley is appointed electrical engineer. Carl Schwartz is appointed engineer of power stations.

W. H. Knowlton, principal assistant engineer, will have direct charge of all contract construction work and right of way matters from the south bank of the Harlem river to Peekskill and North White Plains; resident engineers in this territory will report to him. J. L. Holst is appointed engineer of structures. He will have charge of the design and erection of all steel in the electric zone, excepting erection in the Grand Central terminal; the design of all buildings not in charge of the associated architects, and the design of all masonry and miscellaneous structures north of the south bank of the Harlem river; the assistant bridge engineers, assistant designing engineer in charge of structures north of the Harlem river, architect, cement tester and driller will report to him. W. F. Jordan is appointed terminal engineer; he will have charge of the design and construction of the Grand Central terminal and other work in connection with the electric-zone improvements south of the south bank of the Harlem river, except the structural-steel design and the Grand Central station and other work in charge of the associated architects. The resident engineer and assistant designing engineer within this territory will report to him. L. H. Byam is appointed engineer of company forces.

Digitized by Google

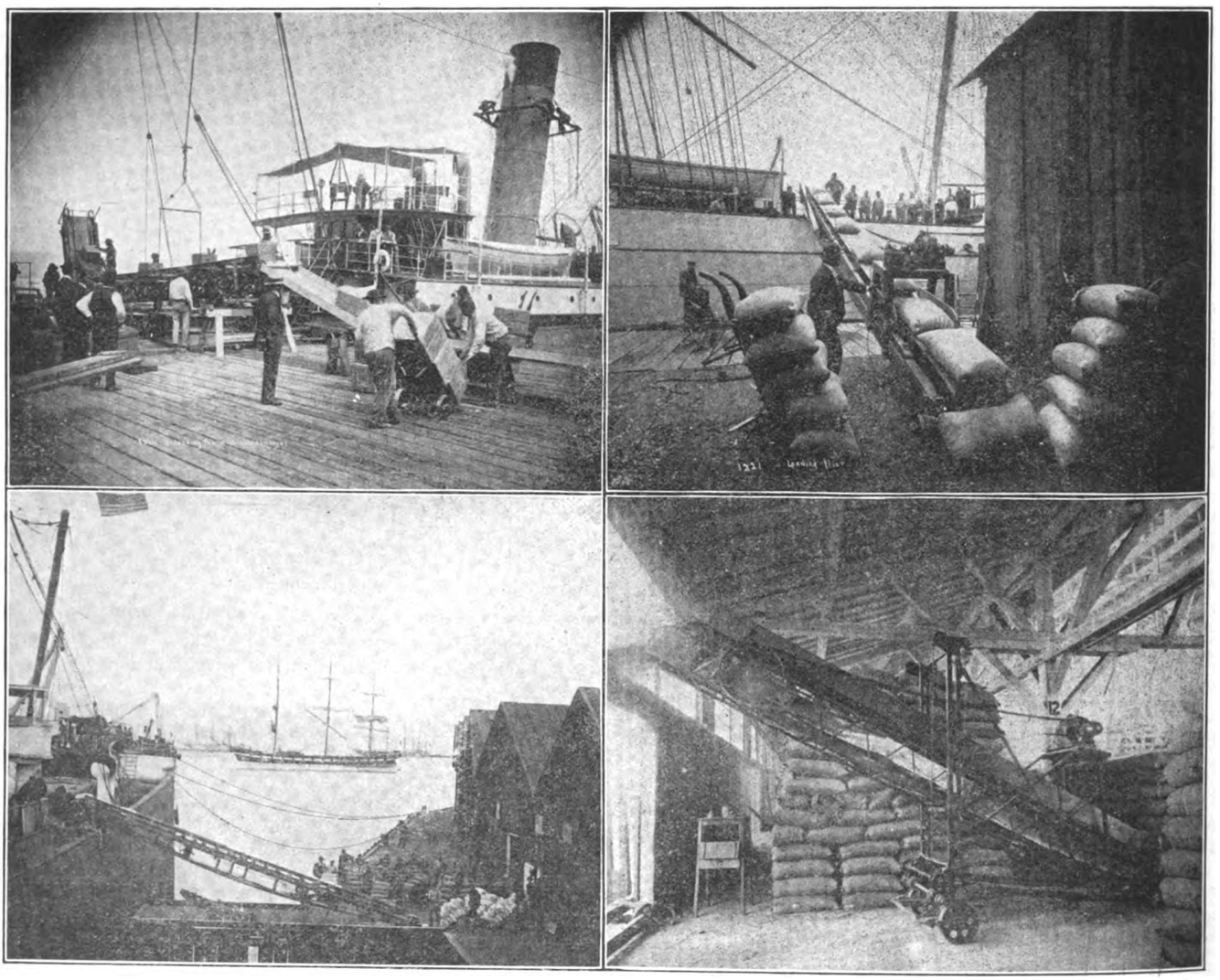
Adaptations of Electrically Driven Conveyers.

By Day Allen Willey.

THE applications of electricity for conveying material are diversified, and some of the apparatus which has been designed for this purpose is very elaborate in character. Where the current can be generated at a moderate cost, it has been shown that the electrically operated conveyer is, in many instances, far more economical and more effective than that driven by steam or other power.

A notable illustration of this kind is given in the method employed for transferring cargoes of vessels at Tacoma, Wash. It may be needless to say that this city is one of the principal shipping ports on the Pacific coast. It exports a large amount of grain as well as flour and lumber, while the merchandise imported includes tea and other Oriental products. The wharf at Tacoma is no less than 13,000 feet in length, lined with warehouses which include some of the largest structures of the kind in the world. The harbor is not provided with piers extending parallel with each other so that the steamships and sailing craft are moored to this one long wharf, one ahead of the other. If steam power or manual labor were employed for loading and unloading cargoes the outlay would be very large, to say nothing of the time required, since many of the vessels have a cargo-carrying capacity ranging from 5,000 to 8,000 tons.

Fortunately, the electric current is available for this purpose and it is employed almost exclusively in carrying merchandise to and from the wharf warehouses. The system utilized is that of the freight gangway. Enough of these have been constructed to serve each warehouse adequately. The gangways are mounted upon trucks which not only move upon wheels resting on the floor of the building, but extend to beams passing through the upper portions, thus aiding in steadying the gangway and preventing it from falling over when loaded. During the times when they are not in use the gangways are rolled back into the warehouses. When required for service it is only necessary to push them to the doorways, when they can be run out and extended over the deck of the vessel. Most of them are equipped with arms or aprons which reach to a point above the hatchways, so that as the cargo to be unloaded is lifted from



Scenes on the Long Wharf at Tacoma, Wash.—Electrically Driven Conveyers at Work Unloading and Warehousing Ships' Cargoes.

Digitized by Google

the hatch by the boom derricks of the ship, it can be lowered directly upon the outer end of the gangway and transferred to the warehouse.

The upper portion of each gangway is composed of an endless belt which is supported upon a series of metal rollers and passes around larger ones mounted at each end of the structure. Attached to the side of the gangway and connected with a shaft driving one of the end rollers is a flywheel. Around this passes a belt which is attached to another shaft directly connected to the actuating mechanism. This is a motor developing twenty-five horse-power, so mounted that it can be adjusted to the outer or inner end of the conveyer as may be desired. As the photographs show, it is usually placed above the gangway for convenience. The motors employed are intended to take a two-phase current which is transformed to low tension of a voltage adjusted to the service to be performed.

It is an interesting fact that the current is obtained from the Puyallup river, one of the glacial water courses which have their origin on Mount Tacoma or Rainier. The generating station is located at a point on the river thirty-two miles distant from the city.

Although the maximum energy required to operate this electrically driven apparatus is but twenty-five horse-power to each one, the series in service perform the labor of over 1,000 men, so that the only force required is a man to operate the electric switch controlling each motor, the loading and unloading squad in the hold of the vessel and the force necessary to stow away the merchandise in the warehouses. A further idea of the service required can be gained when it is stated that this wharf contains no less than five warehouses and elevators which are used for wheat and flour alone, one of the warehouses being nearly 2,400 feet in length and the longest grain warehouse in the world. In addition to the regular steamship lines a fleet of "tramp" steamships and sailing vessels ply between Tacoma and other Pacific ports, so that in a year from 125 to 150 vessels are loaded with wheat alone, saying nothing of other cargo. At one time a dozen cargo-carriers, ranging from 4,000 to 8,000 tons, may be seen at the docks, yet with the entire conveying system in operation not over twenty men are necessary to each vessel and the warehouse from which it is receiving or to which it is transferring cargo.

The breadstuffs exported are usually loaded in bags and so rapidly does one of these electric gangways work that as fast as the receptacles can be trundled to the receiving end they are conveyed on shipboard, while the tea and other commodities unloaded are delivered on the wharf or into the warehouses as fast as the stevedores can handle the packages.

Electric Lighting by Wind Power.

The possibility of making wider use of wind power for electric lighting has been discussed in some detail by E. L. Burne. It is pointed out that the minimum speed of the wind in England is seven and one-half miles an hour; that for approximately one-half the time the velocity is not less than ten miles an hour, and under favorable conditions a speed of fifteen miles and over may be expected for about one-third of the time. During the winter months the averages are about fifteen per cent higher, and in open places, such as the seacoast, these rates are exceeded. The drawback to wind power is that the breezy periods do not succeed each other at regular intervals, and calms lasting from three days to a week must be provided against. Indeed, the latter period is sometimes exceeded. The velocity of the wind at 100 feet from the ground is twenty per cent greater than at fifty feet, and ten per cent less than the latter at twenty-five feet, so that apart from the necessity of being clear of all obstructions to the full flow of the wind a good elevation is desirable for a windmill. Theoretically, the power of the windmill varies as the cube of the velocity, though in practice it is subject to some modification. The limits of useful wind velocity for power purposes may be taken as from ten miles up to twenty, or possibly twenty-five as the upper limit. Of the two types of windmill, the disc and the sweep types, the latter type has the advantage of a higher efficiency per unit of surface and a higher velocity. However, there is but little practical knowledge concerning the latter type. P. La Cour, investigating for the Danish government, found that the best results were obtained from a mill having four approximately rectangular sails, the breadth of which should be from one-fourth to one-fifth the radius of the arm, and the length from three-quarters to four-fifths of the same. The details of construction which bring the wheel up to the wind and which prevent excessive speeds are given at some length, and it is suggested that a centrifugal governor might be employed with advantage. Various methods of obtaining constant speed are dwelt upon. One of these, employed in a mill in operation at Askov, Denmark, depends upon a variation in belt tension which causes the latter to slip on the dynamo pulley. Some particulars are given of a windmill erected in 1897 which has been driving a dynamo since that time. The span of the four sweeps of this mill is seventy-five feet, and the breadth is eight and one-half feet. The mill is provided with two dynamos, one delivering 250 amperes at twenty-eight volts for electrolyzing water, and one forty amperes at 150 volts for charging a storage battery. There are 450 incandescent lamps connected to the battery. A gasolene motor has been added to this equipment as a precaution against calms. The total cost of installation was $4,365. The annual cost of operation is made up as follows:

Attendance for oiling and starting the mill	$55.00
Attendance to the gasolene engine	33.75
Thirty days' consumption of gasolene	55.00
Lubrication	22.50
Making a total of	$166.25

The receipts from the sale of electrical energy during this time amounted to $700, so that the excess of receipts over expenditures amounted to twelve per cent of the capital outlay. Another installation described briefly is at Boyle Hall, West Ardsley, Yorks, England. This wheel is thirty feet in diameter and has fifty hinged vanes, each ten feet long. It drives a dynamo through bevelled gearing and a belt. The battery maintains charged sixty storage cells with a capacity of 490 ampere-hours, a supply sufficient for eight days. This battery supplies 109 incandescent lamps, of which twenty are eight candle-power and the remainder sixteen candle-power. The plant has been in operation since 1899. The total cost was $6,000. The running expenses are $150 per year, or adding four per cent for interest on the installation $390 per year.—*Electrical Review (London), October* 19.

The Rejuvenated Sons of Jove.

A Jovian lunch club was formed in Boston, Mass., on October 31, for the purpose of meeting at lunch each Wednesday noon. The committee of arrangements consisted of Frank Booth, S. B. Condit, W. F. Hessel and Albert Mann. Twenty-six members of the Sons of Jove became members of the lunch club.

A rejuvenation will be held on December 7, under the auspices of Frank Booth, No. 395, Jovian statesman.

Digitized by Google

Vol. 49—No. 19

English Electrical Notes.

(By Our London Correspondent.)

THE troubles of Willans & Robinson, Limited, once of Thames-Ditton, and now of Rugby, and alas! Queen's Ferry also, are fairly common knowledge now throughout all industrial quarters of the globe. So far as Queen's Ferry and the steel works enterprise was concerned, a mistake was committed for which blame has been generously allotted, but the other causes of failure are those which call rather for sympathy than criticism. For years the company had things very much its own way with the Willans engine and "coined" money, but that period of success came to an abrupt conclusion when other prime movers came along with more fascinating qualities which seduced the central station engineer away from his old love. The company, when it thought it saw the trend of things, entered into more or less active agreement with its adversaries. The manufacture of the large gas engine was taken up "as a matter of prudence," because it threatened to supplant the large reciprocating steam engine. A good deal of capital was expended and some gas-driven stations were equipped, but it is now confessed that there is no hope in this direction, for large gas engines "are very difficult to make and to get any profit out of at all." Indeed there has been considerable loss and the whole of the expenditure on the department is to be written off. Reading between the lines, the making of large gas engines at Rugby is to be abandoned.

The steam turbine (Willans-Parsons with Captain Sankey's system of blading) is greatly in favor in England and will, if present indications can be relied on at all, do more than anything else to give the needed fresh life to the concern. The Diesel oil engine is another direction in which the company is energetically working. By means of these, in course of time, Willans & Robinson, Limited, of Rugby, may, when it has been relieved of its Queen's Ferry steel works incubus, once more be able to stand erect. But there are matters of financial re-arrangement to be faced before then. Meanwhile the company is with us to-day as one of the effects of latter-day development and evolution in power-station prime movers—a progress which seemed to come so suddenly that it was not prepared to meet it.

A young butcher, aged twenty-one, has just met his death at Derby, under circumstances which have led eminent electrical experts who have investigated the matter to change their minds and to admit the necessity for earthing electric fans under certain circumstances. The victim, one Allsopp, while his hands and boots were saturated with brine, switched on an electric fan (200 volts) in a cellar where brine was used for pickling pork. When the fan was examined after the accident, a distinct shock of varying intensity was experienced, according to the position of the switch handle. The fan was in perfect order save for this leakage, and this leakage, in the opinion of the city electrical engineer, T. P. Wilmshurst, was due to the action of brine which had been spilt or splashed on the fan and had permeated the working parts. J. F. C. Snell, a well-known electrical expert, attributed the fatal result, with such a low voltage, to the coincidence of a number of favorable causes, the hands and feet being saturated with brine, the cellar damp, the wetness between the switch handle and the casing of the fan, and the action of the deceased in grasping the standard instead of the switch, and being unable to let go. Now, 250 volts is English regulation low pressure, and so far there are no regulations requiring special protection below that. Mr. Wilmshurst, as a result of the case, is inclined to recommend certain precautions though there is considerable difficulty in earthing these portable fans. Mr. Snell confesses that before this fatality he would not have dreamed of suggesting the earthing of such fans. He has now changed his mind.

Manchester has a very extensive municipal system of electric trolley lines. For some time past, too, private parties have been running motor-omnibuses, but these have been creating so great a nuisance from noise and smell that the chief constable and city surveyor condemned them as unsuitable for Manchester's thoroughfares. It is now proposed to refuse renewal of the licenses. The statements made in connection with the Manchester inquiry, as well as the experience now being obtained in London with motor-busses, point very plainly to the excellent reception that awaits the electrical omnibus with its smooth running and freedom from exhaust and offensive smell.

Regarding Manchester's tramways, the efforts of the corporation to compete with private carriers of goods and parcels have been a complete failure. After spending large sums of money setting up the department and organizing a system for horses and vans to deliver goods from the tramway termini, and also after indulging in costly litigation with the private carriers whose interests were unwarrantably attacked, the corporation is going to abolish a very large part of the undertaking. This is a fair example of the way some English municipalities have been spending public money in competition with their own rate payers, nobody, save perhaps the lawyers, being any the better, and many, particularly the affected industries or trades, being considerably the worse off for the transactions.

Electricity supply authorities in England, when they have wanted to change over their supply to consumers from 100 and 110 volts to 200 and 220 volts, have frequently had to contend with considerable hostility from customers who have had a suspicion that they are to bear all the inconvenience of the change, while the supply authority obtains the sole benefit. In most cases the cost of change-over has been borne by the authority, and in this and other ways the consumer has been pacified. But there are districts in which the cooperation of a few consumers in the matter has been withheld, and these few have had to be specially supplied at the old low pressure, while the great bulk fell in with the supply suggestions. A case of this description has just been before the courts. The Marylebone Borough council took over, last year, the supply business of the Metropolitan Electric Company, in its area. At great cost a turbine power-station was put down from which supply is being now obtained, and as part of the scheme it was planned to give a 240-volt supply to the whole of the 6,000 consumers. Previously, however, there had been a variety of voltages in vogue, some as low as fifty volts, and some of the old consumers who had taken energy from the company for ten years or more had the right to oppose the change-over. One large consumer, Map-

Digitized by Google

pin & Webb, of Oxford street, declined to accept the alteration, and for the time being the Marylebone council, having no alternative, agreed to continue the 100-volt supply; for though they had secured the Board of Trade's consent to the higher pressure, they could not effect an entrance to make the necessary alterations without the permission of the consumer. It was because they did not wish to act in a high-handed manner that the Marylebone council temporarily continued the lower pressure, but the ground for the action was that the council did not continue to maintain the pressure at the agreed 100. Indeed on a number of days it fell to ninety-four and even eighty-four volts, causing considerable inconvenience; oil lamps and candles having to be requisitioned to enable business to continue. The magistrate has fined the council heavily for its failure to maintain efficiently the supply agreed upon, but there are indications that the matter will be carried to a higher court.

The generating station at Marylebone is the very latest example of central station practice in London. Arthur Wright is the consulting engineer. Briefly stated, it is a direct-current supply without substations, and the first installment of plant put in consisted of Babcock & Wilcox boilers with chain-grate stokers and superheaters, four 500-kilowatt Parsons turbo-generators running at 240 volts, and four 2,000-kilowatt turbo-generators generating at 480 volts. Each set consists of two dynamos coupled to a steam turbine, the smaller dynamos acting as balancers. The cooling towers are placed above the boiler house.

The city of Oxford, after prolonged deliberations and years of delays, has now definitely approved of the change-over of its tramways from horse traction to electric. At one time it seemed very much as though in the future tramways would be barred altogether and motor-busses be substituted. The overhead trolley system the city will not have on any account, so it has approved of the conversion of the existing system to the Dolter surface stud-contact system. This particular principle has been recently applied to the tramways of Torquay, Mexborough and Hastings, but these are not yet quite completed. The only other examples of surface contact tramway to be found in England so far as the Lorain system which has been running for many years now at Wolverhampton, and the G. B. system which is operating at Lincoln.

Considerable progress is reported from Poplar in connection with the municipal scheme for supplying cheap disinfectant by means of the electrolytic hypochlorite plant installed by Dr. F. W. Alexander. The system is now established on a permanent basis and an offer of free supply to workhouses, asylums and schools in the district has been made.

The vacation of the scientific and engineering institutions is now at an end, and with many of them meetings are about to commence for the new session. The Civil and Mechanical Engineers' Society is the first to set the ball rolling, for on October 4 the presidential address was read by W. B. Esson, an eminent electrical engineer who took for his subject the "Industrial Power Problem," dealing with the production and distribution of power at the lowest cost, in the light of the present position of power affairs in England. He contended that electricity as a means of distributing power had no competitor, though efforts had been recently made to distribute fuel (not power) in the form of Mond gas, which might suit the requirements of some manufacturers better than power delivered electrically. A proposal that has been put forward for distributing fuel gas in Cumberland was touched upon. With power-houses erected at Maryport, Workington and Cleaton Moor, it is proposed to utilize the waste gases from the three greatest ironworks, part of the gas being used in engines for generating electricity and the remainder distributed. According to estimates gas representing 60,000 horse-power is being wasted continuously from these furnaces alone.

During November the Institution of Electrical Engineers will resume its meetings in London and at its half-dozen local sections. Dr. R. T. Glazebrook will deliver his presidential address at the opening London gathering.

Birmingham, though it has made such excellent progress in so many ways in public improvement work, has been somewhat backward in electrical development until the last year or so. This applies to both lighting and tramways, but particularly to the latter. Yet Birmingham was the scene of some of the earliest British work in both departments of electrical engineering. Some six years ago the municipality bought over the old company's light and power system and it has now opened a big generating station which forms part of a development scheme which was put in hand some little time ago under the supervision of R. A. Chattock, the city electrical engineer. The new scheme includes the generating of both direct and alternating current at Summer's Lane station, with transmission of the alternating current at high pressure to a series of substations for local distribution in the form of direct current. In the station the high-tension alternating and the direct-current plants and their respective switchboards are kept separate on opposite sides of the building. When the present plans are completed there will be installed 13,000 kilowatts of direct-current equipment and 13,500 kilowatts alternating. Four of the direct-current sets now in position consist of Belliss enclosed steam engines driving 1,500-kilowatt Dick-Kerr generators which will supply current for either lighting or traction. There are also two 500-kilowatt Parsons turbo-generators for direct current. The alternating-current equipment comprises Belliss steam engines driving British Westinghouse alternators. The alternators have fixed armatures and rotating fields, and two small 100-kilowatt steam-driven sets serve to energize the fields. The switch-gear part of the installation, both direct and alternating, was the work of the British Thomson-Houston Company, Babcock water-tube boilers are installed, the first section consisting of ten. The Westinghouse 300-kilowatt rotary converters which do service in the substation are fed through banks of single-phase transformers.

ALBERT W. BRIDGE.

London, England, October 27.

New York State Telephone Developments.

The United Message Company, of Albany, N. Y., has acquired the Commercial Union Telephone Company, of Troy, N. Y., operating in Troy, Glens Falls, Saratoga and about twenty other towns in New York state. This is in line with the work of taking over all the independent telephone interests in the state as fast as they can be acquired. The corporation has a working capital of $35,000,000. Judge Hendrickson, recorder of the city of Albany, is president of the United Message Company.

Digitized by Google

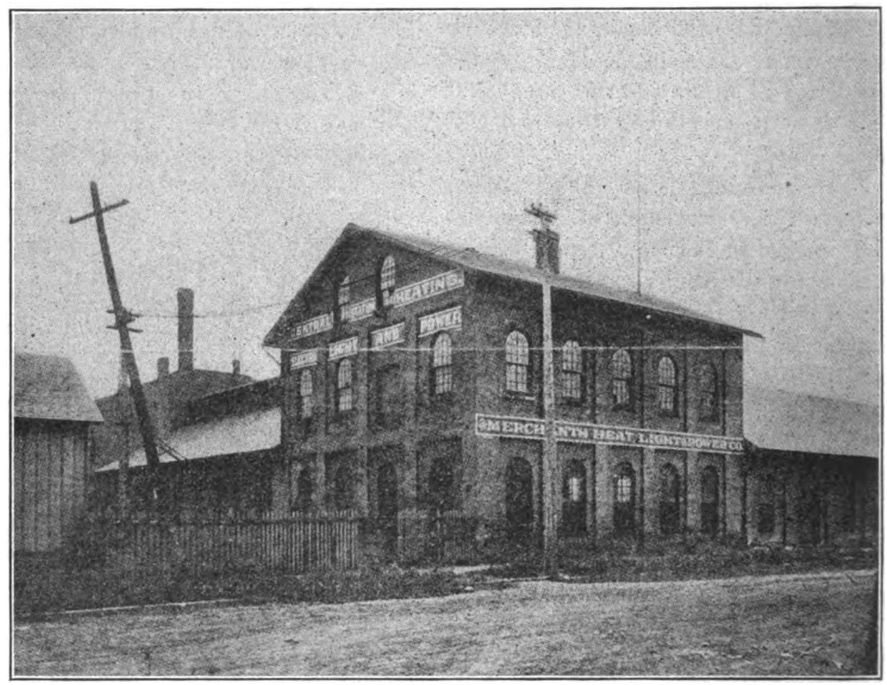
A Combined Heating and Lighting System at Canton, Ohio.

By R. W. Hutchinson, Jr.

WITHIN the last few years there have sprung up in the Middle West a number of combined heating and lighting systems which in many cases have become strong competitors of the more customary "isolated plant" style of heating, as well as the competitors of the natural-gas companies. A plant which stands out prominently as an example of the splendid opportunities in a combined heating and lighting system for even comparatively small companies when ably managed is that of the Merchants' Heat, Light and Power Company, of Canton, Ohio. The beautiful, healthy and progressive little city of Canton, with a population of upwards of 40,000, was from both a technical and commercial viewpoint, a particularly favorable point for the location of such a plant. An insufficiency of water rendered a condensing plant impracticable, hence the use of exhaust steam for city heating affords economies and conveniences to the consumer and makes at the same time a profitable venture for a company which can well invite the attention of other companies similarly situated. The company began business in April, 1905, as the successor of the Citizens' Heat and Light Company, which was organized primarily to supply heat and light to a superb new hotel. The hotel company became insolvent and the newly formed company acquired its franchise for a new heating line through the principal portions of the town. During the past year it has constructed a system under all the central section of the city and has additional franchises for five miles of street.

The power station is rectangular in shape with a peaked asbestos-covered roof supported on steel trusses. Both engine and boiler room have separate peaked roofs. The size of the engine room is forty-three feet by sixty-five feet; the boiler room measures forty-one feet by sixty-five feet. The engine room is equipped with a crane with a track resting on pilasters; the engine-room floor is of concrete supported on a steel frame resting on piers. The concrete is five inches thick and is laid on corrugated iron plates made by the Berger Manufacturing Company, of Canton. Such a construction makes a floor of highest rigidity and bearing power and was rendered necessary in this case by the soft ground on which the station was built.

The boiler equipment consists of three 250-horse-power Sterling water-tube boilers fitted with Roney stokers and arranged in a battery and a half with provision for an additional unit. The grates of the furnace receive their draught from a self-supporting steel stack, resting on concrete fourteen feet thick. The stack is seventy-two inches in diameter and 150 feet in height. The boilers are fed by two boiler pumps immediately in their rear; on the side are two low-duty pumps for pumping from a 2,000-gallon tank supported on a platform near the roof of the boiler room. Two vacuum and one receiver pump are placed below the engine floor. All of this pumping apparatus is in duplicate and was made by the Canton Pump Company. The engine equipment comprises two Russell cross-compound non-condensing engines, each of 375-horse-power capacity at 200 revolutions per minute. The engines are kept supplied with oil by a gravity oiling system; the oil tanks are located on the wall, the oil circulating by gravity, is caught in a receptacle below the engine floor and then pumped back into the tanks. The "Cross system" of filtering is employed. Each engine is direct-connected to a National 250-kilowatt, two-phase, 2,300-volt alternator made by the National Brake and Electric Company, of Milwaukee, Wis. The power-generating equipment is arranged parallel to the walls of the station, with ample space between the units to insure plenty of heat-radiating surface. The units are of symmetrical lines and of fine operating characteristics. The exciting current for the alternators is furnished by two 110-volt direct-current generators, belt-driven from the engine shaft. An additional seventy-five-kilowatt Lundell 250-volt direct-current generator is belted to one of the engines and is employed to supply current to the power load during periods of light load. The power load is carried during hours of heavy load by a 125-kilowatt, 125-volt, direct-current Westinghouse generator, which is belted to a Westinghouse vertical compound engine developing 160 horse-power at 295 revolutions per minute. The switchboard is in gray marble and is installed near the lengthwise wall. It comprises five panels, two of which are the alternator panels; each alternator panel has mounted thereon two 120-ampere ammeters, synchronous plugs and rheostat. The exciter panel has two direct-current ammeters, two rheostats and one field switch and two armature switches. The distributing panel has mounted on it two 300-ampere ammeters, one 140-volt voltmeter, a synchroscope, two oil switches rated at 200 amperes and 3,300 volts. The power panel is equipped with two direct-current ammeters, each of 450 amperes capacity, two rheostats, two circuit-breakers, one double-pole, double-

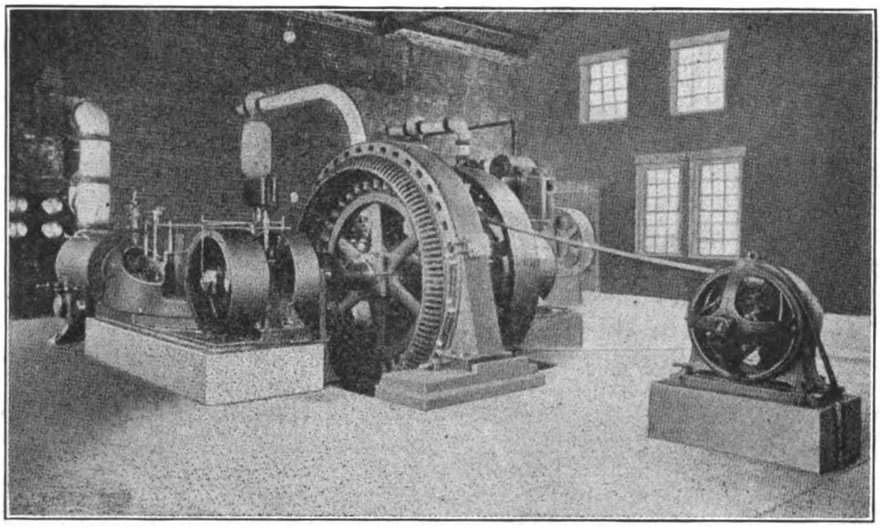


POWER PLANT AND CENTRAL HEATING STATION.

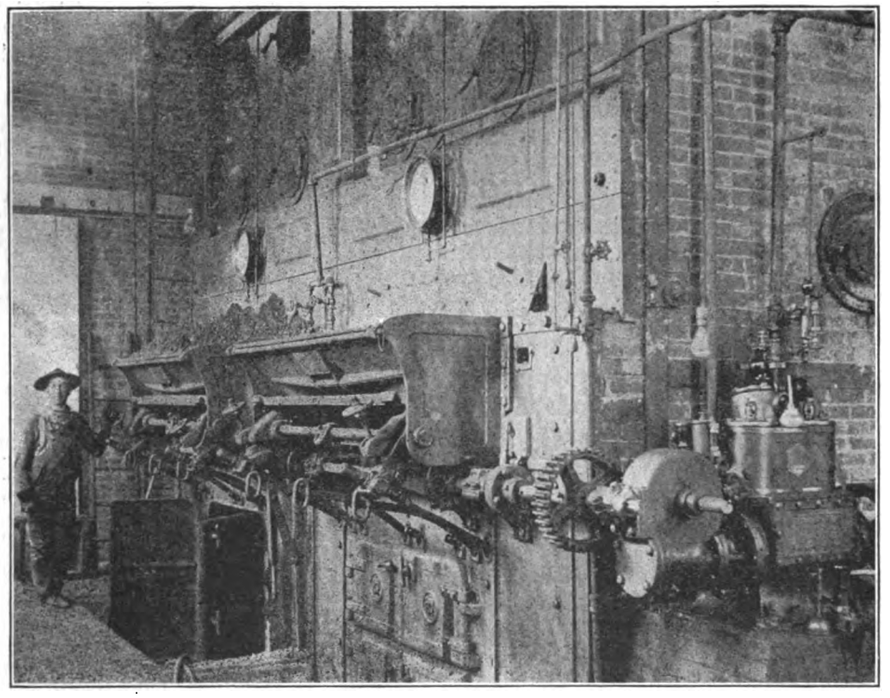
Digitized by Google

throw switch and an integrating watt-meter of 100-kilowatts capacity.

The exhaust from the low-pressure cylinders of the engines is received by an eight-inch and ten-inch main, which conduct it to a sixteen-inch heating main; this heating main is encased in Wykoff covering, which consists of a tube of tin adjoining the pipe. A layer of sheet asbestos is then served to the pipe, which gives a non-conducting air space, then strips of wood, seven-eighths inch thick, are dovetailed together and encircle the asbestos. These strips are then wound with piano wire and a layer of felt paper, which is asphalted, is applied, then another similar layer of felt paper, asphalted, is applied, another cover of wood strips is placed around this and the completed pipe, which is as practically heat insulating as can be made, is asphalted and rolled well in sawdust. The overall diameter of the sixteen-inch pipe is twenty-three and one-quarter inches. The underground steam main extends about five miles throughout the main business portion of the city and a number of the principal residence streets. It is graduated in diameter in proportion to the square feet of heating surface in various sections of the city. The sixteen-inch main extends to the centre of the city with fourteen-inch pipes running north and south through the down-town part of the city. In the main residence district ten-inch and twelve-inch mains are used, which are tapered down to two and one-half inches in outlying districts. The return steam line is four inches in diameter and is laid immediately under the mains. In addition to the gas and water mains, telephone wires and lighting circuits of other companies being underground, the majority of streets are rather narrow, so the difficulties which confronted the company in laying steam mains were numerous, and frequently costly expedients had to be adopted.



View of One of Main Generating Units.



Main Battery of Boilers Showing Stokers and Stoker Engine.

The exhaust steam is first passed through an oil-separator under the floor of the engine room and then goes through an automatic controller valve set for three to five pounds pressure as an average, but the setting is varied with the load up to ten pounds as a maximum. The exhaust steam is utilized first, but on heavy heating loads, live steam from the single boiler is used. A six-inch live-steam pipe line extends from the boilers alongside the heating system and is equipped with an automatic reducing valve, which is so set that if the pressure of exhaust steam falls below four pounds, live steam will be admitted from the "booster pipe" to the main heating line. The returning steam and condensed water is conducted in a 1,000-horse-power Cookson feed-water heater installed in the engine room. Extra exhaust steam from the engines is also led into this heater.

The customers' rooms to be heated are each furnished with a Powers thermostatic temperature-control valve, with a range of from sixty degrees to eighty degrees Fahrenheit; these valves operate automatically without any attention whatsoever and have been found not to vary over two degrees from five degrees below zero to thirty-four degrees above. The valves are controlled by a one-quarter-inch galvanized-pipe air line running alongside the steam mains; the pressure in this line is fifteen pounds and is maintained by a nine-and-one-half-by-nine-and-one-half-inch Westinghouse air-pump.

The manholes for getting at the underground system are located midway of every block and at every intersection of streets, and are situated about 130 feet apart. The standard manholes are six feet square inside and seven feet deep, to give ample room for working in them; they are lined with brick up to fourteen inches of the top and have a concrete bottom. The manhole covers are of cast iron, resting on rectangular cast-iron frames made of seven-inch I beams. The covers are cast with square flanges; they are thirty-six

Digitized by Google

inches in diameter and will support ten-ton steam rollers; they are fastened by lugs instead of hinges.

The main steam line is equipped with a bronze expansion joint at every manhole and the return steam line with a similar expansion joint at every other manhole. The manholes are fitted with a trap to drain into a returning steam line, with the vacuum pumps assisting. All of the steam piping is screwed together, which makes the heat insulation continuous from manhole to manhole. The lined pipe has an extra heavy recessed coupling, and every section of the insulated pipe is tested with fifty pounds pressure for ten minutes without showing any drop.

The lighting cables are laid, eight in multiple, in vitrified clay ducts encased in a four-inch bed of concrete. The conduits are supported above the steam line between manholes and are carried around the sides at manholes, which makes them easily accessible. The five ducts were put in to provide for future increase in feeder systems in the business section. The high-voltage feeders consist of No. 2 and No. 4 lead-covered wire. The low-pressure feeders are copper cables of 500,000 circular mils, rubber-insulated and paper-covered. From the south side of Eighth street to the north side of Fourth street and from the east side of Walnut street to Cleveland avenue all wiring is underground. The company is now devoting its efforts toward increasing the lighting load, so that the already profitable heating load can be added to with a low cost for given amount of heating capacity, by doing away with the expense of firing boilers and supplying live steam. The lighting load is about seventy-two amperes and is largely composed of Nernst lamps operating on a 230-volt circuit and taking eighty-eight watts per glower. They are kept in operating shape by the company. The power load is mainly distributed among small motors, electric flat-irons and signs. The charge for current is ten cents per kilowatt-hour for a one-hour connected load and six cents per kilowatt-hour in excess of this time.

The terms of franchise granted the company allow a charge of thirty-five cents per square foot of radiating surface for seven months' service, or sixty cents per 1,000 feet of water by condensation, measured by a meter. A competing gas company selling gas at thirty cents for heating induced the company to fix its rate at thirty-one and one-half cents per square foot of heating surface or sixty cents by the meter plan stated above. The heating system was designed for capacity of 250,000 square feet at a velocity of 250 feet per second. At present the connecting heating load is 100,000 square feet with provision for increasing to 500,000 square feet. The so-called "2-20-200" formula is applied to determine radiating surface and a seventy-degree temperature at ten degrees below zero is guaranteed.

The personnel of the Merchants' Heat, Light and Power Company is made up of prominent business and technical men of Canton. The president is Thos. F. Turner; vice-president, John Rommely; secretary, Barrett F. Steiner; treasurer and general manager, William Stolzenbach, and B. J. Shockley, a practical lighting engineer, is superintendent and assistant general manager. The plant and system was designed and its construction supervised by E. R. Vincent, consulting engineer, of Indianapolis, with C. C. McLain associated with Mr. Vincent as resident engineer. The writer is indebted to the latter for much of the information herein given. The plant was constructed by the Arbuckle-Ryan Company, of Toledo, Ohio, a well-known contracting firm in this section.

A Prayer to the Wiremen.

The following is a copy of several clever paragraphs which have been addressed to the wire manufacturers of the country by S. A. Hobson, vice-president of the Hobson Electric Company, Dallas, Tex. Along with contractors and supply men all over the country, Mr. Hobson has found it difficult at times to get prompt shipments, owing to the tremendous demand for material.

"We beseech thee, oh mighty Factory! ruling Potentate of the commercial world, to bend thy head and open thine ear, to our humble pleading; for relief from the persecutions of our indignant customers.

"We realize, oh Factory! that we are but thy humble servant, and that our daily acts should but please thy fancy. We further realize that we stand in danger of thy condemnation for having secured so many orders, but we feel that you should overlook our breach of discipline, because we acquired our order-getting habit during the days of thy reign when thou didst command that we send thee more business.

"This was during the great order famine when thy power was endangered.

"We were faithful then and didst have thy approbation and encouragement, but now that thou hast reached the zenith of thy power and glory, it darkens our hearts to feel that thou has abandoned us to the mercy of our clamoring customers.

"Now, oh Factory, we pray thee to "set up and take notice" of our deplorable conditions, and grant us the blessings of a little bit better deliveries of our prayers for some of thy products, which we have hoped for during the past several moons.

"Now, oh mighty producer, if thou wilt but answer our prayer, we will grant to thee all the glory and will shout glad hosannah throughout the land."

ANNUAL REPORT OF THE WESTERN UNION TELEGRAPH COMPANY.

FOR THE YEAR ENDING JUNE 30, 1906.

The annual report of the Western Union shows a substantial addition to gross revenue but a large increase in the expenses, resulting in a decrease in the net. The surplus for the stock was equal to 5.89 per cent as compared with six per cent in the previous year.

The exceptionally large increase in expenses is the unfavorable feature of the 1906 report. The increasing expense of the business, combined with the slow development in earnings has been responsible for the poor showing of the last few years.

The almost stationary position of the gross earnings is shown by the following comparison of the gross per mile of wire operated:

Fiscal Year.	Miles of Wire.	Receipts.
1903	1,089,212	$29,167,686.80
1904	1,155,405	29,249,390.44
1905	1,184,557	29,033,635.04
1906	1,256,147	30,675,654.53

During this period the issue of capital for construction purposes amounted to $4,000,000, the remainder of the three-and-one-half-per-cent real-estate bonds authorized in 1900. In addition, over $2,000,000 was expended for construction out of working capital, leaving a floating debt of about $600,000 on June 30, 1906.

The reduction in earnings per mile is partly the result of the addition in mileage which has not developed as large an earning power as the old mileage, located in larger centres of population. It is also due in large part to the inroads made by competition.

The number of messages and receipts and expenses per message compare as follows:

Fiscal Year.	Messages.	Av. Tolls per Message.	Av. Cost to Company of Message
1903	69,790,866	31.4 cents	25.6 cents
1904	67,903,973	31.7 "	26.1 "
1905	67,477,320	31.6 "	27.3 "
1906	71,487,082	31.6 "	27.6 "

As the cost per message shown does not include the expenditures for maintenance and reconstruction, it will be seen that the increase has been in actual expenses of operation. Higher wages and competition are stated to be responsible.

The report states that the expenditures for maintenance include betterment work which might with propriety have been charged to capital. It is of interest to note, however, that the maintenance absorbs only fourteen per cent of the gross.

The expenditures for new construction during the year were $3,292,981.

Digitized by Google

The Growth of the Westinghouse Interests.

From the *Boston News Bureau*, October 27.

It is not an easy problem to present without the aid of photography the growth of the Westinghouse Electric and Manufacturing interests at East Pittsburg. In brief, the plain has become a city, and yet the plain is such a valley that it can hold only the manufacturing plants, which stretch parallel with the river and the main line of the Pennsylvania Railroad and the hills; and a majority of the thousands of employés move morning and night upon the trains of the Pennsylvania Railroad between the Westinghouse factories and their homes in and around Pittsburg.

Fifteen years ago other growing electrical interests looked upon Pittsburg as a point of electrical contact that they might one day capture or absorb. Few people could believe that Mr. Westinghouse, with his air brake interests extending from the Pacific ocean to St. Petersburg in Russia, his Switch and Signal Company, the Westinghouse Machine shops, and the engineering firm of Westinghouse, Church, Kerr and Company, could make any great expansion in the electric field against the combined electric interests of New England and New York. Such expansion would seem beyond the driving force of a single human mind.

Yet, to-day, we find every Westinghouse company doing more business and earning more gross and more net money than ever before in its history, and the Westinghouse Electric Company close on the heels of the General Electric Company, representing the combined electric interests of New England and of New York, formerly known as the Thomson-Houston of Boston and the Edison of New York. And, as for the Westinghouse Air Brake Company, we find this year its $11,000,000 of capital stock not only paying its regular ten per cent and ten per cent extra, but a second extra of two and one-half per cent the last dividend period, and this notwithstanding the New York Air Brake Company, the newly grown rival of the Westinghouse Air Brake, is paying eight per cent upon its $10,000,000 of capital and doing one-third of the railroad air brake business of the United States. In a foreign field, where the New York Air Brake Company has invested $3,000,000 and has yet to see the return thereupon, the Westinghouse people had invested in advance $1,500,000 capital and earned it all back before the New York Air Brake Company got a footing.

It is generally said in Pittsburg that the employés of the United States Steel Corporation at this point represent or support a population of 100,000, but the Westinghouse interests at and around Pittsburg sustain a population of 75,000 people.

"How many employés have the Westinghouse interests?" was asked by the manager of the *Boston News Bureau* of the manager of the Westinghouse Machine Company at East Pittsburg a few days ago.

The answer was, "If you mean Westinghouse employés throughout the world, we were figuring it the other day and it reached the point of 75,000."

"Nonsense," spoke up Mr. Westinghouse; "we have not any 75,000 employés. We have 15,000 here in the Electric Company, and possibly 30,000 on all our payrolls."

"Here are the figures," responded the manager of the Westinghouse Machine Company.

"Oh!" spoke up Mr. Westinghouse, "you include the Westinghouse, Church, Kerr construction gangs. I do not call them employés. We can not allow that the number of employés on the payrolls of the Westinghouse companies is above 30,000."

"But," said the manager of the Westinghouse Machine shops, "here are 15,000 employés in the Westinghouse Electric Company, and, adding the other factories, the regular employés of the Westinghouse Company, you see by the figures, are far more than 30,000."

"Well," said Mr. Westinghouse, "I have not been here at East Pittsburg for many weeks and I see the shops are pretty full, but I don't think I will own up to more than 35,000 regular employés in all the Westinghouse companies in all places.

"There may be at one time 75,000 people working under the direction of the Westinghouse companies, including construction gangs. We may have 10,000 people one month in Colorado and some months afterward they may be working under the direction of somebody else. These are not our regular people. For regular, salaried people, I think we should not admit of more than 35,000." But even these figures seemed a surprise to Mr. Westinghouse.

The secret of Mr. Westinghouse and his ability to direct his organizations were soon revealed. After inspecting the new type of Westinghouse-Parsons turbines, which have recently been breaking the record for both prices and efficiency, he passed over to the works of the Westinghouse Electric Company and was shown some recent improvements which were going into very important electrical work.

"What shall I pay for this invention?" said the manager of the Westinghouse Electric companies. "You see its efficiency, from twenty per cent to thirty per cent saving at this point."

"Don't bother me with details," said Mr. Westinghouse, "you are paid a salary to run these works and get the best men, the best brains, and the best results."

"But," protested the superintendent, "he cannot speak English, and wants $10,000 a year for three years."

"All right," said Mr. Westinghouse, "take off twenty per cent so long as we have to supply the language," and the inventor's contract was on that day closed.

The secret of Mr. Westinghouse was revealed on the instant. He is an inventor, not alone in mechanics, but with men and with organization.

In twenty years but one financial criticism has been heard of George Westinghouse. Some bankers have called it extravagance, and others have called it too many high-priced men, but the results speak. Mr. Westinghouse does not organize a factory and then run about in bewilderment for somebody to run it. He first buys brains, and then he weaves organization about these brains to produce results, and gets them. He builds in as absolute faith as the farmer plants his corn, in the same faith in which Carnegie and Schwab built steel works, Rockefeller stored oil, or Morgan hives money—the faith that removes mountains because it refuses to recognize their existence.

The Westinghouse Machine shops, with less than $5,000,000 of its $10,000,000 of share capital issued, pays dividends of ten per cent and must be earning very much more, as it has 4,000 employés, and its yards and factories are not only crowded and whirring with the largest kind of machinery, but the units turned out are of the largest size, and must represent a considerable amount of money. One-half the works is devoted to the manufacture of steam turbines, while the Electric company adjoining manufactures the electrical parts.

With natural gas delivered in the machine shops at ten cents per 1,000 feet, one can readily understand why Mr. Westinghouse has devoted so many years to the development of the gas engine, to the manufacture of which a considerable part of the machine shops is devoted. Mr. Westinghouse says that whenever or wherever municipal gas reaches the point it can be sold to the consumer at sixty cents per 1,000 feet, gas engines will revolution-

Digitized by Google

ize light and power. At present gas in cities is steadily going down and the gas engine business is steadily coming up.

The Westinghouse Electric Company must be measured by the acres occupied, number of employés, the gross tonnage, and the gross values produced. The Westinghouse Machine shops occupy twenty-two acres and the Electric Works, forty-two acres. A few years ago the General Electric Company figured 14,000 employés and a gross business of $30,000,000 per annum. To-day the Westinghouse Electric Company has 14,000 employés, and its business has this fall passed the point of $3,000,000 outturn per month, so that gross earnings are now at the rate of $40,000,000 per annum.

The floor space occupied by the Westinghouse companies exceeds the floor space of the St. Louis Exposition and the largest of all the Westinghouse companies is of course the Westinghouse Electric. This company seems not only to eat up acres of ground and swallow in thousands of employés each morning, but the employés have to go out in differently timed companies at night in order not to more dangerously overcrowd the platforms and cars of the Pennsylvania Railroad.

It eats up capital in million-dollar junks. Its inventories show $12,000,000 of material in process. Its warehouses and yards have to be filled to overflowing with more shapes and sizes of iron, steel, etc., than even a United States Steel Corporation could be expected to keep on hand for immediate delivery. More than 2,000,000 pounds of copper per month go into this factory.

English Experiment of Shipping by Electric Wagons.

Consul Albert Halstead reports from Birmingham that an experiment is being made in North Staffordshire with a seventy-horse-power motor wagon for heavy freight traffic that may have far-reaching results, especially in the United Kingdom, where distances between industrial centers and to the seaports from the interior are comparatively short. Mr. Halstead writes:

"The present experiment in using a heavy motor wagon, capacity six tons with a trailer carrying four tons, to carry goods from Hanley to Liverpool is especially interesting to Birmingham, whose manufacturers constantly complain of high freight rates, unfair and inequitable classifications, and the autocratic attitude of the railways that act in concert, even though there is no concentration of ownership. A Birmingham paper says that 'if the scheme should prove successful, the promoters hope in time to run wagons also to Manchester and Birmingham and to tap the big railway companies at convenient points. As the scheme develops the promoters propose to establish depots and warehouse accommodation in the same way as railway companies, and they profess to have every hope of a successful issue to their enterprise.'

"If it be found that freight can be carried expeditiously and economically by motor wagons the industrial situation of the United Kingdom will be materially strengthened. High freight rates, which seem inevitable because of very heavy capitalization of British railways, which was due to the immense cost of their initial construction, are a serious toll on British commerce. Canal traffic is important and helpful, but very slow. The canals are also small and many are owned by the railways. Compared to the splendid system of canals in Germany and France with their low freight rates, the United Kingdom is at a serious disadvantage and feels it more and more because of German competition for the markets of the world, which becomes more aggressive and keener each year. Then, too, German exporters have the advantage of lower railway rates on merchandise destined for export, while the greater regularity of shipment of foreign goods into the United Kingdom results in what are really better rates on merchandise and food products that come from abroad than are obtained by those destined for export. In these circumstances pronounced demand for the improvement of the British canal system, and even for its nationalization, is not surprising.

"If heavy motor wagons prove successful carriers of freight, the further development and improvement of the canal system will not be so important, railway freight rates will naturally come down, whatever arbitrariness there may be on the part of railways will disappear, and the Kingdom will be in far better position to hold its own in the markets of the world, and even to increase its share of those markets.

"There is little reason why the experiment with motor-wagon freight carriers should not be successful here. Roads are almost universally good, distances are not great, motor construction is improving and the output increasing; while rates for carriage should remain low because the highways are free. There can, therefore, be no monopoly of the new method of freight transportation which experts have declared would certainly result from the development of motor wagons."

Cooperative Electrical Development Association.

Arthur Williams, president of the National Electric Light Association, arranged a few weeks ago, a committee of five central station managers to cooperate in the developing and execution of the plans of the Cooperative Electrical Development Association.

This committee, which consisted of three members last year, has been enlarged this year to a committee of five, consisting of the following representative gentlemen: W. W. Freeman, Brooklyn Edison Company, chairman; John W. Gilchrist, Chicago Edison; R. S. Hale, Boston Edison; J. E. Montague, Buffalo and Niagara Falls Electric Light and Power Company; F. M. Tait, Dayton Lighting Company.

Paul Spencer, the previous chairman, rendered excellent service in the development of the plans last year, but special attention required on another committee necessitated his withdrawal.

Mr. Freeman called a meeting of the above committee in Brooklyn on October 30, and the entire day was given over to a careful and detailed consideration of the proposed constitution and by-laws, as well as the detailed commercial plans for 1907, submitted by J. Robert Crouse. The committee was honored for a good portion of the day by the presence of President Williams.

This conference, which will be followed rapidly by similar conferences with the cooperating committees of the manufacturers, jobbers, contractors and representatives of the technical press and advertising agencies, is all preliminary to a meeting of the joint committee of all branches of the trade, to be held in New York within a few weeks, at which it is expected to formally complete and finally agree upon a scheme of organization and the commercial plans for work in 1907.

After a very busy day, Chairman Freeman and his associates, W. F. Wells, Joseph F. Becker, Jr., P. R. Atkinson and M. S. Seelman, gave a dinner for the confreres at Delmonico's, followed by a theatre party. The day's activities concluded very pleasantly with a luncheon and smoker given by President Williams.

It was the unanimous expression that the day had been crowded as full of "Cooperation," both business and social, as was possible, and this meeting doubtless marks a long step in the progress of this cooperative compaign, which is now being recognized by all branches of the trade as having great commercial possibilities.

Digitized by Google

Electrification of the West Jersey & Seashore Railroad—II.

Description of Transmission System, Third-Rail Construction and Car Equipments.

THE 33,000-volt high-tension transmission line is in duplicate throughout. It is Y-connected with the neutral grounded and consists of six No. 1 B. & S. hard drawn copper wires mounted on porcelain insulators. The poles are of chestnut, their height being forty-five feet, with extra long poles where special conditions require. They are spaced 125 feet apart, but at street crossings the spacings are reduced to 100 feet. Head guys are used at distances of approximately one-quarter of a mile. There are two cross-arms, the top arm being twelve feet in length, carrying four insulators, and the lower arm, which is eight feet six inches, carries two insulators. The six wires form two inverted equilateral triangles, and the insulators on each triangle are forty-two inches apart. These wires in each triangle are transposed by one complete spiral between each substation. Locke insulators are used, made in three parts and designed to stand double the working pressure. Each petticoat was tested separately—the top section to 45,000 volts, and the assembled insulator was subjected to 85,000 volts for ten minutes, and also a precipitation test was made at 52,500 volts. The insulators are mounted on iron pins.

The method of protection from lightning consists of a seven-strand galvanized steel cable five-sixteenths inch in diameter strung for the entire length of the line on top of the transmission poles, four feet above the nearest active wire, and provided with ground connections at every fifth pole. This form of protection from lightning is believed to be an efficient supplementary adjunct to the arresters.

In all there are seventy-one miles of transmission line.

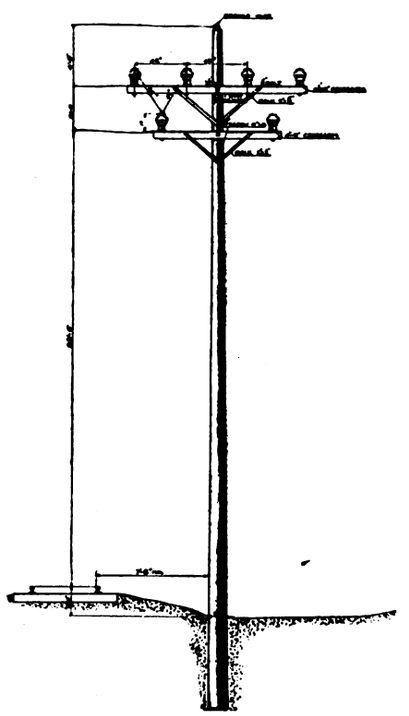
THE THIRD RAIL AND TROLLEY.

The proposition of installing the third rail for the double-track road of this length in the prescribed time demanded a considerable amount of skill on the part of those organizing the work, and the fact that a large amount of steam traffic and double tracking was going on at the same time materially added to the difficulties of the undertaking.

The Pennsylvania Railroad Company provided and installed all the necessary long ties on which the insulators are placed, and also provided and distributed along the track all the third rail, third-rail splice bars and bolts.

The rails used for this purpose are of the Pennsylvania Railroad standard cross-section and composition; they are in lengths of thirty-three feet, weighing 100 pounds per yard, and have a conductivity about equal to that of a copper rod of 1,200,000 circular mils. This type of rail was used in order that it might be interchangeable with the track rails.

The insulators are reconstructed granite, and are held in position by a metal centering cup which is secured to long ties by means of a lag screw. The insulators are ten inches in length and five and one-half inches broad at the base with an effective



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—HIGH-TENSION TRANSMISSION LINE.

depth from the bottom of the rail to the tie of three and one-half inches. An advantage of this method of securing the position of the insulator is that on the ties being depressed by the passage of a train no tension strain is brought to bear in the insulators. The insulators are spaced about eight feet apart. The top of the third rail is three and one-half inches above the top of the track rails, and its gauge twenty-six inches distant from the gauge line of the adjacent track rail, these dimensions constituting the standard of the Pennsylvania Railroad and the Long Island Railroad, which is interchangeable with the Interborough Rapid Transit of New York city.

The approaches of the third rail are made of cast iron. The third rail is bonded with concealed ribbon bonds with solid copper terminals compressed into one-inch drilled holes in the rail. There are two bonds to a joint, and each has an area of 500,000 circular mils.

The third-rail jumpers are of a specially neat design. They are used at all grade crossings and wherever a continuous third rail is impracticable. The cable is drawn into a black bituminized fibre tube, which is laid in a solid concrete protection. Terra-cotta covers are employed to protect the cable terminals. Those for single cable jumpers are of the round form and those for double cable of an elliptical shape as shown.

The third rail is anchored at intervals; this is acccomplished by means of metal clamps secured to the under flange of the rail in such a position as to engage the insulator on each side. The third rails are arranged in such a manner that each track may be isolated from the other, but normally the third rails are electrically connected midway between the substations through a combined switch and fuse box, thus obtaining the combined conductivity of the third rails. There are also section insulators opposite each substation so that in the event of an accident on any part of the system only a short section of the third rail would be dead.

The right of way is fenced in, and at all crossings the fence turns in from the property line to meet Climax cattle guards at the edge of the crossing. In this way the public is prevented from reaching the third rail.

At all stations and in the Atlantic City and Camden yards, the third rail is protected by a wooden top and side guard, consisting of a two-inch plank carried on castings attached to the top of maple posts, which are secured to the third rail at intervals of about six feet. The top casting is of such form that although it is provided with a web for strength no part of it extends either above or below the protection plank.

Opposite all platforms the rail is further protected by a plank fastened to the side. Wherever possible, the rail is kept between the tracks, and is therefore on the side of the track farthest from the station platform, and inter-track fences are provided

Digitized by Google

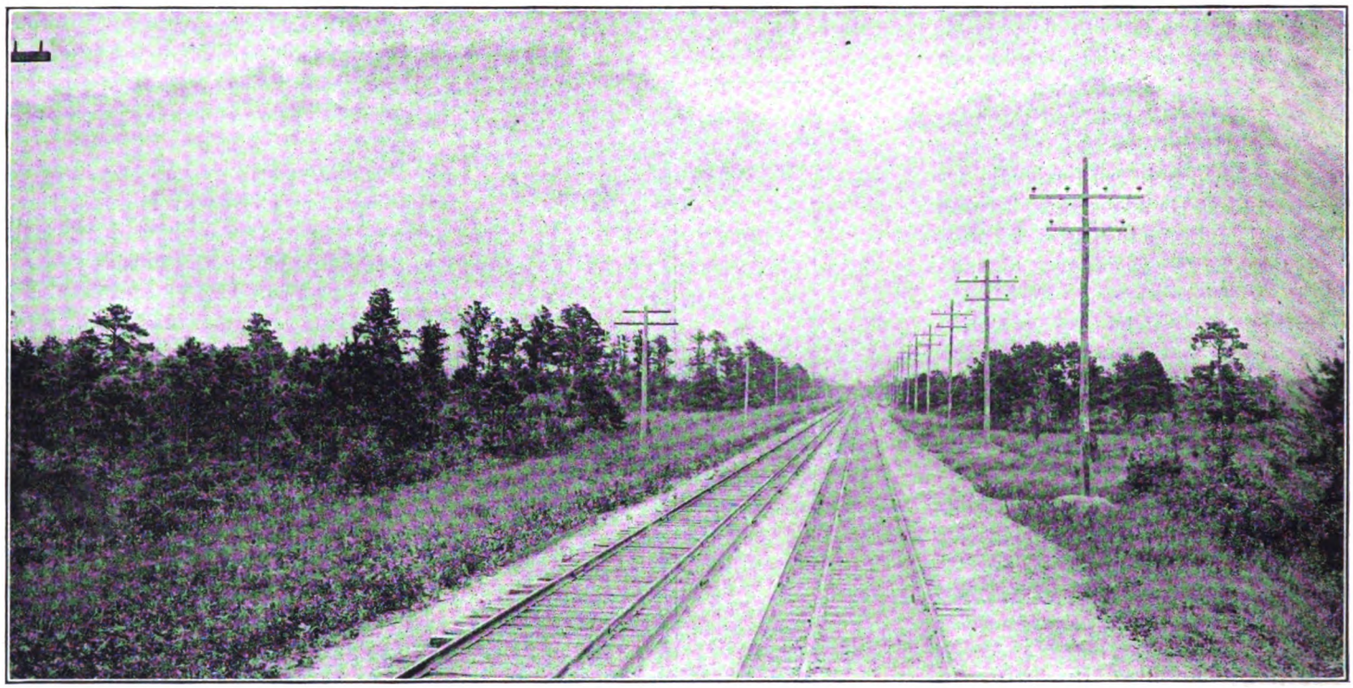
to prevent crossing the tracks. In order to prevent passengers or others on the platforms from touching the contact shoes on the platform side of the car, there is a protecting plank similar to the third-rail protecting plank but carried on castings fastened to the ties. The shoes are at all times under this plank and therefore protected. This is used at all stations, even where the third rail gives way to the trolley, although there is a switch on the car which enables the contact shoes to be cut out when operating from the trolley.

At Atlantic City, where the tracks cross the Thoroughfare, a new drawbridge has been built. The third rails on this draw are connected to the third rails on the approaches by sliding contact shoes, so that when the draw is closed the rail is continuously connected. In addition to this, two 1,000,000-circular mil submarine cables are provided connecting the rails so that the opening of the draw does not interrupt the circuit. The submarine cables for the return circuit are bare.

A point of great interest is to be found in the fact that the third-rail system has been adopted at both terminal stations where there are a number of platforms, and it will be interesting to engineers to learn that this system was adopted on the score of less difficulties being encountered in its installation than would have been the case had an overhead trolley been erected.

BONDING OF MAIN TRACKS.

The bonding of the main track between Camden and Atlantic City was done with a heavy steam traffic in progress during the whole period. All the holes were drilled by hand and the bond terminals were expanded by means of screw compressors. Two bonds of the concealed type were used per joint, each with a capacity of 400,000 circular mils, and on account of the large size of bonds special angle plates had to be provided. This work was performed almost entirely with untrained labor under skilled foremen. The men were given a royalty of five cents on each hole drilled above thirty per day, and some reached as high as eighty in a day's work. The railroad company required that one splice bar should always be kept in place against the rail to provide for the safe operation of the passing trains.



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—ROAD-BED NEAR MIZPAH, N. J.

TROLLEY LINE.

The trolley construction between Newfield and Millville and on the stretch of track between Haddon avenue and South Gloucester is of the span type, with poles spaced at a distance of 100 feet, and where practicable the high-tension transmission poles have been used for supporting the span wires. Through Camden the greater part of the trolley construction is on tubular steel poles. The trolley is suspended twenty-two feet above the top of the track rails.

There are no copper feeders used on the third rail, but those for the trolley lines are as follows: Two 750,000-circular mil feeders from South Camden to Haddon avenue. One 750,000-circular mil feeder running from South Camden to Brown's Crossing.

Both of these form a conjunction with the third rail. The copper feeder between Newfield and Millville is 500,000 circular mils in section.

The length of line between Newfield and Millville is approximately ten miles. The trolley wire is of No. 0000 grooved section. The bonding is similar to that already described on other portions of the road. The span wires are of stranded galvanized steel, three-eighths-inch in diameter. The lightning arresters are installed at approximately 1,000 feet apart. All pull-offs, strain ears, feeder ears and splicing sleeves are of bronze, and as these items, together with all other line material, such as frogs, etc., are of standard pattern, a further description would be superfluous.

CARS.

For initial service sixty-two passenger cars and six combination baggage and mail cars have been provided. All of the cars are motor cars, the motor and control equipment being the same in all. The design resembles that of the standard Pennsylvania coaches, except that the height is less to decrease the weight, the shape of the roof is changed and the interior finish is of mahogany instead of oak.

The seating capacity is fifty-eight passengers and the seats are of the standard type, made by the Hale & Kilburn Manufacturing Company. Both ends of the cars are provided with vestibules and have

Digitized by Google

the standard arrangement of steps, trap doors and vestibule side doors. The vestibule centre door is so arranged that when it opens it slides over and encloses the control apparatus.

The entire underside of the car is protected by one-quarter-inch transite and above the motor truck steel plates over asbestos fire felt is used. The general dimensions of the car are as follows: length over buffers, fifty-three feet five and one-half inches; length over body end sills, forty-six feet six inches; truck centres, thirty-three feet; width over eaves, ten feet one and one-quarter inches; height from top of rail to top of roof, thirteen feet three and thirteen-sixteenths inches; total weight of car, fully equipped, 89,000 pounds.

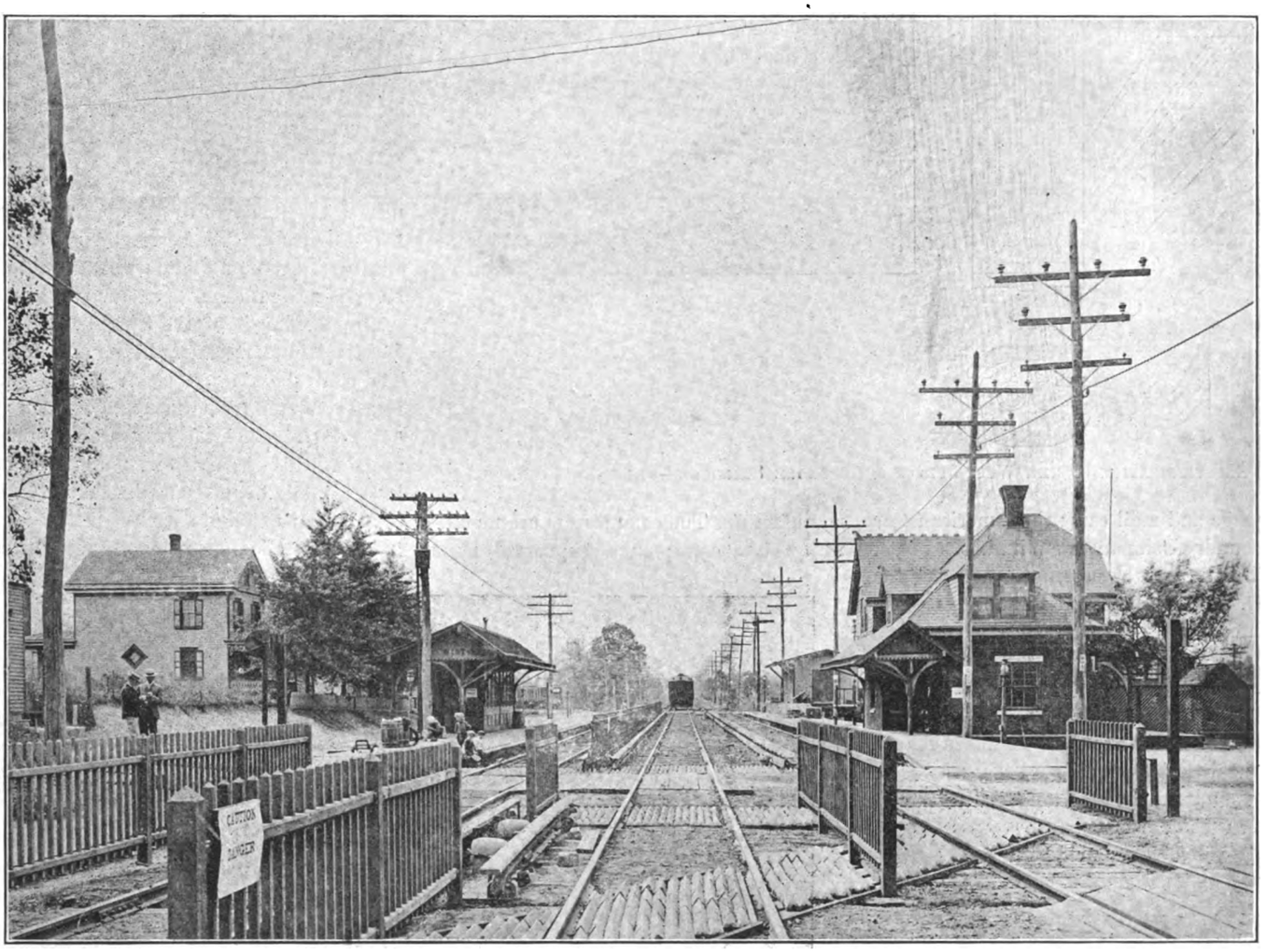
The combination baggage and mail cars are of the same general dimensions as the passenger cars and have similar vestibules. The mail compartment is twenty feet long inside and the baggage compartment is twenty-nine feet nine and one-quarter inches long inside. The arrangement of the baggage compartment is similar to the standard Pennsylvania Railroad combination car and the fittings and arrangements in the mail compartment are in accordance with the standard requirements of the post-office department.

All cars are provided with a fifty-candle-power incandescent electric headlight and two electric markers or route lamps on the hood at each end. These were manufactured by the Dressel Railway Lamp Works, of New York. In the interior of the car there are five five-light clusters and in the saloon there is a single lamp. There are two lights in each vestibule, one being over each trap door, arranged in reflectors so that the lamp does not come below the vestibule ceiling. All wiring for lights is done in galvanized iron conduit on the roof of the car so that it is at all times accessible. Where the conduit goes through the roof to the fixtures, special roof-plates are used, laid in so as to be watertight. On the roof, in the centre of the car, there is an illuminated numeral panel which permits the car number to be read from either side. The lamps in this panel are in the headlight circuit so that they are only lighted on the leading car of the train.

Each car has two trolleys, each with a retriever, and on the roof between the trolley bases there is a box containing the lightning arrester, trolley cutout switch and trolley fuse. Steps are provided on the vestibule corner posts and there are grab irons and roof platforms to permit of easy access to the roof.

The cars are heated by Gold cylindrical heaters, one being under each seat and a total of twenty-eight heaters per car. There are two coils in each heater, thus providing three rates of heating.

In the vestibule, at the saloon end of the car, on the motorman's side, there is a switchboard on which are mounted the headlight and air compressor switches and fuses, the switch for cutting out the contact shoes when operating on trolley, the trolley cutout switch and the current limit relay. This switchboard is provided with double steel doors lined with asbestos and is accessible from the vestibule. This switchboard, as well as all conduit wiring

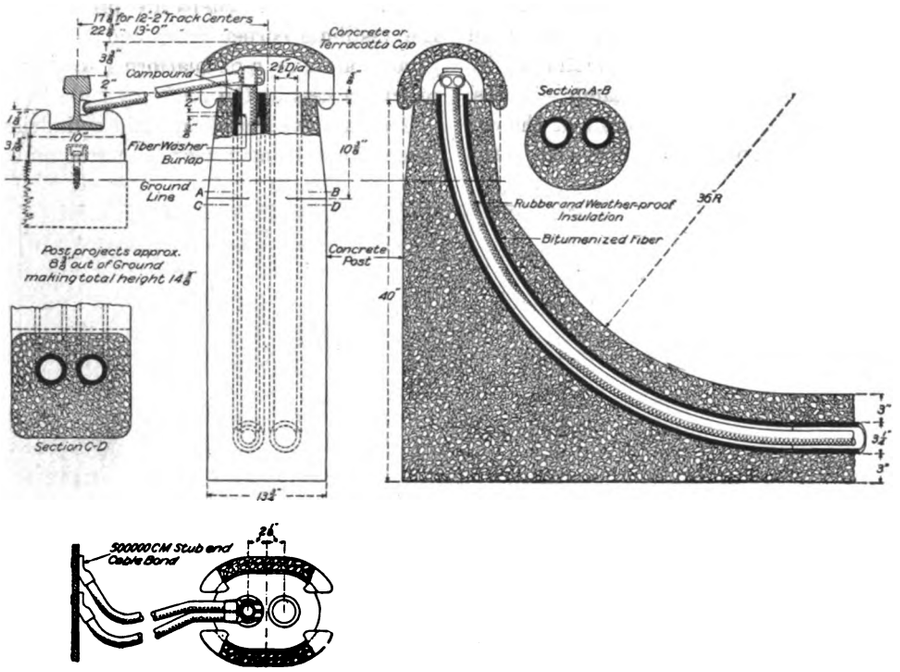


ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—CATTLE GUARDS AND THIRD-RAIL COVERING, WESTVILLE, N. J.

Digitized by Google

and fixtures for heating and lighting, was installed by the General Electric Company.

The Wason Manufacturing Company, of Springfield, Mass., built twenty-two of the passenger cars and the six combination baggage and mail cars; the American Car & Foundry Company, of Wilmington, Del., built twenty-eight passenger cars, and the J. G. Brill Company, of Philadelphia, Pa., eighteen.



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—THIRD-RAIL JUMPER.

TRUCKS.

The motor and trailer trucks are of the M. C. B. double side bar equalized type, somewhat similar to those used on the cars of the Interborough Rapid Transit Company and the Long Island Railroad, but with greater wheel base, which is here, seven feet. The weight of motor truck complete, without motors, is 14,934 pounds, and the weight of trailer truck complete, 9,633 pounds.

The wheels of the motor truck are steel-tired, with separate cast-steel spoke centres. They are thirty-six inches in diameter with M. C. B. standard tread. Tires are three inches thick, shrunk and bolted to the steel centre. The journals are five inches by nine inches, the diameter of the axle at the wheel fit is five inches and diameter between wheels is seven inches, finished all over.

The motor and trolley trucks for sixty-five cars were built by the Baldwin Locomotive Works, of Philadelphia, Pa., and for three cars by J. G. Brill Company, of Philadelphia, Pa.

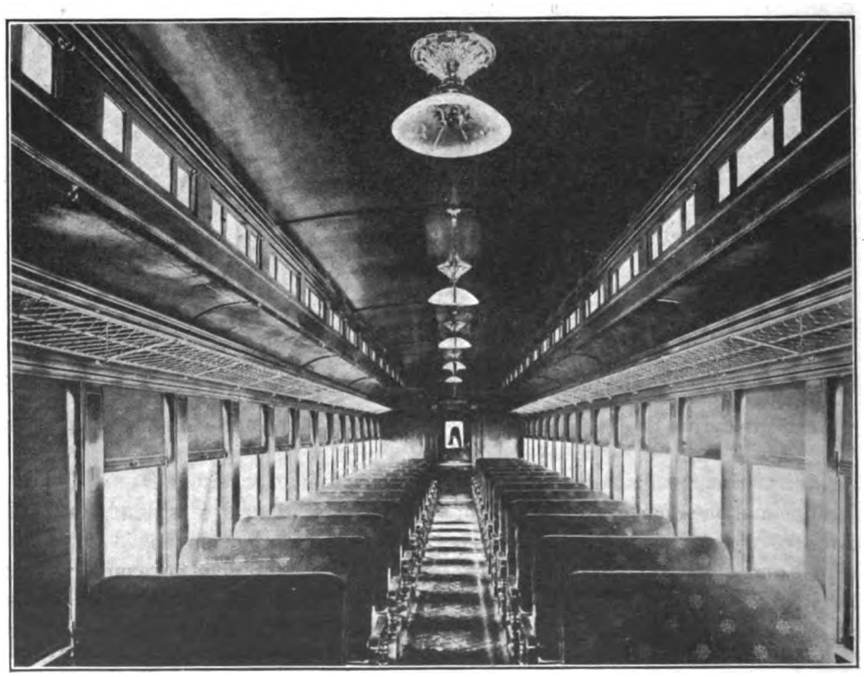
The cars are equipped with hand brakes and with Westinghouse quick-service automatic air brakes.

The motor-driven air-compressor, with its governor, together with the whistle, are all of the General Electric Company's manufacture. The compressors are mounted on two oak planks, supported by a cradle of wrought-iron bars. The cradle is suspended beneath the car near the motor end and permanently bolted to the sills. The compressor consists of a duplex single-acting air pump, driven by a herring-bone gear and pinion from a railway-type motor. All parts of the pump and motor are easily accessible and are designed so as not to be damaged by the severe conditions met with in this class of service. The motor is of the entirely enclosed type, and required no additional housings or protection of any kind. The governor is a combination of diaphragm, piston, springs and operating levers connected to a single-pole switch of a type similar to the contactors used in the motor circuits. The working parts are protected by a hinged cover which can readily be dropped for inspection.

The General Electric Company installed all the brake apparatus, including piping, but not the foundation brake rigging, which was furnished by the car builders.

The electrical equipments were furnished and installed by the General Electric Company. There are two General Electric sixty-nine motors which are 200-horse-power units on each car, while the control system is of the Sprague-General Electric automatic multiple-unit type. The controllers are so arranged that current is cut off from the motors throughout the train and the brakes are applied automatically should the motorman release his hold of the controller handle.

A large portion of the electrical apparatus was installed on the car bodies during their construction at the works of the three car builders. All the cables for the electrical conduits are run in grounded loricated conduits, the outlets of which are provided with rubber-bushed bell mouths.



ELECTRIFICATION OF THE WEST JERSEY & SEASHORE RAILROAD—INTERIOR VIEW OF MOTOR CAR.

Digitized by Google

The conversion of the lines of the West Jersey & Seashore Railroad above described from steam to electric traction was carried out by the following organizations:

The construction of the terminals, inspection sheds, double tracking, changes in existing tracks, grading, new bridges, changes in telegraph lines and installation of a special telephone system, were carried out by the regular engineering and maintenance-of-way departments of the Pennsylvania Railroad Company.

The installation of the interlocking plants and automatic block signalling was carried out by the Union Switch & Signal Company in accordance with plans of the signal department of the Pennsylvania Railroad Company.

The new cars and trucks required for the electric service were designed by the motive-power department of the Pennsylvania Railroad Company.

The entire contract for the electrical equipment, including the construction of the power-house, substations and the electrical equipment on the cars, was awarded to the General Electric Company, and in accordance with the plans and under the supervision of George Gibbs, chief engineer of electric traction, in consultation with the officers of the railroad company. Stern & Silverman, of Philadelphia, were appointed by the General Electric Company as their general subcontractors, and the Scofield Company, also of Philadelphia, acted as general engineers for the power-house and subcontractors for the piling and foundations.

The whole of the electrical work was under the personal supervision of W. B. Potter, engineer, railway engineering department, General Electric Company, directly assisted by J. Elliot Hewes, C. E. Eveleth and W. H. Clapp.

The Production of Platinum in 1905.

The year 1905 saw a phenomenal rise in the price of platinum and a greatly increased production in the United States. The annual report of the United States Geological Survey on the production of platinum, prepared this year by F. W. Horton, contains details of exceptional interest. It shows that early in March, 1905, the price of ingot platinum advanced from $19.50 an ounce to $21 an ounce, surpassing gold in value. On April 1, 1905, the price fell to $20.50 and remained firm at this quotation until February 1, 1906, when it jumped to $25 an ounce, where it remained until September 1, or about six weeks ago, when it leaped to the unprecedented value of $34 an ounce. Mr. Horton's report also shows that the production of platinum in the United States increased from 200 ounces in 1904 to 318 ounces in 1905.

The rise in the price of platinum and its increased production in this country may be ascribed to two causes: the growing demand for the metal and the reduced yield of the Russian platinum placers, which usually furnish about ninety per cent of the world's supply.

The anxiety felt by the platinum dealers during the Japanese-Russian war has not abated since the settlement of international difficulties, but has rather increased as Russia's internal dissensions have developed. Even before the uprisings, it is said, the large Russian mines were purposely curtailing their production. This reduction of the output is due to the fact that the entire product for a varying term of years was bought up under contract and at prices that now seem ridiculously low. As the mine owners receive only the fixed price, they do not participate in any gain due to rise in value and are, therefore, not desirous of a large production, but are husbanding the limited resources of their mines until such time as they can dispose of their product to better advantage. Meanwhile the small mines, which, generally speaking, are not hampered by such agreements, are working to their full capacity to take advantage of the stimulated prices; but their entire output is only a small percentage of what is usually produced. A greatly increased consumption of platinum in the electrical and chemical industries, together with this stringency of supply accounts for the prevailing high prices.

The exhaustive tests and examinations of black sands commenced early in 1905 in connection with the Lewis and Clark Exposition, and still being carried on at Portland, Ore., by the United States Geological Survey, have done much toward placing platinum mining in this country upon a stable footing and developing it into a permanent and profitable industry. Not only have many discoveries of platinum in new localities been made, but the tests have revealed the fact that there are in this country districts which contain surprising quantities of platinum, and they have also given much valuable data as to the best method of obtaining it.

Platinum is now known to exist in fifteen counties in California: Butte, Calaveras, Del Norte, Humboldt, Mendocino, Nevada, Placer, Plumas, Santa Barbara, San Luis Obispo, San Bernardino, Shasta, Siskiyou, Trinity, and Yuba; in nine counties in Oregon: Baker, Coos, Curry, Douglas, Jackson, Josephine, Lincoln, Linn, and Union; in eight counties in Idaho: Ada, Bingham, Boise, Elmore, Idaho, Nez Perces, Oneida and Shoshone; in four counties in Colorado: Chaffee, Park, Saguache, and San Miguel; in three counties in Washington: King, Skagit, and Whatcom; in two counties in Montana: Custer and Granite; in Utah, in Garfield county; in Arizona, in Yavapai county; and in Wyoming, in Albany county. The metal is also rarely found in Alaska and in the gold bearing sands of Corozal river, Porto Rico. Isolated occurrences of single nuggets or mere traces of the metals have been found in many other counties of these states, as well as in four of the eastern states, namely, New York, Pennsylvania, North Carolina, and Georgia. In many of these localities the metal occurs but sparingly. The most promising fields are in the counties of southern Oregon and northern California. Here the metal has been found in commercial quantities. With proper methods a considerable annual output should be obtained.

The platinum metals are usually found in working gold placers, especially where the gravels are derived from peridotites. Many managers of placer mines have been convinced for a long time that it would pay to save the platinum in the gravels, if it could be done by some inexpensive method. The experiments of the Geological Survey which were conducted under the supervision of Dr. David T. Day, have shown conclusively that ninety-five to ninety-eight per cent of the precious metals both gold and platinum, contained in the sluice box sands can be saved on concentrating tables of the Pinder or Wilfley type, such as are used in everyday practice; and that in most cases the concentrates thus obtained will represent less than one per cent of the total weight of sand fed to the table.

Besides discussing the experiments made in the recovery of platinum in this country, Mr. Horton describes the methods of extraction in vogue in Russia.

It should be noted that the imports of platinum during 1905 were valued at $2,173,263, as against $1,879,155 in 1904, an increase in value of $294,108. Considering the increased demand for platinum, the gain in importation is slight, but if the high price and scarcity of the metal be taken into account the wonder is that there was not a large decrease in the quantity imported.

This report of Mr. Horton's is published as an advance chapter of the annual volume, "Mineral Resources of the United States, 1905," and is distributed, free of charge, on application.

Digitized by Google

ELECTRIC RAILWAYS IN SPARSELY SETTLED COMMUNITIES—II.[1]

BY E. P. ROBERTS.

(*Concluded.*)

Generally, interurban roads entering a city of any considerable size use the tracks of the local street-car system, but sometimes it is possible to obtain an independent entrance, and, when the financial condition warrants it, this is preferable. It is, however, seldom warranted unless the anticipated travel is very considerable, and, of course, is materially affected by the cost of construction required in the city, including the cost per mile and total mileage, which includes the first cost and the maintenance of street paving, sprinkling charges, if any, etc., and city taxes. It also depends upon what arrangement can be made with the local company for operation over its tracks.

In a general way the shorter the route in the city, or more correctly, the less the time of the run in the city, the better for the interurban railway.

The foregoing materially depends upon the frequency of service given by any competing steam road and by the time required between the station of the steam road and the retail centre, not only in the principal terminal city, but also in the principal towns along the route.

Another point is the location of the road in cities and towns along the route. The receipts of an interurban electric railway depend largely upon the accessibility of its cars and its frequent service, but, on the other hand, accessibility in the cities and towns generally means somewhat increased first cost, also a longer time for the run. If freight cars are to be handled it means considerable additional trackage for the freight line.

In addition to the foregoing, the recent development of the alternating-current motor system makes it desirable for such roads as use such system to keep on private right of way to as great an extent as possible, and when in cities and towns to use only such streets as will allow the use of high-voltage trolley. As a matter of fact, high-voltage trolley is now used in some towns of considerable size and on roads passing through the heart of same, but it is hardly probable that this will be permitted in all towns. In some locations it may not be found advisable even if permitted.

Having made a preliminary location and ascertained the distances in the cities, towns and country; having considered that a certain sized passenger car operating on a certain headway will give the best service, and on the presumption that, all things considered, a certain grade will be most economical, a train schedule is prepared showing the time of the run for passenger service. There will generally be two train schedules, one for express and the other for local service.

It is advisable that the trains should follow at regular intervals, which intervals, however, may be varied at different times of the day and at different seasons, but the trains should always start from one end on the hour, and when more frequent service is desired, half-hourly and quarter-hourly. The time of leaving the other end should also be on the hour, or at some regular division, such as the half or quarter-hour. It is evidently necessary, therefore, to provide motors which will make such speed as is required to give a schedule enabling a car to make the run one way and provide at the end of such run sufficient time for layover, so that it can unload and load with sufficient leeway, and, in case of delays, it will still start out on the return run on the schedule time. The time of the run in the principal city is dependent upon the schedule time of the city cars if the local company's track be used, or upon local ordinances and conditions if the interurban company has its own track. The schedule speed in the principal terminal city will probably be approximately eight to twelve miles per hour, being somewhat less in the congested portion of the city run, and possibly slightly greater in the suburbs.

The same conditions apply to the runs in the towns along the route, although generally to a less degree, but in any case the schedule in cities and towns is based on local conditions, and not upon the speed obtainable by the motors.

The speed on the country run, which for modern roads is generally on private right of way, depends upon the grade, and, for any given weight of cars, upon the power of the motors, and, of course, upon the maintenance of the voltage. The schedule speed depends upon the above and also upon the number of stops.

The length of layover is often of material bearing on the question of size of motors. Sometimes by allowing a car to layover at one or both ends of the run for fifteen or thirty minutes it is possible to use a smaller motor than would otherwise be necessary. Such layover is seldom objectionable, as it gives an opportunity to sweep out and clean up a car, and frequently when the car barn is at one end of the terminal, it is possible to provide such a layover without any additional expense. By so doing, a material saving can be made on the first cost of all the car equipments, and may more than offset the first cost of the extra cars and equipments which may be required, and the repair and depreciation may be less. Actually it is seldom that additional cars would have to be purchased as there are always supposed to be enough cars for special occasions.

The number of stops made by a car has a very decided effect upon the size of motor necessary to drive it, and with any given schedule and car the less the number of stops the smaller and cheaper the motor equipment.

Taking a given car geared to a maximum speed of forty miles per hour, with eight stops per mile, the possible schedule speed is less than ten miles per hour. With four stops per mile the possible schedule is less than fifteen miles per hour. With two stops per mile the schedule speed is about twenty miles per hour, and with one stop per mile the schedule speed is about twenty-six miles per hour. On the other hand, with one stop in eight miles a schedule speed of thirty-four miles per hour can be made. Of course, the above is based on having a level and straight road.

Had the same car been equipped with motors geared to but thirty miles per hour, it would have made with eight stops per mile a schedule speed of eight miles per hour, which is practically the same as before; with four stops per mile it would have made a schedule of thirteen miles per hour; with two stops per mile a schedule of seventeen miles per hour. The schedule will not only be practically as good as that made with higher gearing, but also the motor equipment can be decidedly smaller and cheaper, and the fluctuation of load at the power-house will be much smaller than that resulting from the higher-speed car.

Some roads have larger cars than are most economical for the service, and the use of smaller cars is of additional value by reducing the size of motor equipment required, and by lessening the fluctuation of load at the power-house. Smaller cars also permit of lighter track construction, small substations and, in fact, lower costs generally. On the other hand, if travel is great enough so that a small car can not handle the traffic, then two cars can be run on half of the headway with but little more cost, except as to train crews, than for the operation of one large car, with the result of much better service, with

[1] Abstracted from a paper read at the convention of the American Street and Interurban Railway Association, Columbus, Ohio, October 18.

Digitized by Google

consequently increased income, and with comparatively small increase in the power-house and substation equipment required.

If, for example, a preliminary estimate shows that it will take two hours to make the run over the proposed road, forty miles in length outside of the principal city, and possibly three miles therein, it is evident that a time-table based on cars leaving such end of the route on the hour will necessitate the car leaving at the same time as it arrives; in other words, there is no provision for layover. It is evidently necessary to lessen the time of the run, and this must be done by lessening the time of the run in the cities and towns, which presumably can only be done by lessening the length of the run in same, especially the run in the congested district, or by increasing the speed of the cars, requiring, therefore, more powerful motors, or by reducing the number of country stops, which necessitates a consideration of the effect of same on travel, or by reducing the grades, and unless the grades are considerable, the amount of the reduction, as far as time is concerned, will generally be found quite small and not comparable with lessening the number of stops.

When considering freight service the principal consideration is the train load, schedule speed within considerable limits not being of great importance, but the load which the electric locomotive can haul, requiring the service of only one train crew, is of vital importance. In connection with passenger service it is of great importance to make such schedule as will use the time of the train crews to the greatest advantage, as the cost of their time is one of the principal items of operating expense.

Having obtained a general view of the proposition, especially as to its general character and the approximate amount of traffic, and having from a map obtained distances, and from examination of a preliminary or a final profile, ascertained approximate grades and the amount of grading construction, the investigator is in a position to decide as to the general type of road, the system to be used (alternating-current or direct-current motors), and to prepare a preliminary estimate of first cost, cost of operation, and, most important of all, net income.

The preliminary report informs the projector as to whether or not the proposition has such merit as to warrant its construction, and if it is not warranted, then the sooner such fact is ascertained the less the time and money which will be wasted. If, however, it is warranted, then successful operation depends to a large degree upon the design being that best suited to the conditions; such amount of money being available as required in order to obtain the best net results, and its construction to be so supervised as to assure that the contracts are lived up to.

Some interurban electric railroads should never have been constructed, as under no conditions were they warranted. Others have been improperly designed, considered from the standpoint of obtaining the best net results. In some cases the construction has been of too expensive a character, and in other cases there has not been sufficient money expended on the construction. Other roads have not been properly maintained, and still other roads have not been properly managed. Of course, some roads come under more than one of the above classes. If, however, a road is justified, then its success, exclusive of its financing, depends upon obtaining the best location, proper design for the conditions, proper construction, competent operation. It is noted that the first three are dependent upon the expert adviser, and that the result which can be obtained by the fourth is largely affected by the attention given to the first three. Moreover, the first three are practically unchangeable after the road is constructed, whereas the fourth, if in incompetent hands, can be changed.

If the project is warranted, then the maximum degree of success in financing depends largely upon the proper presentation of the proposition. There should be a short, clear and concise statement as to the territory served, the estimated first cost, and the gross and the net income, followed by such detailed estimates, statements and other information as experience indicates is desired by financial houses.

When it is decided to construct the road a location survey is made, which may or may not have been preceded by a preliminary survey. The latter may have been, and frequently is, made prior to the preparation of the report submitted as the basis of the financing. In fact, sometimes a location survey is made prior to such time.

The object of a preliminary survey is to ascertain distances more accurately than are generally obtainable from published maps, and also to more closely approximate the grades and amount of grading than can be ascertained merely by going over the route, although, as before stated, if the country is reasonably level, an expert in such work can quite closely approximate the amount of grading.

Preliminary surveys of alternative routes are frequently made and are useful for comparison of length of routes, cost of construction, comparative value of route from earning basis, and are sometimes of assistance in obtaining rights of way at minimum cost.

As the civil and mechanical electrical engineering departments are closely related, it is necessary to decide as to what grades will be most economical. Reducing the grades adds to first cost and also adds to the maximum power required, and consequently, unless storage batteries are used, reducing the ratio of average power to maximum power, and such reduction increases the cost of fuel. The effect of grades on passenger schedule must be noted and also on the load which the freight locomotives can haul. In a general way, it is evident that the most frequent the service and the heavier the trains, the greater the amount which it can be most economically expended in the reduction of grades, and as a future improvement of grade will require a greater expenditure than if such grade were established at the start, it is wise to give consideration to the somewhat distant future.

Having decided as to the grades, the train schedules and the motor equipments, the next point is to provide for the furnishing of power to the cars. Presumably decision has been reached as to the system to be used, also as to the most desirable location of the power-house and substations. The next point is to definitely determine the general character of the machinery for same and the rated capacity and number of the various units.

Each substation must have sufficient capacity for maximum demand, and judgment must be exercised as to whether to provide any reserve capacity in excess of such maximum. The number of units must be such as will furnish power for the average load, even though one unit be crippled, and also will enable the units in operation at any one time to operate as nearly as possible at their rated capacity. It is also desirable not to have an excessive number of units, as for a definite total capacity this increases the first cost.

The general proposition as to the design of the power-house is the same as above stated for substations, but on the basis that such power-house is to be a steam plant, careful study must be made of the cost and character of fuel, the required draught

Digitized by Google

for such fuel, the best ratio of grate to heating surface; and if compound engines are used, the best ratio of cylinder diameters in order to obtain the maximum economy under operating conditions, taking into account steam pressure, superheat, if any, and the most economical vacuum.

It will be noted that the preceding necessitates a predetermination of the load curve, the probable momentary and short period fluctuations, and, as before stated, and these are affected by the grades, the weight, maximum speed and schedule speed of the cars, and by the train schedules, all of which indicates the close interrelation of the various factors entering into the problem of so designing an interurban electric railway as to obtain the maximum rate of dividends.

After all plans and specifications are prepared, the contracts are awarded, and it is unnecessary to state that there is considerable opportunity for saving money in awarding contracts.

The next step is to so supervise construction as to assure that the contracts are fulfilled. When construction is completed and accepted, then the road is turned over to the operating department, and on the basis that such department is competent, the results obtained depend very largely upon the character of the work which has preceded. A comparatively few extra dollars expended in assuring the best possible design and construction will probably save many times the interest on such additional expenditure, and there is no investment which pays as large dividends as that which can wisely be expended in order to "start right."

Electrical Machinery Breakdowns.

Michael Longridge, the chief engineer of the British Engine, Boiler and Electrical Insurance Company, Limited, of Manchester, England, has for some years past made a special point, in his annual reports, of selecting from the daily experiences of his inspectors and engineers such incidents as will act as sign posts to warn users of electrical machinery of the many pitfalls which experience alone can teach them to avoid. His report for the year 1905 was issued recently, from which the following interesting points are taken:

The report shows a large increase in the company's business accompanied by a still larger increase in claims. The explanation suggested is the deterioration of electrical machinery by age and use. At the same time it is believed that the heavier fuses which the insurance company has been compelled to allow to meet the heavy starting currents required by motors in so many cases are not without influence on the rate of breakdown. This rate among dynamos is decreasing, but among motors, particularly small motors, it is increasing, and somewhat rapidly increasing. In 1905 it was no less than one in eight, which means that every eighth motor insured broke down within the year. Among dynamos it was lower. The rate among continuous-current motors exceeded the rate among alternating-current motors by forty per cent, while the rate among alternating-current dynamos exceeded the rate among continuous-current dynamos by twenty-nine per cent.

The proportions in which the various parts of the machines are thought to have given way are set out in the following tables:

	Dynamos. Per Cent.	Motors. Per Cent.
Armatures and rotors	53	48
Magnet coils and stators	6	13
Commutators and brush gear	25	28
Miscellaneous	16	11
	100	100

STARTING SWITCHES AND CONTROLLERS.

	Per Cent.
Resistance coils	48
Contacts or switch arms	15
Automatic apparatus	13
Miscellaneous	24
	100

And the causes of the breakdowns were probably the following:

	Dynamos. Per Cent.	Motors. Per Cent.
Accident	15	9
Dirt and neglect	14	19
Age and deterioration	21	25
Bad workmanship and design	23	18
Overloading	0	2
Unascertained	27	27
	100	100

STARTING SWITCHES AND CONTROLLERS.

	Per Cent.
Accident	22
Dirt and neglect	11
Age and deterioration	23
Bad workmanship and design	9
Improper use	7
Unascertained	28
	100

The following reports of breakdowns are particularly interesting:

A continuous-current forty-eight kilowatt motor transformer, with double-wound armature receiving current at 1,000 volts, and generating at 115 volts; one of several placed in different substations to feed a low-tension network.

In ordinary working the field magnets were excited by current shunted from the low-tension brush leads, but for starting purposes there were also a fairly large number of coils in series with the high-tension circuit, which were automatically cut out by a "stray-field" switch, when the excitation was complete. There was also an automatic single-pole switch on the low-tension side for connecting to and disconnecting from the low-tension cables.

The high-tension cables were protected by double-pole fuses at the generating station. One day these fuses melted, indicating some fault in the system, which was afterwards found to be a short circuit on the mains supplying the transformer.

A man was at once sent to the substation. He found the transformer running at an excessive speed and stopped it, but not before the binding wires had been broken and the end connections to the armature spread by the centrifugal force, so that the armature had to be entirely rewound.

There was some uncertainty as to the cause of the mishap, but after getting all the information obtainable the insurance company came to the conclusion that when the high-tension current was cut off by the melting of the fuses and the machine began to run as a motor with current from the other transformers, in connection with the low-tension network, and to deliver current to the short circuit created by the fault, the current taken from the low-tension mains would be so great as to cause a heavy momentary fall of potential in these mains, and in the shunt, which would demagnetize the field sufficiently to throw out the "stray-field" switch and throw in the series windings. These opposing the effect of the current in the shunt would permanently weaken the field, and allow the armature to attain a speed sufficient to cause the damage above described. This conclusion was supported by a very important fact not hitherto mentioned. The automatic switch on the low-tension side was out of order and failed to fall out at the moment the current was reversed. Had it acted as was intended, the machine would have been switched off the low-tension mains when the fuses on the high-tension cables melted.

A semi-enclosed three-phase alternating-current motor, taking eighty-five amperes per phase at 350 volts, driving shafting in an ironworks. In consequence of persistent melting of the fuses the inspector was sent for to ascertain the cause. On testing for insulation he found the stator windings earthed. As far as could

Digitized by Google

be seen through the openings in the front cover of the casing everything appeared to be in order, but on taking off the cover at the pulley end, which was unprovided with inspection holes, and taking out the rotor, the cause of the trouble became evident.

That end of the machine was saturated with oil and covered with dust, and the stator windings were burnt in many places by arcs caused by temporary short circuits. Their condition was so bad that the stator had to be entirely rewound. The oil had come from the bearing at the pulley end of the rotor shaft. This bearing was partly inside the casing, and the mouth of its overflow pipe was placed so high that the oil well could be almost filled with oil. This, combined with an inefficient guard over the oil thrower and the high speed of the shaft, 750 revolutions per minute, allowed the oil to creep along the shaft and to be thrown on to the windings of the motor.

There seems to be a somewhat widely-held impression that alternating-current motors can not be damaged by oil or dirt. As regards the rotors there is some excuse for the belief, because the difference of potential between the windings themselves and between the windings and the frames is low, and therefore imperfect insulation may be sufficient to confine the current; but as regards stators the only advantage they have over the armatures of continuous-current machines is this, that they are stationary, and therefore their insulation is less liable to disintegration and will hold out longer in a deteriorated state than if it were subject to the vibration of a moving part.

The above is quite a typical example, twenty-three per cent of the failures of alternating-current motors in 1905 being due to this same cause.

A continuous-current, series-wound, four-pole motor, rated at four horse-power when running at 600 revolutions per minute with current at 220 volts. The motor drove the longitudinal traveling motion of a ten-ton crane. It was placed below one end of the girder, which had a span of about thirty feet, and was coupled to the driving shaft by gearing. The armature shaft broke at an abrupt change of diameter. The armature dropped upon the pole pieces, which tore off the binders and damaged the insulation of the conductors. As a previous shaft had been broken in an exactly similar way a year before, the owner decided to alter the design.

Some tests were made after the new shaft had been put in to ascertain the starting and working currents with the carriage carrying the motors for the lifting and cross traverse in three different positions—at the same end of the girder as the driving motor, half way along it, and at the end farthest from the driving motor. The results are given below:

Position of Carriage.	Starting Current. Amperes.	Working. Current. Amperes.
Same end as driving motor	25	15
At middle of girder.....	30	15
At end furthest from driving motor	35	15

The experiments were repeated with a weight of five tons hanging from the carriage, with very similar results.

It is not quite clear why the starting current increased with the distance of the carriage from the driving motor. The most probable explanation seems to be that the cross shaft which drove the wheels at the end of the crane furthest from the motor was weak and twisted, so that the wheels next the motor began to revolve before those at the far end of the girder and thus caused one end of the girder to advance before the other, throwing the wheels athwart the rails. As the twisting of the cross shaft would depend on the inertia of the mass to be moved it would be greatest with the carriage at the far end of the girder. When the driving motor is geared to the middle of the driving shaft the tendency to slew the girder is not so great.

The breakage of the shaft must be attributed to the weakening effect of the abrupt change of diameter, for with the highest starting current the stress would not have exceeded 3,400 pounds per square inch.

A common cause of damage to the field coils of shunt-wound motors and to the no-volt release coils of starting switches, is high voltage generated by induction on breaking shunt circuits.

Berlin Street Lighting.

The different systems of street lighting in Berlin is the subject of a letter from Consul-General A. W. Thackara. He writes:

"An English company which secured the charter eighty years ago for providing Berlin with gas continues in active operation, competing, however, with municipal gas works established later. The prices of gas have been reduced several times, and now stand at eighty-three to eighty-seven cents per 1,000 cubic feet for lighting and eighty cents for cooking and for power. These price reductions lessened the profits of the gas works; nevertheless, profitable results have accrued to gas-works operations. For the fiscal year 1903 (the latest figures obtainable) the value of the municipal plants totaled $24,564,000 and the receipts were $7,085,896. The actual amount of loans on the plants were $10,111,893, and $425,854 was required for paying interest. Other expenditures were $305,679 for redemption of debts and $5,192,203 for working expenses, leaving a net balance of $1,159,780. In addition to the three city gas works now in operation, which can produce about 1,000,000 cubic meters every twenty-four hours, a new large gas plant is in construction which will produce 780,000 cubic meters per day, and a plot of ground has been purchased on the Upper Spree for a similar gas works. That the municipal gas works is regarded as a commercial concern is proved by the fact that the contracts for the delivery of gas made with the public are considered as contracts according to civil law, like any other contract made between a merchant and his customer. The different systems of street gas lighting are the inverted Welsbach lights and the Erich and Gratz, each of which consumes 100 liters every hour, the upright Welsbach lights, which consume about 125 liters, and the Millenium, which consumes nine-tenths of a liter per Hefner candle.

"The supply of electricity for lighting and industrial purposes has for many years been in the hands of a private company, which is bound to light the streets at the same price charged for industrial purposes, which is 3.8 cents per kilowatt-hour. Moreover, the company has to pay the city treasury 10 per cent of its gross proceeds and to give it a share in the clear profits of its business. If the clear profit exceeds six per cent of the joint stock up to the amount of $4,760,000 the company must pay fifty per cent of the clear profit; should the joint stock be augmented beyond $4,760,000, fifty per cent must then be paid of the clear profit that exceeds four per cent of the capital. Although this contract grants to the company the right to use the streets for electric conduits it provides that competition shall not be excluded. The municipality shall also be entitled in 1915 to claim that the whole electric plant shall pass into its hands on payment of the estimated value.

"For the fiscal year 1903 the Berlin electric works paid to their shareholders $569,772 and a total to the municipality of $677,419. This is an excellent comparison with the 1899 figures, when $449,820 went to the shareholders and a total of $368,630 to the municipality. For lighting purposes the cost of electricity in Berlin ranges from 7.6 to 9.5 cents per kilowatt-hour. Between the hours of 10 P. M. and 6 A. M. the rate is 7.14 cents. For industrial power purposes the rate is 3.8 cents per kilowatt-hour."

Digitized by Google

THE NEW MUSPRATT LABORATORY OF PHYSICAL AND ELECTRO-CHEMISTRY AT LIVERPOOL UNIVERSITY.

BY JOHN B. C. KERSHAW, F.I.C.

The new laboratory for the study of physical and electrochemistry which has been built in connection with the University at Liverpool, is the gift of E. K. Muspratt, of Seaforth Hall, a member of the old Lancashire family of alkali and chemical manufacturers.

The building with its equipment is likely to cost between £15,000 and £16,000. The original sum offered by the donor was £10,000, but the extra cost of the laboratory is to be borne by Mr. Muspratt, who has been anxious to render the building and its equipment one of the most complete in this country for the study of physical and electrochemistry.

The new laboratory has been erected upon a plot of ground behind the existing chemical laboratory of the University in Brownlow street; and is a striking building of four stories of red brick and stone, surmounted by four stone cupolas which serve as draught exits for the ventilation of the building.

The plan of the laboratory may be gathered from the following details of the rooms, etc., upon each of the four floors:

The basement contains a dynamo room, battery room, store, furnace room, and extra research room, to accommodate four students.

The ground floor contains lecture rooms, accommodating eighty to ninety students, library, workshops, preparation room, and photographic room.

The first floor contains the elementary laboratory, accommodating twenty-one students, optical room, instrument store room, research room for members of staff, research room accommodating two students, and balance room.

The second floor contains the senior laboratory, accommodating eight students, research room for members of staff, research rooms accommodating six students, and balance room.

The roof contains the lavatory, distillation room, store and small roof laboratory.

It will be seen, therefore, that the laboratory contains good accommodation for about forty-three persons.

The benches are supplied with gas, water, and electricity, but not with vacuum, compressed air, or steam. Close to each working bench is a fire-proof slab, composed of compressed red Ruabon tiles, set in cement. This material is used throughout instead of slate, except for supports for balances. For the floors of fume-chambers, slabs of white glazed fireclay are employed. The fume chambers are ventilated by separate shafts of glazed earthenware pipe—the draught is obtained by gas burners. The same system is employed for the general ventilation of the rooms, mechanical ventilation by exhaust fans being considered unnecessary. The floors are constructed of concrete carried by steel joists and girders, and are covered with a layer of coke and cement, to which the wooden flooring is nailed. In the basement the floors are finished with cement and granite aggregate. The waste-channels are set in the concrete, and are constructed of sections of glazed Doulton half-piping, jointed with cement protected by china clay and pitch. The walls are finished with plaster, the ceilings with Portland cement, both walls and ceilings being provided with wooden fixing battens. Rooms intended for ordinary teaching work are fitted with working benches of the usual type, but several of the research rooms are arranged for movable tables, so as to permit of greater flexibility.

The main lighting is effected by brackets or pendants carrying incandescent gas burners, but the fume chambers and certain rooms are lighted with tantalum electric lamps.

Current is supplied from the town mains at 460 volts, and this is employed to drive the motors of three direct-coupled motor-generators, arranged as follows:

(1) A thirty-kilowatt direct-current generator, supplying current at 80 to 100 volts.

(2) A ten-kilowatt charging set, consisting of two machines on the same axle, each giving 250 amperes at twenty volts.

(3) An eighty-kilowatt alternator, with two windings, to give 1,000 amperes at eighty volts or 500 amperes at 150 volts.

The charging set is employed to charge (in sections) a battery of thirty-six Tudor cells, arranged in six sets of six cells. Vertical cables carry the current from the generators (1) and (3) and from the cells to four distributing exchange-boards arranged on each floor. Each working bench is provided with a circuit to carry fifty amperes running to the corresponding distribution board. Here, by means of flexible connections, the bench circuit can be connected up with the various voltages.

Three wires run from the battery switchboard to each of the three exchange boards, and by means of flexible connections, each of these sets of three leads can be connected up on the battery switchboard so as to supply each exchange board with current at four, eight and twelve volts. To secure greater constancy of voltage, the battery is divided up into six cells, so that each floor may have the use of a separate set of cells. Arrangements are also made whereby the cells may be put into series or parallel for special purposes. In order to obtain relatively heavier current at lower voltages, a cable to carry 1,000 amperes is run from the battery switchboard to the room intended for furnace operations. The cable and wires which are not rubber-insulated, are run on porcelain insulators attached to the walls and ceilings by wooden battens, so that all wiring is exposed. To reach centre benches the wires are dropped from the ceiling to the bench, so that no wires are carried in the floors. In addition, the benches are supplied with ten-ampere plugs connected with the 230-volt town mains. The wiring of these is rubber-insulated and enclosed in wooden casing. The fuses for the plugs and bench circuits are situated at the top of the exchange boards. The panels of the latter are of marble, whilst the terminals at the benches are fastened to slate panels.

The architects of the new laboratory are Messrs. Willink & Thicknesse, of Liverpool; the electrical machinery is being supplied by Messrs. Siemens Brothers, of London; while the wiring and switchboard work is being carried out by H. S. Martin, of Liverpool. The British Insulated and Helsby Cable Company supplied the cable and distributing wires.

The formal opening of the laboratory took place on Saturday, October 13. Dr. F. G. Donnan has been appointed professor in charge of the new laboratory.

The Alaskan-Yukon-Pacific Exposition of 1909.

A $10,000,000 fair—the Alaskan-Yukon-Pacific Exposition—is announced for Seattle, Wash., in 1909. It is stated that $650,000 has been raised through the sale of stock in the exposition corporation. This will be primarily an Alaskan fair, held to exploit to the world the resources of this territory. It is expected that a most remarkable collection of mining exhibits will be shown. The Washington University grounds, comprising 355 acres bordering on Lake Washington and Lake Union, have been chosen as a site, and landscape gardening will soon be begun. The site is twenty minutes' ride from the centre of the city.

Digitized by Google

HANDLING PUBLIC COMPLAINTS.[1]

BY JOHN A. BEELER.

To deal with the traveling public without developing undue friction is one of the most perplexing problems which daily confront a street-railway manager. While ninety-nine out of every 100 persons who patronize the street cars will do so, month after month, without the slightest trouble, the other individual, who "don't like corporations, anyhow," often boards the car with the hope that something may occur which will ruffle his feathers and give him the much-longed-for opportunity of giving the company or its employés a piece of his mind.

On the other hand, it must also be admitted that employés are sometimes overbearing in their conduct toward passengers, surly and impertinent in giving answers to questions, and slow to render assistance and perform acts of kindness which tend to increase their popularity and make friends for the company. The superintendent can not long remain ignorant of the methods of such men. If not detected by other means, it is certain that many complaints will be recorded against them, and if their habits of action can not be corrected they must speedily be eliminated from the service. Many a complaint of comparatively trivial nature could easily have been forestalled and the patron satisfied had the employé concerned exercised a little diplomacy in dealing with him. While many conductors and motormen often exhibit this faculty to a remarkable degree, others seem utterly devoid of any power to enforce the company's rules without giving offense, and it is against the latter class that nearly all the complaints are made. A man who has no tact can not get along with passengers, and such a man is sadly misplaced when he attempts to act as a conductor.

Many and varied are the complaints and grievances. Some of them are sublimely ridiculous, while others are weird, a few highly dramatic, and occasionally we hear one which even borders on the tragic. For an instance of the former, there is a woman who lives out in a suburb; it is not a thickly settled community, and, as is often true of such districts, the residents are strenuous in their efforts to become familiar with each other's doings. The woman comes into the office greatly disturbed and angry. She has a hunted look, and with bated breath informs us that her neighbors are talking about her in a most cruel manner. When she passes by, they look at her out of the corners of their eyes, shake their heads knowingly and make veiled insinuations that she is not just right. They even gossip with the conductors on her line and have enlisted their sympathy, and while none of the car men have actually spoken to her, nearly all have glared unutterable accusations at her. They look at her when she is getting on the car, they stare at her as she sits in her seat minding her own business and speaking to no one. They observe her actions when she is alighting, and actually watch to see where she goes. She can not endure this treatment any longer, and something must be done at once. She wants the company to correct and discipline its employés. The poor scribe, with patience born of long suffering, assures her that something shall be done to divert these annoying glances, and he hopes she will experience no further trouble, while inwardly he wonders what is wrong at the box-office in her roof garden.

Another pathetic case is that of the forlorn maiden who has handed the conductor a five-dollar gold piece, thinking it was a nickel. It was all the money she had, and the big hot tears are overflowing into briny rivulets as they trickle unchecked toward a bright red spot at the end of her little nose. Her woful countenance would evoke pity from a placid wooden Indian. She can remember on what line she was a passenger, and is sure that it was somewhere between half-past eight and a quarter after nine o'clock. Can't the company refund her four dollars and ninety-five cents, and collect the money from the conductor? The man, in sympathetic tone, assures her that he will cause an immediate enquiry to be made of conductors who passed a given point between half-past eight and a quarter after nine, and will make every effort to recover her money. During all this conversation he is harassed by a painful recollection of a time when his sole wealth consisted of a solitary V, and, try as he may, he can not imagine any combination of circumstances that could have resulted in his even dreaming that it was only a nickel.

Here comes an elderly woman with rotund figure. If you meet her in the hallway you will notice that her features wear a look of savage determination. As she enters the office, it is clearly seen that all her sensibilities of right and justice have been grossly outraged. She is visibly angry. She singles out the young man with the gazelle eyes, and with a commanding frown over her spectacles that brings him to his feet, and says to him louder than words, "Insignificant hireling of a greedy monopoly, approach me?" she begins. "Young man, I want to see the general superintendent, personally." "The superintendent is out, madam, and may not return for an hour or two." "Well, I have no time to wait in this office—I want justice, that's what I want." "Madam, the superintendent sometimes entrusts me with the taking of complaints. Can I be of any service to you?" "Well, if I can't see him, I suppose you will have to do, but I want you to tell him what I said just as soon as he gets back. I have ridden on your cars for the past fifteen years, and I and the members of my family have paid your company hundreds of dollars. Yesterday I was on a car and handed the conductor a dollar to pay my fare. When he gave me the change, there was a quarter with a hole in it." "Did you call his attention to it, madam?" "No, I did not; in fact, I didn't notice it at the time, but I know your conductor gave it to me, because I hadn't changed a bit of money anywhere else. To-day, I got on a car and handed this quarter to another conductor, and d'ye think he'd take it? Not he! The impudent rascal refused it! I said to him, 'that's a nice way to beat a poor woman! I got that quarter from a street-car conductor yesterday, and now, when I offer it to you to pay my fare, you won't take it! Young man, you may think that's clever, but I don't!'" "Madam, can you identify the conductor who gave you the mutilated quarter?" "No, I can't. I didn't pay much attention to what he looked like, but I know he gave it to me, and I think it's a shame that I can't get another quarter for this one. Such robbery ought to be exposed in the newspapers. I am going to see if I can't get justice somewhere!"

Here comes a tall, thin man, who speaks in a high voice. From his appearance it is evident that he is no spendthrift. He holds a transfer in his hand. The issuing conductor punched out the wrong line, and when he boarded the connecting car, the other conductor asked him for an additional fare—manifestly a base imposition for the purpose of securing two fares. He cares nothing about the nickel, mind you, but the principle of the transaction he can't endure, and will not allow it to pass without protest. When he called for the transfer his falsetto effort no doubt sounded to the conductor, above the rumble of the car and the roar of street

[1] A paper read before the American Street and Interurban Railway Association, Columbus, Ohio, October 18, 1906. Mr. Beeler is general manager of the Denver City Tramway Company.

Digitized by Google

traffic, something like the name of the line that he punched, and instead of making enquiry, as he should have done, punched the line, as he was in a hurry, taking for granted that it was right. The thrifty one in such case is generally satisfied with a return of his fare and a little "regretting" on the part of the man; but the latter can not help speculating as to whether in all his past travels there never were any occasions upon which the conductors failed to get his fare, and thus compensated this downtrodden individual many times for his loss.

Then there is a nervous lady who rushes into the office, trying to tell, between gasps for breath, about a horrid mean conductor—she didn't think to take his number, but he is on the car that just passed the office—who gave her only forty-five cents in change for the dollar she handed him. She is sure that it was a dollar, because it was every bit of change she had. There was a woman sitting in the seat beside her, and she is sure this woman would swear to the value of the coin, but in her excitement she forgot to ask her name. The conductor insisted that she gave him only fifty cents; but she guesses her reputation in the community is such that if she says it was a dollar, that is sufficient, and the evidence against the conductor is conclusive. After being assured that an immediate investigation shall be ordered, she is somewhat mollified, and is willing to await the turn of events. When balancing his cash, the conductor sometimes finds that he is fifty cents over, and readily admits his error. In other cases the lady has the courtesy to inform us that she found the coin under her powder-box on the chiffonier at home—she very much regrets, etc.

And so the daily pantomime continues, and will no doubt continue as long as street cars are operated by human beings. Happy the individual who can, month after month, listen sympathetically to the grievances and lamentations of the traveling public, and yet find enough humor therein to act as a nerve tonic, help to lay the foundation for an angelic temperament, and not disturb his digestion.

In cases similar to that cited in the last instance of complaint, we find that the plan of filing papers pertaining to each employé in a separate folder, which will be described hereafter, is a particularly advantageous one. If a conductor is using the "short change" method for gain, such fact, if not otherwise detected, will soon become evident from the numerous protests of passengers that will accumulate in his file. There is no doubt but that tricks of this nature have been perpetrated to some extent in every city. Conductors have been known to openly boast that they took advantage of a certain class of passengers whose sight was poor, who were slightly under the influence of liquor, or whose attention was otherwise taken up. Unprincipled conductors have also been known to carry a supply of Mexican coins, and to work them off when giving change to this same class of patrons.

In Denver all complaints, unless manifestly absurd, are carefully investigated by the management. When a written complaint is received, it is at once acknowledged by a courteous note stating that the matter will be thoroughly investigated. The standing of the party who makes complaint or the evidence of sincerity with which it is written is taken into consideration. The party is thanked for calling the company's attention to the matter, and if the information contained seems insufficient, further information along indicated lines is requested. We find that parties making written complaint usually have had some just provocation, for by the time the party complaining has gotten home or arrived at his office and penned a note, he has generally cooled off to an extent sufficient to either give a clear account of the trouble, or entirely ignore it and not make complaint. Very little attention is paid to anonymous complaints.

A printed form for complaints made in the office has been in use for some street-railway companies. It is known as a "complaint card." One side of the blank is devoted solely to the statement of the complainant, who is required to write the same over his signature. The other side is reserved for the division superintendent or special investigator, who writes thereon the result of his investigation and his recommendations; and below this there is also a space for the judgment and final action of the superintendent. While this method seems very concise and complete, we find that while many persons who wish to register complaints have rehearsed the incident or accident so fully in their own minds that they can relate all the harrowing details if subjected to a little judicious questioning, yet, in their excitement, when they undertake to write their statement, seem to think they have conveyed all the particulars in a few disjointed sentences. Some persons have the ability to express themselves on paper, while others have not. From our experience we believe that the best plan is to have the complainant make his report to a competent stenographer, who is well enough posted to make proper enquiries and draw out information which may be needed to make it complete. The complainant may be required to sign the typewritten record, if thought necessary or advisable. In this manner we may render material aid to those who are required to make the investigation.

After passing out of the stenographer's hands the complaint is laid before the superintendent of transportation, who will, unless immediate action becomes necessary, refer it in turn to the division superintendent. It may be found more prudent to withhold the complaint from the employé against whom it is registered, and require him to write the details of the alleged occurrence from his own viewpoint, giving also the names of any witnesses that may have been secured on the car. After gathering all the information possible, the division superintendent returns to the superintendent of transportation the statement of the employés, together with all the papers in the case, and also adds his findings and recommendations. If names of any witnesses have been furnished by the employé or complainant, the superintendent of transportation will communicate with them, unless he has already fixed the blame. At the completion of his enquiries, he issues such orders for discipline as his judgment may dictate. No matter what other action may have been taken in cases of complaint wherein employés have been found at fault, the details are briefly written in their records, together with the final disposition of the matter.

For filing complaints we use the ordinary vertical cabinet file, with folders of light cardboard, similar to those used for correspondence. The folders are numbered to correspond with the numbers of employés' badges, so that it becomes a simple matter, when reviewing a man's record, to open the cabinet and take out the folder containing the complaints and other papers bearing on his past conduct. Should it become necessary to call an employé into the office for discipline, the superintendent may, in a few moments, examine his record card and folder, and quickly form his judgment as to such employé's future value to the company.

Briefly our aim has been, as far as possible, not to antagonize the public in any manner, but to rectify all mistakes and make an apology for all incivilities on the part of our employés; to correct such tendencies, especially those of impudence and impertinence, to pour oil on the troubled waters, and adopt Denver's motto of "Smile and Push" for the company.

Digitized by Google

An Electric Car Brake.

To the Editor of the Electrical Review:

I was very much interested in reading your editorial in the issue of October 6, on the report of Director Scholtes concerning electric and air brakes for trolley cars. I fully endorse the views expressed by Director Scholtes.

The experience with the Pfingst Electric Brake on a Broadway and Columbus avenue car of the Metropolitan Line, for forty days commencing July 23, of the present year, shows conclusively that this particular electric brake could handle a car with absolute safety, and make easier and better stops than with the air brake, and at the same time there was no limit to the number of applications which could be made within a given time, as there is with the air brake. There is a limit to the number of applications which can be made with the air brake and I am informed that one of the reasons why the air brake was taken off the Third avenue line was because a sufficient amount of air could not be stored to be absolutely sure at all times.

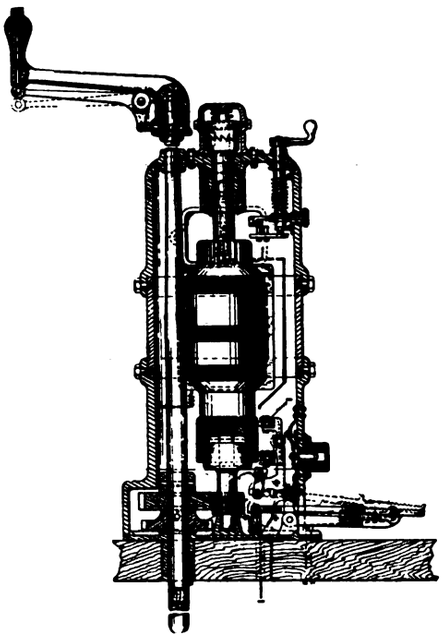
The Pfingst Electric Brake is constructed as follows:

The motor as shown in the accompanying illustration is constructed around the brake spindle, and this brake spindle is connected at the bottom through a mechanical clutch with gearing which operates the brake spindle at the bottom and to this brake spindle is attached the ordinary brake chain, which should, for safety, be double.

A simple controller, with a handle, similar to the air brake, applies the power. This controller is held "clear" of the contacts by the motorman and the removal of his hand causes the controller to force the brake instantly into "emergency" application and the brake is applied with the full force of the trolley current. A "service" application is controlled by the resistances in connection with the contact points on the controller so that any amount of power can be applied. The releasing of the brake is affected by pressing a foot pedal which is connected with the mechanical clutch by means of a collar around the shaft; this collar being fitted with roller bearings so that the releasing is very quick and absolutely noiseless.

With this arrangement the hand brake is always ready for use and the handle is operated by a ratchet in the usual way. While the brake is being applied with power the hand brake handle remains absolutely stationary. This is accomplished by means of a collar around the shaft. All of the power thus applied, is held by a roller jamb against the shaft at the top so that the motor always runs in one direction, and when the brake has been applied the power can be taken off and the brake will remain applied indefinitely, or until the foot pedal is pressed and the mechanical clutches separated. The mechanical clutches are always engaged and ready for action, therefore the brake is absolutely automatic.

This patent covers application on two or more cars. The circuit is so arranged that if the cars separate and current is carried on the following cars, the brakes will be applied in the emergency application at once. The application of the brake on one or more cars is controlled



Pfingst Power Brake.

by means of the controller on the forward platform, and the clutches are separated by means of solenoids.

The Broadway car on which this device was placed, was a steel car weighing over twenty tons, and was run in daily service operated by motorman Michael Spaulding, who felt his work was reduced fully seventy-five per cent, and that all anxiety about striking teams or persons was removed. The easy stops made by the car were so very pronounced that a great many men who boarded the car questioned the conductor and the motorman as to what kind of a brake they were using. There was absolutely no surging of the car in stopping, and yet if a quick stop was necessary, it could be made. The absence of surging is due to the fact that the brake can be released instantly by the pressure of the foot on the pedal. This, of course, can not be accomplished with the air brake, as the air must escape from the cylinder before the pressure can be relieved on the wheels.

This brake changes nothing underneath the car. The foundation brake remains the same as at present. It can be placed on any wooden car within two hours, including the wiring of the car.

Mr. Scholtes' position was criticised by his associates because the electric brake is not considered as available if the current should fail. One of our patents shows a connection through one of the car motors to the controller on our brake device, with the connection reversed on the motors, so that if the trolley current fails, the circuit of the car motors can be passed through a resistance of fifty ohms, which will cause a short circuit of the motor, and this "bucking" will quickly bring the car to a standstill. As these connections are passed through fifty ohms, it will not cause any damage to the motor. The contacts for these motor connections on our controller are in such a position that it is almost impossible for a short circuit to be made while the trolley current is on.

J. B. Stewart.

338 South Station, Boston, October 13.

New York Electrical Society.

The 262d meeting of the New York Electrical Society was held at the Edison Auditorium, October 31st. Professor V. Karapetoff, of Cornell University, delivered an address on "The Human Side of the Engineering Profession." Professor Karapetoff defined the principal requirements for an efficient engineer, and gave some valuable hints as to acquiring the necessary qualifications for securing a commanding position in the engineering field, by study, observation and the training of the character. He also showed many of the factors which stand in the way of success. The lecture was full of interest and at its close the lecturer was greeted with prolonged applause.

Exposition of Safety Devices.

The American Institute of Social Service announces considerable interest in the exposition of safety devices which it will hold in New York city, January 28, to February 9, 1907. Prominent Americans and quite a number of European authorities have pledged exhibits. Requests for information concerning this exposition should be addressed to Dr. William H. Tolman, director, 287 Fourth avenue, New York city.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Radium and Geology.

A reply is made here by R. J. Strutt to O. Fisher's comments on the former's suggestion that the heat of the earth may be due to radium. These comments were noted in the ELECTRICAL REVIEW for November 3. In them Mr. Fisher pointed out that apparently the theory left no room for that shrinkage of the globe required by geological theories, and which is generally attributed to cooling. Strutt's contention is that the production of radium from uranium, and the decomposition of the former, are changes which may themselves cause the shrinkage believed to be taking place. It is probable that radium is widely distributed throughout the earth's crust, and the fact that it is never given as a constituent of rocks may be due to its small proportion, as the quantity is of the order of one one-hundreth per cent. Mr. Strutt also replies to a point raised by B. J. Palmer, that, arguing from analogy, if the heat of the earth be due to radium, we should be led to the conclusion that the moon is not a cold body, and must possess internal heat. Mr. Strutt points out that the absence of volcanoes is no proof of the coolness of the moon, for volcanic action is due to the presence of highly heated steam, and the absence of water on the moon would account for its quietness.—*Abstracted from Nature (London), October* 18.

Economical Importance of Gas Engines in Generating Stations.

A discussion of economies to be effected by the means of gas engines was presented by E. A. Ziffer to the recent railway congress in Milan. The author first gives in some detail the different systems of producing power gas, then gives some interesting figures showing the relative cost of power when obtained in different ways. He estimates that allowing two cents per kilowatt-hour, and seven and one-half per cent for interest and depreciation, that the annual cost of running a twenty-five-horse-power motor is $1,050. For a 100-horse-power motor it would be $4,170. The cost of operating two steam engines with similar ratings is estimated as follows: For the twenty-five-horse-power engine $867, and for the 100-horse-power engine $2,487. This is figured on the basis of about five pounds of coal per horse-power-hour, and with coal at $3.00 per ton. Interest and depreciation is taken at ten per cent. For a gas engine with gas at two cents per cubic meter, the annual cost for a twenty-five-horse-power engine is estimated at $695, and at $2,320 for a 100-horse-power unit. Using producer gas the cost for a twenty-five-horse-power gas engine is found to be $347, and for a 100-horse-power engine at $1,194.—*Translated and abstracted from L'Electricien (Paris), October* 20.

Increasing the Constancy of Batteries Giving Currents.

The use of storage batteries to steady the voltage of electrical supply systems has suggested to W. P. White that a similar plan might be adopted with a set of batteries in order to maintain a constant current or a constant voltage of delivery. The plan adopted consists in placing in two parallel circuits two batteries, or sets of batteries, one having a somewhat higher voltage than the other. In each circuit is placed a resistance, and by properly adjusting these two resistances the potential at the terminals of the circuit containing the lower electromotive force may be maintained equal to that electromotive force due to the current delivered by the other circuit. Under these conditions the system will maintain a constant voltage, or, if connected to a third circuit having a constant resistance, will deliver a constant current. While variations in the voltage of either of the batteries due to discharge may cause a slight unbalancing of the system, the effect upon the voltage or current delivered will be considerably less than the cause itself. The system is not intended to enable primary batteries having poor discharge characteristics to operate at a constant potential, but is rather intended for making still more constant the voltage of constant potential cells such as storage batteries. The plan is best suited to batteries with low internal resistance, and in particular it is suited to giving constancy in the main current of potentiometers of very low resistance. —*Abstracted from the Physical Review (New York), November.*

Platinum in the Yukon.

Platinum was discovered in the black sand residue obtained along the Teslin or Hootalinqua river, Yukon Territory, as early as 1898, but until recently no active preparations have been made to recover it. The river named is one of the southern tributaries of the Yukon. Its gravel bed carries gold in payable quantities, even by hand-working. Throughout its lower part the river is wide and shallow and has a sluggish current. Black sand from this river was treated by the United States Geological Survey's plant at the Portland (Ore.) exhibition of 1905, the opinion reached being that the platinum, although exceedingly fine, is capable of recovery. From ten ounces of black sand taken at random from a gold washer, sixty cents' worth of platinum was recovered. A more recent test on fifteen ounces of black sand recovered from 200 pounds of original gravel gave 0.7 gramme of platinum and 0.023 gramme of iridosmium. A dredging syndicate is now preparing to work the sands of the river, with the idea of extracting the platinum. Concessions covering fifteen miles up the river from its mouth have been secured, and the necessary machinery can be readily carried there by rail. This would be the first attempt to recover the platinum in the far north.—*Abstracted from the Engineering and Mining Journal (New York), October* 27.

Heating of Underground Cables.

A recent investigation conducted by Professor Mie of the heating of underground cables is discussed here by R. V. Picou. In order to simplify the analytical consideration Mie adopts the idea of an equivalent radius of cable, that is to say, he substitutes for a two or three-conductor cable a single conductor cable which he computes produces the same conditions in the external surroundings. For this purpose the approximate formula used by Teichmüller and Humann is employed. A further assumption is made that the surface of the ground is an isotherm. This assumption may be questioned, but it simplifies the question considerably as it enables the problem to be treated by the method of images. The experiments were

Digitized by Google

conducted by surrounding the cable with sand and adding to this different percentages of moisture. It was found that the relation between specific resistance, r, measured in electrical units to thermal conductivity, k, in thermal units, is given by the equation $k = \frac{0.24}{r}$; the mean value of r was found to be 650 for simple cables and about 600 for multiple cables. This gives a value for k nearly ten times greater than that which has heretofore been assumed. For this reason it is necessary to take into consideration in such studies the character of insulation on the cable itself. It was found that the condition of the soil affected enormously the heat conductability, for the specific resistance expressed electrically was found to be 322 with sand containing one-half per cent of moisture. With 4.4 per cent of moisture the specific resistance had fallen to eighty-one, and with 9.9 per cent of moisture it was sixty-two. For earth with a percentage of moisture of twelve, the specific resistance was 117. These studies show that in order to predetermine the heating of any particular cable it is necessary not only to know the character of its insulation, but that of the soil through which it is to be carried as well. The author suggests that it would be advisable to carry out new experiments in this important subject since the results here discussed differ so greatly from previously-held ideas.—*Translated and abstracted from L'Industrie Électrique, (Paris), October* 10.

Locomotives versus Motor Cars.

The comparative merits of locomotives and motor cars for railway work are examined here by C. F. Street. Local conditions must necessarily have an important bearing on the problem, and, in general, the following rules will apply: With approximate fixed weight for the majority of trains, locomotives have advantages; with a variation in the weight of trains, motor cars have advantages, which increase in proportion to this variation. The advantages of locomotives are a smaller number of parts to be inspected, and these are more accessible. The number of cars in service can be changed at any time, and without regard to whether they are fitted with electric wiring. When the number of cars in a train must vary, the motor cars have an advantage, since the weight of the train is reduced and the tractive effort increased; in fact, the motor-car equipment has an advantage from every standpoint. With a fixed number of cars a locomotive can be designed which will meet the tractive conditions almost as well as the motor cars, and which will have the advantages mentioned above. The author then compares the cost of maintaining steam locomotives and electric. One of the heaviest items of expense incident to the maintenance of steam railroads during the past few years has been the extension to and construction of repair shops. Some of the large steam railroads now have several million dollars in shops for making repairs to locomotives alone. The electric lines, however, have not found that any such investment is necessary for maintaining their equipments. The Interborough Rapid Transit Company, of New York city, has a repair shop of small dimensions, containing a few machine tools, all of light capacity, and giving employment to probably forty or fifty men. In this shop all the repairs are made to an equipment of 430 motor-cars, each fitted with two 200-horse-power motors, or a total equipment representing 172,000 horse-power in 860 motors. This would be equivalent to 215 steam locomotives of 800 horse-power each and it will be found that the steam road having in the neighborhood of 200 locomotives to keep in repair has shops covering many times the area of those of the Interborough company and containing an equipment of tools and machinery much more extensive and giving employment to five or six times as many men; and in addition several roundhouses, any one of which represents a greater investment than the Interborough shops. The average cost of maintaining steam locomotives varies considerably. On some roads it has been over $4,000. On thirteen of the largest railroads the average cost of over 7,000 locomotives was, for 1904, $2,212. The average cost per year of maintaining an aggregate of 7,684 motor-cars was only $107 per annum. The average cost of maintaining the steam plant, electric plant and cars, including electric equipment on these roads, was only $255 per car per year.—*Abstracted from the Electric Journal (Pittsburg), October.*

An Alternator with an Auxiliary Field for Direct Compensation for the Armature Reaction.

The reappearance of the auxiliary pole in direct-current machine design, whether it be for giving better regulation or improved commutation has suggested to A. Heyland that a similar plan might be useful in alternator design since its benefit rests largely upon the compensating effect with respect to the armature reaction. The use of an auxiliary pole seems, however, unadvisable because with low-speed alternators the cost of an already expensive design would be increased, while in the design of high-speed machines considerable difficulty would be encountered in securing a satisfactory mechanical arrangement. Some other way of obtaining the same result seems necessary. This may be obtained by compensating the exciter field for the armature reaction of the alternator since all alternators are separately excited. This may be accomplished in an ingenious way when the exciter is mounted on the main alternator shaft. The exciter has generally a less number of poles than the alternator, therefore a system of electrical compensating circuits can not be employed, but it is possible to cause the magnetic field set up by the armature so to change the exciter field as to secure the desired compensation. The plan consists simply in making use of the magnetic leakage which takes place through the alternator shaft and in securing sufficient leakage to accomplish the end sought. This is done by winding the alternate poles of the alternator field with an unequal number of turns, thus subjecting all of the north poles, say, to a greater magneto motive force than the south poles; then the pole faces of the north poles are turned off so as to give a wider air gap and thus reduce the magnetic induction there to the same density as that produced under the south poles. The two poles thus create similar magnetic conditions at the surface of the armature, but are unequally affected by the armature reactions. Magnetic leakage would, therefore, be set up by this latter effect and would pass through the alternator shaft, and can be caused to return by way of the exciter armature, exciter field and machine carcass. This leakage would normally decrease one set of exciter fields as much as it increased the other, but the same principle of construction is adopted for the exciter, one set of field poles being turned off so as to give a greater length of air gap. With this arrangement and a proper connection of exciter field the reaction of the alternator armature may be made to strengthen the exciter field, and thus to increase its voltage so as exactly to compensate for the alternator reaction upon its own field, and since this reaction will be proportionate not only to the current in the alternator armature, but to the phase relation of this current, the exciter will compensate for phase relation as well as load. In practice it will probably be found bet-

Digitized by Google

ter to adjust the alternator and the exciter fields so that there will be a demagnetization of the exciter field due to leakage when the alternator is unloaded. At about half load then the alternator will have no effect upon its exciter field, but at full load will cause an equal strengthening. The advantage of this is that to bring about a certain total effect only one-half of flux need be carried through the shaft.—*Translated and abstracted from L'Eclairage Electrique (Paris), October 20.*

Report of the Alameda (Cal.) Municipal Light Plant.

The annual report of the electric light and power system operated by the city of Alameda, Cal., for the twelve months ending June 30, 1906, has been made public. A digest of this is given in the *Journal of Electricity, Power and Gas* (San Francisco) for October 13. The plant consists of a frame power-station building containing boilers, engines and generators, the equipment being rather antiquated in type. It consists of four return-flue, fire-tube boilers, a cross-compound engine driving a generator by means of a belt, a second tandem-compound engine driving its generator in the same way, and a third tandem-compound engine direct-connected to its generator.

For the year the output of the plant for street lighting was 202,405 kilowatt-hours; for commercial lighting and power, 941,680 kilowatt-hours, a total of 1,144,085 kilowatt-hours. For commercial lighting there were in service 1,039 meters and ninety-two flat-rate consumers. The expenditures for the year aggregated $52,687.21, of which $36,455.11 was for operating expenses and $16,232.10 for new construction. The earnings of the plant were $55,746, of which $20,594.45 is credited to municipal street lighting and the remainder to commercial light and power and miscellaneous income. The new construction going on includes the installation of a new generating unit. The plant burns oil for fuel, paying from fifty-five cents to eighty-five cents a barrel, delivered. The street lights are operated upon a moonlight schedule. The investment in the plant at the time the report was made was given as $91,076.82. The total investment has been $107,317.08, from which $16,240.26 had been deducted for depreciation covering two full years ending June 30, 1906. Since May 1, 1904, the plant has been operated condensing, and alternating enclosed arc lamps have been in use in place of direct-current open arc lamps for street lighting. To these two changes is attributed a saving of 120 barrels of oil per month with the same output of plant.

Results by Telephone.

How little advertising is based on the telephone. The merchant prints his telephone number on each folder, or says "telephone orders given prompt attention." But very seldom does he send out advertising matter in which telephone orders are made the main issue.

A barber in New York city has the right idea. His shop is on Broadway, in the downtown business district, where men are in a hurry. He distributes blotters through office buildings in his territory, and about the only thing on the blotter is the suggestion "make appointment by telephone and so avoid waiting." Then follows the telephone number. This convenience requires no laudation, nor does the manner of exploiting it. They speak for themselves.

Hotels in the uptown Broadway district distribute every morning about ten o'clock a printed menu of the day's luncheon through surrounding office buildings. Business men see what's for lunch, and are doubtless often led to a particular hostelry by some special dish. But this advertising would be made much more effective if upon the menu were printed a prominent note to the effect that tables would be reserved by telephone. It might even be practicable with guests who are known to state that steaks, chops and other dishes requiring some time to prepare would be put on the fire at any desired time by telephone order, and served at the moment the guest is ready to come, thus saving what is to most people an unpleasant wait.

The grocer is a man who ought to profit by the consistent exploitation of this telephone idea. Telephones mean prosperous customers, living on a fairly liberal scale. The morning delivery service and house-to-house canvass for orders could be very materially accelerated by issuing a daily folder from which customers could order by telephone. A brief price list of vegetables, fruits and other green stuff would not be costly or inconvenient where a printing office is within reasonable distance, and the price list could be issued within two hours after the morning's stock was in, and distributed to householders in the grocer's territory. Or if this were not advisable, folders could be sent out emphasizing the fact that housekeepers have only to take down their telephone receivers any morning to learn what is in the market.

People need to be reminded that they have telephones, and shown how to use them in ordering. The telephone companies make good capital of folders that explain the uses of a telephone. Hundreds of persons would dash madly for the nearest fire-alarm box in emergency, never reflecting that the telephone is the quickest of all fire-alarms, did not the companies remind them of it in advertising. Every telephone order received puts the cost of selling on the customer, who pays for the message. What is needed is advertising matter that will make this telephone issue prominent. Readers should be impressed with the idea that the telephone is there in their own homes, and that messengers wait at the store to carry out any order they may send in. The druggist should educate his neighborhood to the speed, ease and advantages of the telephone in sending emergency calls for medicine. The physician would find this an unobjectionable form of advertising. The bank can get deposits by telephone, sending a messenger for them on request. The department store should make its daily bargains accessible by wire. Telephones are universal nowadays. They have a universal application to business. But the public is blind to many of their uses, and needs to be reminded by special telephone arguments.—*Printers' Ink.*

Electrically Lighted Railway Mail Cars.

The committee appointed by the Railway Mail Agents at their March meeting at Portsmouth, N. H., to draw up resolutions expressing the opinion of the executive committee as to the proper manner of running and lighting railway postal cars, passed a resolution that "in a great number of instances mails have been either delayed or totally destroyed, cars either totally damaged or destroyed, and the loss of some of the twenty-one of our fellow clerks killed in the line of duty during the past year is chargeable to the use of Pintsch gas as an illuminating material." The committee considers that "it is imperative for the public interests and the safety of the postal clerks that the existing requirements of the post-office department wherein railway companies who furnish gas should be changed and railroad companies compelled to equip all railway postal cars with electricity."

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

A short time since we called attention to the excellent work which was being done by the West Ham (England) Corporation Electricity Supply in the way of getting out a bulletin which was distributed among consumers and prospective consumers of electricity. That the agitation for systematic publicity is assuming greater dimensions abroad is indicated by an editorial and introductory chapter on "Some Practical Notes on the Commercial Development of Electricity Supply Undertakings," by R. Borlase Matthews, in the issue for October 19 of our London contemporary, the *Electrical Review*. Mr. Matthews says: "It is now rapidly becoming an accepted fact that the incorporation of a new-business department into the organization of a public electricity supply undertaking is an absolute necessity. Only a short time ago managers looked askance upon this idea, and though they considered it as possibly a good thing for the large cities, they thought it to be sheer waste of good money and valuable time in the case of the smaller towns, especially those of under 50,000 inhabitants. In time, however, comparisons of the kilowatt-hour consumption per capita in various cities indicated that where an aggressive new-business-getting policy was put into operation the figures soon increased in a very acceptable manner, and likewise the profits, owing to the additional output and the increased load-factor, or, as it is sometimes expressed, the smoothing out of the load curve."

Mr. Matthews calls attention to the organizations of men expert in the work of promoting publicity and in the preparation of technical literature for advertising purposes, and views the evidences which are now found in every central station man's mail as an indication of a very healthy attack which is being made upon the conservatism of the central station operator.

In commenting upon the great development which this new idea has had in so short a time in the United States, Mr. Matthews remarks that "in England so far no similar systematic collective or cooperative efforts have been inaugurated."

"Compared with other methods of artificial illumination and sources of motive power," Mr. Matthews says, "electricity plays but a small part in its bid for the business of English towns at present. There is no reason for this other than the lack of knowledge on the part of the general public of the possibilities and advantages of electricity, except, perhaps, in certain cases where prices are high; but if the output can be increased these prices can be reduced, as the fixed charges will then bear a smaller and smaller proportion to the total cost of production."

In a second article by the same writer in the following issue of our London namesake, Mr. Matthews makes some suggestions regarding the organization of a new-business department, outlines the system of working, and discusses briefly the art of canvassing. For a town of 20,000 inhabitants or over a man not over thirty-five years of age, with the instincts of a salesman, and who has also been trained in the office of a central station, so that he has some understanding of the conditions of operation and distribution, is suggested as the manager of the new-business department. An attractive office and showroom, where the general public can make inquiries, pay their bills and see actual examples of methods of lighting and various forms of labor-saving appliances, is considered an important auxiliary. The canvassers, Mr. Matthews thinks, need not be very high-priced men, and they should preferably have had experience as travelers or salesmen, not necessarily in the electrical line. In a fairly prosperous town one canvasser per 15,000 inhabitants would seem to be required.

Mr. Matthews thinks that the keynote of modern successful business is system, and that advantage should be taken of all the modern office methods of keeping records. A standard size of card should be used, preferably of thin material, so that it can be easily used in a typewriter.

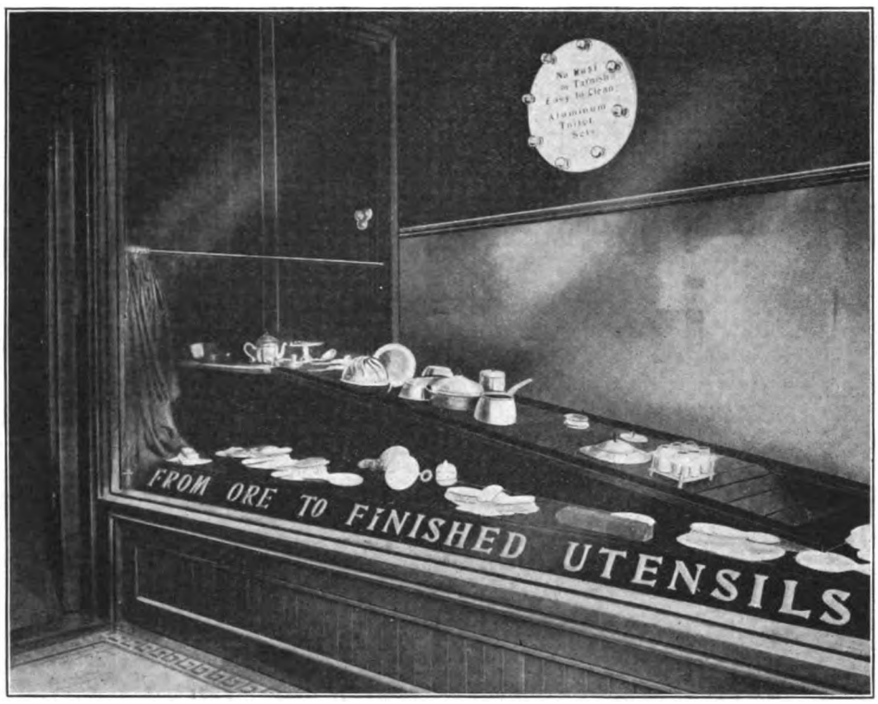
MOVING WINDOW DISPLAY.

In making a canvass for new business, after every available bit of information concerning the prospect has been properly carded and put in such shape that it is accessible for instant reference, the way for solicitation should be prepared, as far as possible, by suitable advertising, and the day before a call is made a postal card should be sent making mention of the fact, paving the way for a favorable reception.

Whether or not the canvasser is a technical man, he must be thoroughly coached

Digitized by Google

and posted in those matters with which he is to deal. In residence canvassing it is well to endeavor to be allowed to estimate for wiring the house. The specifications should be prepared in two ways, one with the wiring done in the way that best suits the ideas of the householder, and the other in such a manner that the cost is reduced as much as possible by omitting all lights but those which are absolutely necessary.



Moving Window Display.

The accompanying illustrations show an ingenious idea developed by a Cleveland (Ohio) man and utilized for multiplying his available show-window space. The window floor was arranged so that it revolved like an endless chain over two drums at either end. The window floor extended back into the store the depth of the window, the view being shut off by a black velvet curtain. The different articles—some 200 in number—were wired to the moving window floor, and thus a unique and striking effect was produced, attracting the attention of large numbers of pedestrians.

Before this device was installed but fifty pieces could be shown, and that in the old-time stationary style. The device was home-made, simple in design, inexpensive, and driven by a small electric motor concealed below the floor.

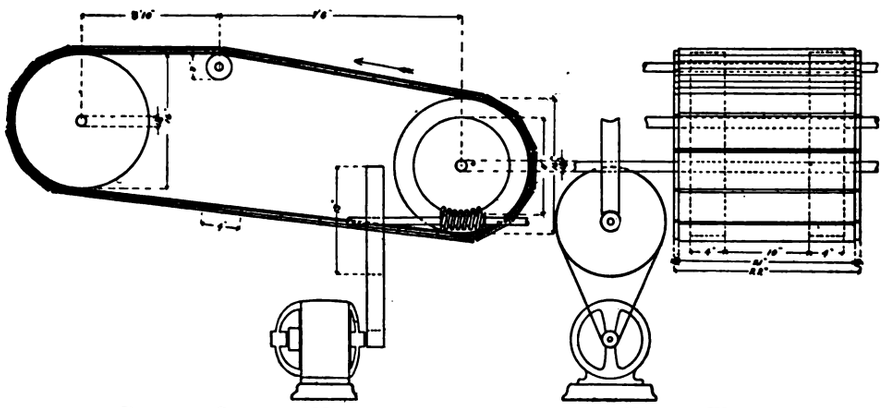


Diagram Showing Mechanical Arrangement of Moving Window.

The Lighting of Railway Cars by Electricity.

One of the changes that will come in with a rush throughout the country in general will be the lighting of all the cars on what are now steam roads, because when all the trains on the trunk lines centering in New York are operated by electricity they will be lighted by the same power—and as the country takes its fashions from New York, so must they follow the lighting fashion. While this change means loss for the gas-lighting companies, it also means a great gain for the companies who make a specialty of train lighting by electricity.

Needless to say, in this matter, as in all others where electricity is introduced, the public becomes the greatest gainers, but it is also true that the railroad companies will benefit, as, in the cost of operating, electricity must surely cost less than gas; while, perhaps, a still greater gain to the railroad companies will be a reduction in the cost of fire insurance, as, eliminating the locomotive fire and the dangerous gas tanks, the loss from fire will be practically eliminated. Another danger, in many cases as great as fire, is the danger of asphyxiation from gas. This, of course, will disappear.

While electric lighting on railways has not progressed as it should, it is bound to be universally adopted; already the national government is moving to have all mail cars lighted by electricity, as in case of wreck the loss of lives of the postal employés and the amount of mail matter destroyed has been great at times, and it is a fact that there is no service more dangerous to life in this country than is the railway mail service. This, of course, is the moving consideration underlying the government action, which took the shape of having a bill for the lighting of all mail cars introduced into the last Congress by the chairman of the Judiciary Committee of the House of Representatives.

The two things that perhaps have retarded the growth of train lighting by electricity have been crudeness of apparatus for this service, aggravated by lack of electrical knowledge and experience on the part of railroads. This is largely disappearing, as to-day American devices lead the world in their simplicity and reliability, and the railroads, at least the most progressive ones, are creating electrical departments in their service, placing at the head of these departments highly trained electricians who can reason as well as act, the action of these men naturally being far more effective than that of the "rule-of-thumb" men who have had much to do with railway lighting in the past to the retardation of the art and increased expense to the railway companies.

By general adoption of electricity for lighting the public will also be benefited by the introduction of fan service on all cars. As the matter stands to-day the country around Chicago is far better served in these matters than is the public around New York, but with electrification on our roads a fact all this will be changed.

J. H. M.

Digitized by Google

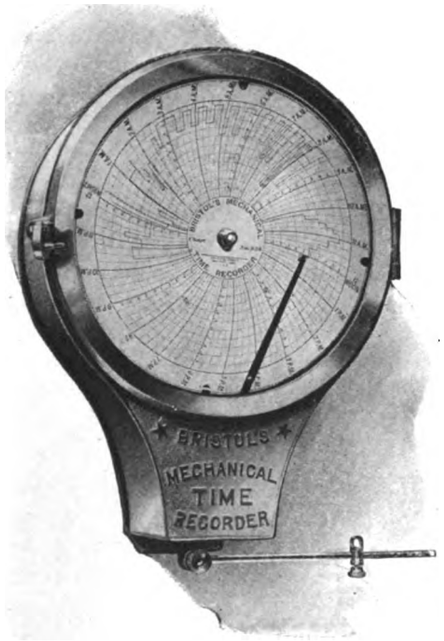
INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Mechanical Time Recorders.

To fill the continued and increasing demand for an instrument which makes a graphic record of variations and the time of such variations, of mechanical movements, The Bristol Company, Waterbury, Ct., has placed on the market the instrument illustrated herewith, to which has been given the name "Mechanical Time Recorder." A circular chart revolves by clockwork at uniform speed, while the pen moves over the chart an amount proportional to the motion to be recorded.

The chart is eight inches in diameter, being the same size as on the well-known



MECHANICAL TIME RECORDER.

standard Bristol gauges. Clock movements can be supplied for complete revolution of chart once in fifteen minutes, one hour, two hours, three hours, four hours, six hours, eight hours, ten hours, twelve hours, twenty-four hours, or seven days. The pen arm is rigidly attached at its lower end to a shaft which is turned by a short arm projecting through a slot in bottom of the case. The lever shown in the illustration projecting to the right, is clamped to the short arm by a thumb-nut. Special attention is called to the fact that this lever is adjustable and can be clamped to the arm at any convenient angle. The motion to be recorded after being properly reduced, if necessary, is imparted to the lever, which in turn transmits it to the pen. The total scale on the chart is usually taken proportional to the total motion to be recorded. Reduced motion, if necessary, can easily be arranged by the aid of pulleys, levers or other reducing devices.

Fine adjustments can readily be made by applying the motion at the proper point along the lever, and to facilitate this, a metal attaching piece is provided, which is adjustable on the lever arm and secured in any position by thumb-nut. It will be seen that by the aid of the adjustable lever arm and the adjustable slide on the arm, the instrument is most conveniently adapted to record motions of all amounts and directions.

Total deflection of the pen is obtained by turning the lever through an angle of about twenty-one degrees, or five-inch motion at its outer end.

This instrument can be used to record the rate of motion and position of sluice gates, turbine or engine governors, gate valves, etc. It is also adapted for recording the rise and fall of liquids in tanks, rivers, reservoirs, and fore bay.

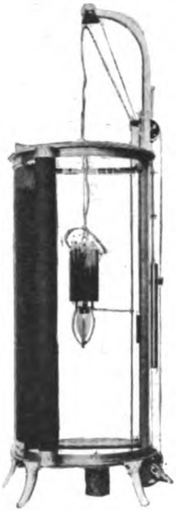
In the gas industry it can be used to check up the operators and thus prevent the "blowing" of the holders either day or night.

Hydroelectric Contract for J. G. White & Company.

The Glastonbury Power Company has awarded a contract to J. G. White & Company, incorporated, engineers and contractors of New York, for the construction of a hydroelectric plant at the Cotton Hollow property on Roaring Brook, near Hartford, Ct. Current will be transmitted probably at a pressure of 11,000 volts to Hartford for light and power purposes and also be supplied in town and vicinity. A hydraulic filled dam, 600 feet long and sixty feet high, will be thrown across the river, from which a fifty-four-inch wooden stave pipe, nearly two miles long, will lead to the power-house, which will be a modern stone building. The pipe will be constructed of California redwood, as this is the best wood obtainable in long clear lengths. Twenty car loads of this lumber will be brought from California for the purpose. Two spiral Francis turbines of 750 horsepower each, will be installed, working under a 200-foot head. Work will be started immediately and it is expected that the plant will be in operation by the first of April next.

A New Electric Blue-Printing Machine.

The accompanying illustration shows a new electric blue-printing machine manufactured by J. H. Wagenhorst & Company, Youngstown, Ohio. The Wagenhorst blue-printing machine is entirely self-contained and occupies a floor space about three feet square. As may be seen from the illustration, the printer is of the cylindrical type, consisting of a glass cyl-



ELECTRIC BLUE-PRINTING MACHINE.

inder with an arc lamp arranged to descend axially through the cylinder, giving an equal light radiation on the interior surface of the cylinder.

When quick exposures are desired a second lamp is suspended immediately below the first lamp. The sensitive paper is, therefore, acted upon simultaneously at two different points, and the whole is exposed in one-half the time taken when but one lamp is used.

The roller curtain device by which the

Digitized by Google

tracings and sensitized paper are held in place leaves both hands of the operator free to adjust the tracings and the paper. The curtain holds the paper and tracings securely against the glass, so that the rollers can be partly rolled back, permitting an examination of the prints, without in any way disturbing the position of the tracings.

An oil plunger speed regulator is provided, which secures a uniform speed of the descent of the lamp at all times. This also provides a wide range of speed regulation, so that the machine may be adjusted to meet all possible requirements. By means of a valve regulator the speed can be varied either before or after turning on the current. The machine is noiseless in operation and automatically cuts out the lamp current and also stops its descent at the end of its travel.

American-Ball Engines and Generators.

The American Engine Company, Bound Brook, N. J., manufacturer of the American-Ball high-speed engine, both simple and compound, and dynamos and motors, announces the following sales:

Three duplex-compound engines to the Ely Dupont Company, to be used in the new plant at Toluca, Col., making the eighth order from this company for American-Ball engines.

One 200-kilowatt generating set consisting of generator direct-connected to a duplex-compound engine for the American Vulcanized Fibre Company, Wilmington, Del. This is the third order from this company.

Three complete generating sets, two of seventy-five kilowatts and one of 150 kilowatts capacity, driven by duplex-compound engines, for the Cambridge Gas Light Company, Cambridge, Mass.

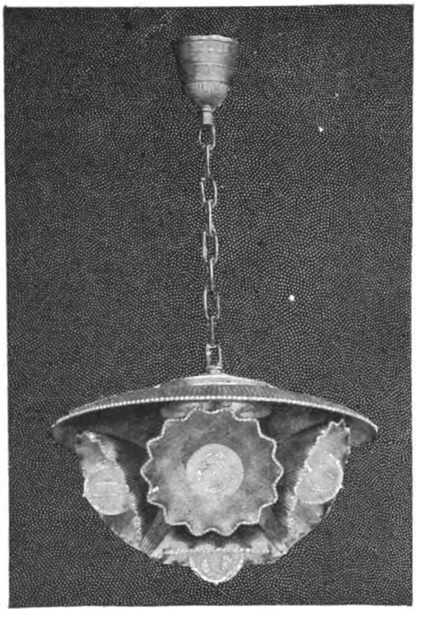
Two 200-kilowatt, direct-current, 500-volt generators and two 125-horse-power and one 300-horse-power motors for W. D. Boyce, Marseilles, Ill.

In building up the armatures of Ball generators provision is made for blocking apart and separating the laminations in the centre of the armature. The coil slots are milled out of the laminated core in the usual manner, and the coils inserted. In separating the teeth of the core formed by the coil slots a patented device is employed, consisting of small slabs of tough fibre board, the shoulders being so beveled that they engage the teeth and hold them apart, maintaining a proper distance between the laminations necessary for the ventilating air duct.

The armature coils are formed of solid bar copper without soldered joints. The insulation consists of double windings of cotton impregnated with insulating compound. The difficulty of bending the bar in shape for the coil has been overcome by a special machine, which receives the long strips of cotton-wound bars from the spool, cuts them into proper lengths for the coils, and bends them edgewise without injuring the insulation. The coils are treated with the insulating compound after they are formed.

The New Holophane Reflecting Arcs.

Considerable attention is being attracted by the new Holophane reflecting arcs which have recently been placed upon the market. The accompanying illustration

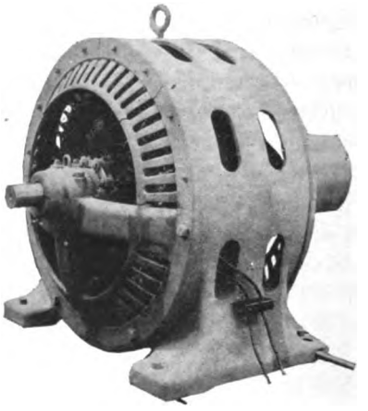


NEW HOLOPHANE REFLECTING ARC.

shows a cluster utilizing the new "Gem" high-efficiency lamp of forty candle-power, consuming 100 watts per lamp. The six-light cluster consumes about the same amount of energy as a five-and-one-quarter-ampere, direct-current, enclosed arc lamp. These reflecting arcs are made up with four, five or six lights. Photometric tests showing the distribution of candle-power have been prepared by the manufacturer of this apparatus, the Holophane Glass Company, whose sales department is at 227 Fulton street, New York city

Western Electric Belted Alternator.

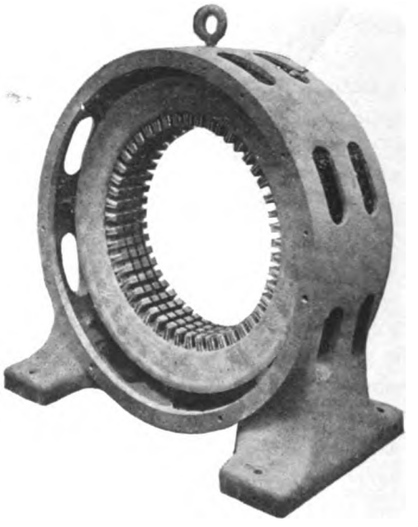
The accompanying illustrations were shown over the titles of induction motors, in an article descriptive of Western Electric alternators in the issue of September 22. These titles were in error, as the illustrations represent the design of the belted alternator of this company.



"S" DESIGN, BELTED TYPE ALTERNATOR.

As a form of construction for alternators, the open slot shown in the unwound stator is used. This form has an advantage in alternators which usually operate at high voltages, due to the possibility of insulating the coils entirely before placing in slot, and also the ease of replacing damaged coils.

In induction motors, however, this company does not use the open slot. Induction motors, usually of low voltage, require very high mutual induction between rotor and stator. This makes the semi-enclosed slot and small air-gap a preferable design in these machines, and the impression given by the unwound stator above referred to as used for an induction motor is erroneous.



"S" DESIGN, BELTED TYPE ALTERNATOR, SHOWING OPEN-SLOT CONSTRUCTION.

Digitized by Google

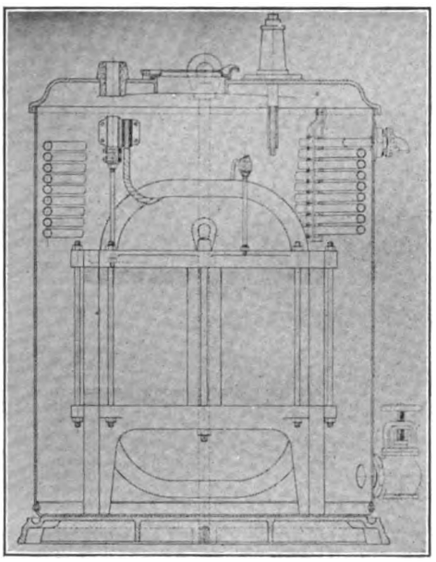
Allis-Chalmers Oil-Insulated Transformers.

The accompanying illustrations show two types of oil-insulated transformers built by the Allis-Chalmers Company, Milwaukee, Wis. Both of these types are oil-filled, but in one case the transformers are water-cooled, and in the other, self-cooled. In the latter type the heat is carried off by radiation from the case, while in the former, water circulation is used to ensure cool running.

The self-cooled transformers are built in sizes up to 300 kilowatts. Above this size the external surface of the case is not sufficient to radiate the heat developed in the transformer core and coils, unless the enclosing tank is made abnormally large.

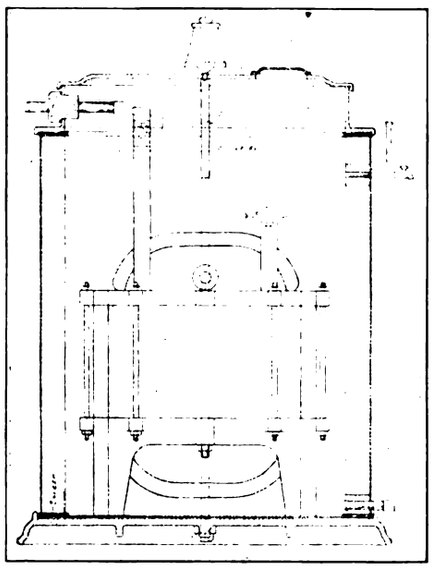
The water-cooled transformers are made in sizes from 100 kilowatts up. Water is circulated in a coil of seamless copper or brass tubing immersed in the oil, and the heat is effectively carried off.

The oil-filled, water-cooled transformers are placed in boiler-plate tanks cylindrical in form and provided with a substantial cast-iron base and cover. The tanks are riveted and caulked, and are supplied with I-bolts extending from the cover to the base, so that the transformers as a whole can be lifted without straining the tank. The cooling coils are made of one and one-quarter-inch tubing without joints throughout the portion immersed in the oil, and all coils are tested with a water pressure of 200 pounds per square inch. The ends of the cooling coils are brought out through stuffing boxes arranged below the oil level. The lower end is thus below

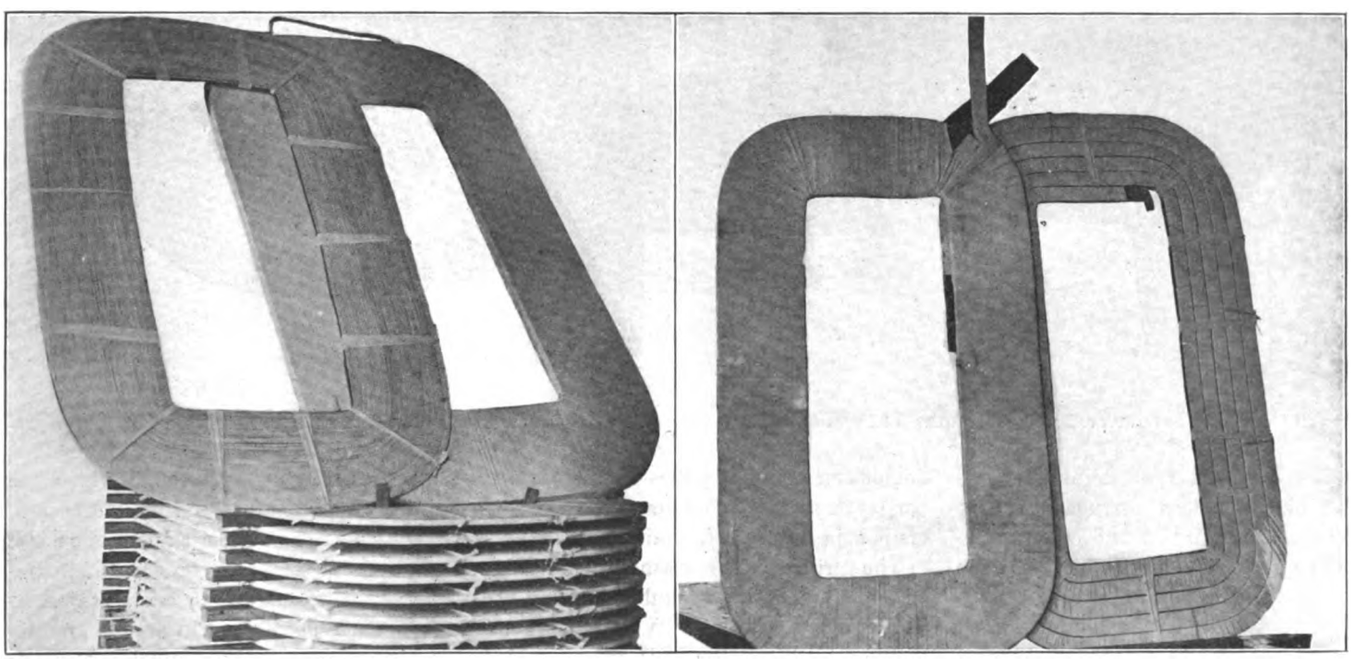


SECTION OF OIL-FILLED, WATER-COOLED TRANSFORMER.

500-KILOWATT, TWENTY-FIVE CYCLE, 405-2,200 VOLTS OIL-FILLED, WATER-COOLED TRANSFORMER.



SECTION OF OIL-FILLED, SELF-COOLED TRANSFORMER.



HIGH-VOLTAGE AND LOW-VOLTAGE COILS OF OIL-FILLED TRANSFORMER.

Digitized by Google

the level of the lowest coil, so that all water can be easily drained off. The coils are permanently fastened to the case, and are of such diameter that the transformer can be lifted out without disturbing the coils or water connections. The water-cooled transformers are supplied with an oil gauge, drain valve, and thermometer with contacts for an electric alarm attachment that gives a signal in case the temperature exceeds the allowable limit.

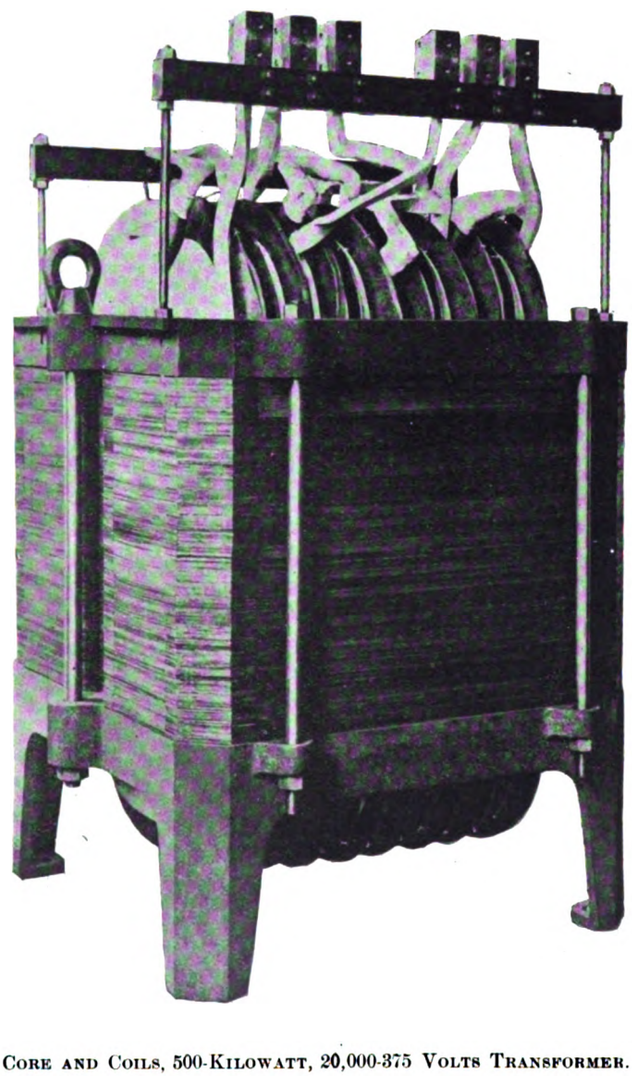
For self-cooled transformers, the case is made of terne-sheet formed into a cylindrical tank with deep corrugations that present a large radiating and cooling surface. The tank has a double bottom made of two flanged pieces of sheet iron riveted together, and the cylindrical corrugated part is soldered into the annular channel-shaped space between the flanges, thus making a tank that is perfectly oil tight. The tank is provided with a substantial cast-iron base and cover, a lid being placed on the latter to allow inspection and give access to the terminal board in case it is necessary to make any changes in the connections.

All transformer coils are wound with double cotton-covered strip copper, one turn per layer, with fullerboard insulation, in addition to the cotton covering, between turns. Exceptions to the foregoing are made only when the size of the conductor is so small as to make this construction impracticable, and in such cases the coils are wound with round double-cotton covered wire with few turns per layer, so that the voltage between layers is kept within safe limits.

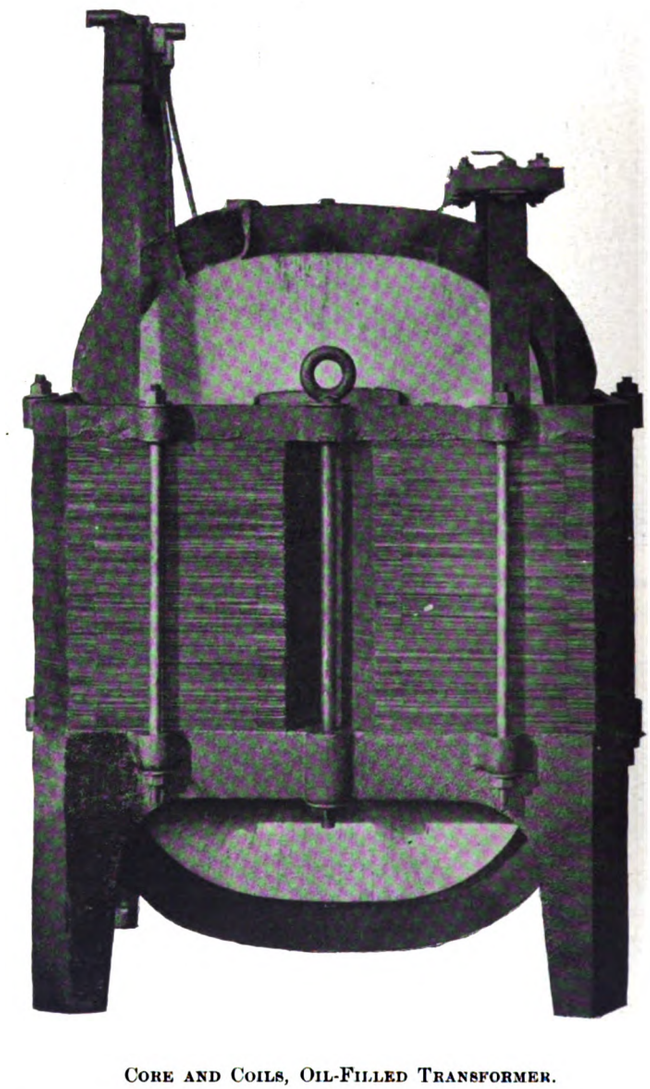
The primary and secondary windings are subdivided into a number of these flat coils which present a large cooling surface to the oil. When the coils are assembled the primary and secondary sections are interleaved. When the conductor is large, several strips are used in parallel and insulated from one another. The coils are neatly and tightly bound with extra long linen tape, and no varnish or insulating compounds are used on the windings.

The transformer core is built up of selected sheet steel 0.014″ thick. The steel is the best obtainable and is thoroughly annealed. The laminations are thoroughly insulated from one another by a coating of varnish. The steel is practically non-ageing, *i. e.*, the core loss does not appreciably increase under long continued operation. In larger sizes space blocks are placed every few inches in the core, providing ducts through which the oil can circulate and carry off the heat.

The oil used in these transformers is a special grade selected after long and careful tests; it contains no acid, has slight evaporation at 100° centigrade, and its flashing point is about 190° centigrade or 375° Fahrenheit. It is a thin oil that circulates rapidly throughout the transformer, quickly carrying off the heat, and its insulating qualities are said to be excellent.



Core and Coils, 500-Kilowatt, 20,000-375 Volts Transformer.



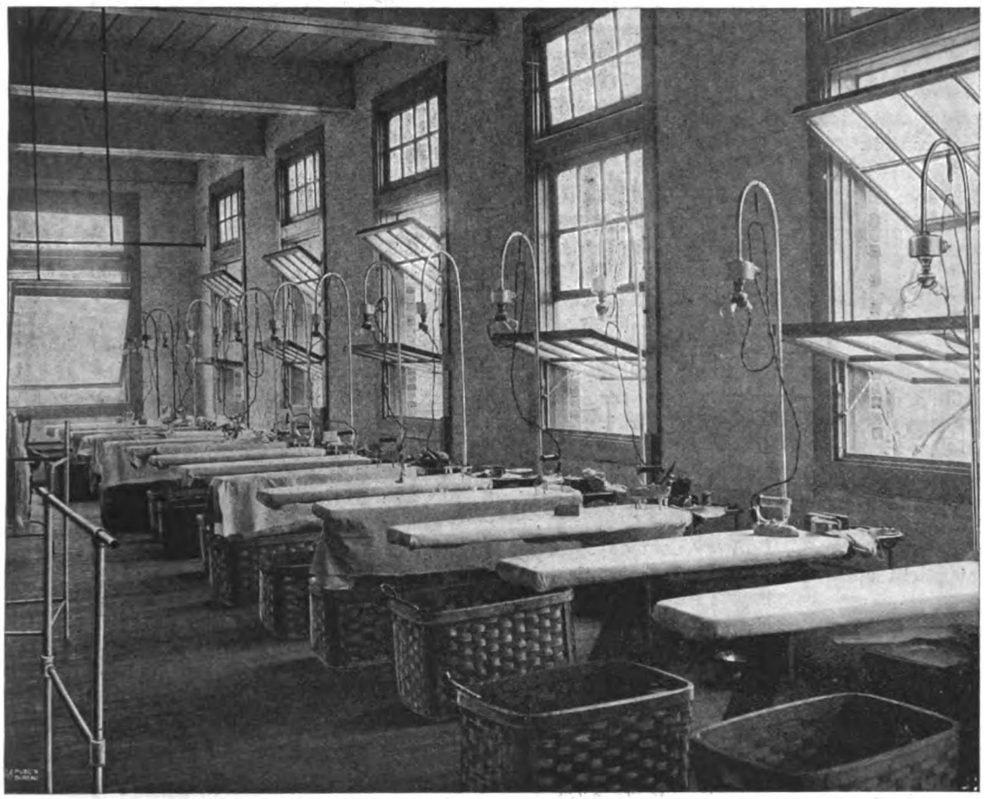
Core and Coils, Oil-Filled Transformer.

Digitized by Google

The Electrical Equipment of a Modern Steam Laundry.

The Guthman Steam Laundry at Atlanta, Ga., presents an interesting example of the use of electricity for lighting, heating and power, and is a model establishment in this, as well as in other respects.

The building in which the laundry work is carried on was built especially for the purpose and is entirely self-contained, being a brick structure of three floors and a basement, comprising some 24,000 square feet of floor space. The arrangement of the processes in washing and ironing the clothes is somewhat unusual. The basement contains the generating equipment, repair shop and storerooms, while primary washing machines and centrifugals for extracting water from the clothes are located on the top floor, which is, on this account, constructed of cement fourteen inches thick. In this way the first and second stories, used for offices, ironing and drying, are kept entirely free from all odors of boiling clothes and soapsuds which will permeate a building in which the washing is done in the basement.



ELECTRIC IRONS IN A MODERN STEAM LAUNDRY.

In the basement boiler-room are located two 200-horse-power water-tube boilers which supply steam at both low and high pressures, respectively for laundry purposes and for an automatic engine which drives a fifty-five-kilowatt, compound-wound, 110-volt General Electric generator for supplying light and power. On the first floor, in addition to the general offices, are four large mangles each driven by a five-horse-power, direct-connected motor. Individual motor drives are also used on the shirt bosom ironers, body ironers, wristband ironers, moisture-applying machines, etc. The primary washing machines on the third floor, as well as the centrifugals, are grouped and are driven from two lines of shafting, each belted to a fifteen-horse-power motor. Aside from the machine drives, there is also installed an electric elevator which carries the work from the delivery wagons in the basement to the sorting room on the top floor.

It is the hand-ironing department on the second floor, however, where the most interesting use of electricity is evident. Here are installed thirty six-pound and ten three-pound electric flat-irons of the cartridge type built by the General Electric Company. The method of installation is unusually neat and emphasizes the convenience and adaptability of the electric flat-iron over the gas-heated iron. Over each ironing table, as shown in the accompanying illustration, there is a special goose-necked fixture fitted with a four-candle-power indicating lamp, both controlled by a ten-ampere snap switch. This novel arrangement tells at a glance which irons are doing useful work or which are standing idle with the current turned on. Moreover, this method of attachment allows the operator the greatest freedom in the use of the iron.

The electrical equipment of this laundry was installed by the General Electric Company after plans of George Wade as consulting engineer for the Guthman Company. It has been demonstrated by the Guthman Laundry that by the use of the electric irons twenty per cent more work can be accomplished by each operative per working day than that formerly done by the older methods.

Window Lighting.

The Frink special patent window reflector is earning an enviable reputation for store-window lighting and, it is stated, has been adopted by all of the large department stores in New York and other cities. Among others, the following companies have placed orders for the Frink system of show-window lighting: B. Altman & Company, Jas. McCreery & Company, Lord & Taylor, New York city; the May Company, Denver, Col.; Watt, Rettew & Clay, Roanoke, Va.; H. Astrich, Harrisburg, Pa.; Hutzler Brothers, Baltimore, Md.; W. D. Kinsman Company, Springfield, Mass.; D. J. Donahue Company, Missoula, Mon.; M. S. Plaut Company, Danville, Ill.; Sibley, Lindsay & Curr, Rochester, N. Y.; Julius Sycle Sons, Richmond, Va. This line of reflectors is made by I. P. Frink, 551 Pearl street, New York city.

Illustrated Lectures on Illumination.

The illustrated lectures which A. J. Marshall, illuminating engineer, of the Holophane Glass Company, is giving before the central stations and gas companies on the questions of light and illumination, are proving very successful, and it is expected that this work will be the means of greatly assisting the growing demand for the best kind of lights properly placed for desired effects. Mr. Marshall lectured before the West Penn Electric Company, Connellsville, Pa., on Thursday evening, October 25, at which an enthusiastic audience displayed great interest.

The Holophane Glass Company states in this connection that, while this lecturing is planned out for some time ahead, it will, nevertheless, be pleased to consider application for this kind of work and deliver lectures in the order that requests are received.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

LIGHT AND POWER COMPANY FLOATED—Capitalists of Columbus and Cincinnati, Ohio, and Salt Lake City, Utah, have organized the Salt Lake Public Service Company, which proposes to supply light, heat and power for Salt Lake. The company has a capital of $3,000,000, with an authorized bond issue of $2,500,000, of which $1,500,000 will be sold in the near future. James J. Chambers, of Salt Lake, is president of the company.

NEW ELECTRIC ROAD—Surveys have been begun at Traverse City, Mich., for the Northern Michigan Traction Company, which will build an electric line 225 miles in length extending from Manistee to Cheboygan, taking in Traverse City, Charlevoix and Petoskey, with several branch lines. The contemplated road will cost $7,000,000, and F. O. Oleson, general manager, announces that there is ample capital behind the scheme. It is proposed to install local systems wherever there is sufficient population to warrant it. The third-rail system, with the overhead trolley in towns, will be used. From Traverse City a branch will run to Old Mission, eighteen miles, and from Petoskey a branch will run to Walloon Lake, East Jordan and Bellaire, connecting with the main line at Elk Rapids.

LIGHT AND TRACTION DEAL—Negotiations in a deal involving millions of dollars have progressed so far that terms for the leasing of the Cincinnati, Covington & Newport Light and Traction Company have been practically agreed upon, and that property will probably soon pass into the control of the Columbian Company, a holding corporation, formed under the laws of West Virginia. This company, which will have a capital of $75,000,000, will also purchase the control of the Union Gas and Electric Company, of Cincinnati, Ohio, the two Cleveland gas and electric properties, and own outright many thousands of acres of oil and natural-gas-bearing lands in West Virginia and a pipe line to Cincinnati. The aggregate capitalization of the subsidiary companies will amount to between $160,000,000 and $175,000,000.

PROPOSED CHICAGO TRACTION IMPROVEMENTS—An ordinance has been prepared by the traction interests operating the Chicago City Railroad Company and the Chicago Union Traction Company, and submitted to the city council's local transportation committee. The companies propose to expend approximately $40,000,000 for reconstruction, provided the ordinance meets with favor. All work is to be carried on under a board of three supervising engineers. It is proposed to expend $5,000,000 for a subway, and more after five years if the board of supervisors sees fit. Provisions are made for the purchase of the lines by the city and a reduction in fares is suggested, provided the city shall reduce the sum to be set aside as compensation. Underground trolleys after five years are made a possibility if the engineers in charge so decide. Spaces are left in the proposed ordinance where the amount of compensation and other figures open for discussion are involved.

LARGE COLORADO POWER COMPANY—The Central Colorado Power Company is in process of organization under the laws of Colorado, for the purpose of acquiring and developing water-power properties on the Grand river in Central Colorado. The company will have a total authorized capitalization, including bonds and stocks, of $42,500,000, made up as follows: Forty-year five per cent bonds, $20,000,000; preferred stock, six per cent, cumulative after January 1, 1910, $7,500,000; common stock, $15,000,000; total $42,500,000. It is proposed to develop, ultimately, 80,000 continuous horse-power. However, in the first instance, 30,000 continuous horse-power will be developed, and for this purpose arrangements are being made to sell $9,000,000 of the bonds. Besides the bonds, $4,500,000 of the preferred stock and $15,000,000, or all, of the common stock will be issued now. The preferred stock is redeemable at 120 after July 1, 1912.

TRACTION SYNDICATE FORMED—A new traction syndicate has been formed to build a long-distance fast-service line from Pittsburg, Pa., down the Ohio river on the west side of the junction with the Beaver river, crossing the Ohio river, one branch going up the Beaver valley to Newcastle, a distance of fifty-two miles, and the other down the river to the new steel town of Midland. This line will compete with the Beaver Valley system of the Philadelphia company. It will connect at Newcastle with the Sharon and Newcastle trolley and will form a part of a Cleveland-Pittsburg system. Grading for the Sharon-Cleveland line is under way and the building of the road will be started early next spring. The entire line will be 150 miles long. The scheme is being promoted by Francis J. Torrance, president of the Standard Sanitary Manufacturing Company; W. H. Hartman, of Elwood City; W. F. Clayton, of Denver, Col., and others. If built it will be a most expensive system, estimates of the cost of construction running up to $20,000,000.

NEW HAVEN ROAD BUYS CONNECTICUT RAILWAYS AND LIGHTING PLANTS—The negotiations for the purchase of the Connecticut Railway and Lighting Company by the New York, New Haven & Hartford Railroad have been completed, and it is announced that the transaction will take effect December 1. The Connecticut Railway and Lighting Company controls a number of electric properties in Connecticut, including 186 miles of city and interurban railway lines. The New Haven & Hartford, within the past few weeks, sold all its holdings in Massachusetts street-railway properties, turning the stock over to the New England Investment and Security Company. This was done because of the opposition in Massachusetts to the control of the electric lines by the railroad company. The Connecticut company has outstanding $9,191,000 common and $5,809,000 preferred stock. Outside of the Consolidated Railway Company, which was the New Haven's holding company for its Massachusetts electric roads, the Connecticut Railway and Lighting Company is the largest combination of electric railway lines in New England.

DEAL FOR MADISON (WIS.) ELECTRIC PROPERTIES—A syndicate of New York capitalists is negotiating for the purchase of the Madison Gas and Electric Company and the Madison and Interurban Traction Company. The purchase, if it is consummated, will involve about $2,500,000. The syndicate will combine the two properties and operate them together. The gas and electric company is owned by the McMillin syndicate, of New York city, which also controls the Milwaukee Gas Light Company and several other lighting properties in Wisconsin. It is believed that the recent decision of the Supreme Court holding that the city of Madison could be empowered by the legislature to fix maximum rates for gas and electricity has had some effect in causing the McMillin syndicate to entertain negotiations for the sale. The Madison & Interurban Traction Company was purchased a little over a year ago by F. W. Montgomery, a New York capitalist. The road has been almost entirely rebuilt, the old rolling stock replaced by modern and up-to-date cars and the service greatly improved. The street-car company has a capital stock of $500,000 and a bonded indebtedness of $685,000, a total of $1,185,000. The capital stock and bonds of the gas and electric company aggregate $1,100,000.

OBITUARY NOTE.

MR. GEORGE HERRING, a prominent English philanthropist, died in London on Friday, November 2. Mr. Herring was chairman of the City of London Lighting Company, the Electric and General Investment Company, the Municipal Trust Company and several mining companies.

Digitized by Google

ELECTRIC RAILWAYS.

TOPEKA, KAN.—The Topeka & Southwestern Railway Company, the proposed line between Topeka, Eskridge and Council Grove, will be constructed and be ready for operation by September of next year.

BUFFALO, N. Y.—A trolley line connecting the village of Barkers, in the town of Somerset, Niagara county, with Olcott is under consideration. It is said such a line would cost about $150,000.

PEORIA, ILL.—A large appropriation has been voted by the officials of the Rock Island Southern interurban line for an extension from Monmouth to Rock Island. The sum of $1,250,000 was set aside for the work, which will be completed in less than a year.

PORTLAND, ORE.—Two electric railways to Mount Hood are planned to be built within the next two years. One will reach the vicinity of government camp from Portland, and the other will reach the eastern side of Mount Hood in the vicinity of Cloud Cap Inn.

PITTSBURG, PA.—Grading has started on the new trolley line running from Bridgeville to Mount Lebanon. The contractors began work at Bridgeville and will push the work as far as possible this winter. The line is to continue from Bridgeville to Oakdale and later on to McDonald.

ALBANY, N. Y.—The state board of railroad commissioners has approved the application of the New York & Long Island Traction Company for an increase of its capital stock from $1,000,000 to $1,600,000, the increase to be used in buying the stock of the Long Island Electric Railway Company.

MONTGOMERY, ALA.—The Montgomery Traction Company will run an electric-car service from Montgomery to Wetumpka, and it is proposed to extend the line through Tallapoosa county to Anniston some time in the future. Work on the line from Montgomery to Wetumpka will begin next spring. Already the land has been surveyed.

TAYLORVILLE, ILL.—Mayor Leigh has signed the ordinance granting the Springfield & Southeastern Traction Company a fifty-year franchise to operate the road on the streets of Taylorville. The company now has the entire right of way for its proposed route from Pana to Springfield. The company has located its head offices in Taylorville.

LA PORTE, IND.—By unanimous vote of the council of La Porte, a fifty-year franchise was granted to the Chicago-New York electric air line railroad. This franchise will be used by that railroad for the entrance into and terminal in La Porte for their spur track from the main line, which passes about three and one-half miles south of this city.

MUSKEGON, MICH.—Plans have been announced in Muskegon for a new $2,500,000 interurban railway, to be completed for next year's fruit season and to traverse northern Muskegon county, the heart of the Oceana fruit belt, touching at Hart and Pentwater and making Ludington the terminal. E. R. Trowbridge, of Chicago and Detroit, is behind the proposed road.

HAGERSTOWN, MD.—Directors of the electric line running from Pen-Mar to Greencastle have decided to expend between $25,000 and $30,000 in making improvements to the road. Several sharp curves will be eliminated and two large new cars will be purchased. These improvements have been decided upon, in view of the increased traffic coming to the road from the connection with the Hagerstown & Northern at Shady Grove.

WATKINS, N. Y.—The state railroad commission has authorized the Elmira Water, Light and Railroad Company to increase its capital stock from $1,000,000 to $2,000,000 and to issue bonds to the amount of $3,605,000 for the purpose of retiring former bonds and purchasing new properties, including the Glen Route Railway, between this village and Elmira, twenty-two miles in length, now owned by the Seneca Traction Company.

NEW BRUNSWICK, N. J.—Articles of incorporation have been filed for the Perth Amboy & Staten Island Ferry Company, which proposes to operate between Perth Amboy and Tottenville. The new company proposes also to build a new electric railroad across Staten Island. The company has purchased land in Tottenville for its ferry landing and is trying to obtain a landing in Perth Amboy. Its capital stock is $125,000.

SAGINAW, MICH.—Isaac Applebaum, of Detroit, who controls about $410,000, or two-thirds of the bonds outstanding, announces that he will complete the Detroit, Flint & Saginaw electric railroad from Frankenmuth to Flint. The company has been reorganized. The new officers are: president, Isaac Applebaum, Detroit; vice-president, T. G. Sullivan, Detroit; treasurer, M. Mitchkum, Detroit; secretary, C. T. Anderson, Saginaw.

JANESVILLE, WIS.—In special session the council granted a franchise to H. H. Clough, of Elyria, Ohio, who proposes to build the Madison-Janesville electric line. The document gives the right to lay tracks on any and all streets, provided no other companies are thereby excluded, and provides that the local street-railway line be taken over. The privilege of furnishing electricity for light and power also is given Mr. Clough.

HARTFORD, CT.—The Consolidated Railway Company has perfected plans to increase the power capacity for its Meriden and Wallingford division. A substation will be erected north of the North Haven railroad station. This will supply power for the service between Wallingford and New Haven and will relieve the Meriden plant. The Consolidated Railway Company expects to have the trolley line between Rockville and Stafford Springs completed by next July. Several lines of the road at the Stafford end of the line are already finished and a large force of workmen is now pushing construction toward Rockville.

HUNTSVILLE, ALA.—Articles of incorporation of the Huntsville & Birmingham Electric Railroad Company have been filed in the office of the probate judge of Madison county. The company proposes to construct an electric railroad from Huntsville to Birmingham, through Marshall, Cullman and Blount counties, comprising one of the richest mineral, timber and agricultural sections in the South. The proposed railroad will supply the line of road to the South that has always been deemed necessary for the complete development of Huntsville into a manufacturing city. It is understood that strong financial interests are backing the enterprise.

ROCHESTER, N. Y.—A certificate of public necessity and convenience, which carries with it permission to build, has been granted to the Rochester, Scottsville & Caledonia Electric Railway, with head offices in this city, by the state railroad commission. It is expected that the work of securing the right of way and work preparatory to the letting of the contract will be begun without delay. The company is capitalized at $500,000, and practically all of the stockholders are residents of Monroe county. The road will extend from the south line of Rochester through Brighton, Mortimer, West Henrietta, Wheatland and Scottsville to Caledonia.

CASTLE ROCK, WASH.—The Cowlitz Valley Railway and Power Company has been organized for the purpose of utilizing the water powers of Spirit lake and Toutle river and developing the agricultural industries of Cowlitz county. One of the trustees is C. C. Brown, of Castle Rock. No definite plans have as yet been decided upon, but the proposed line has been thoroughly gone over by expert engineers, who pronounce the route as a feasible one. The power developed at Spirit lake will be sufficient for the line, which will probably be electric. It is proposed to build from some point on the Columbia river to the St. Helens mining district, north into the coal district and southwest through Cowlitz valley, opening up several hundred inland towns, among which will probably be Toledo. Work will be commenced not later than next spring.

ALBANY, GA.—At a meeting of prominent Georgia and New York capitalists held in Macon, the organization of a company for the purpose of building an electric railroad from Macon to Albany was perfected. Application for charter will be made at once and the actual construction of the road will be under way in the near future. The new company is backed by ample capital to carry out its plans. The Albanians who are interested in the organization are Joseph S. Davis, N. J. Cruger and S. W. Smith. In connection with the announcement of the organization of the electric railway company comes the definite announcement of the development of the 10,000-horse-power water-power on Flint river two miles north of Albany. The railway company will require about 7,000 horse-power when in full operation, leaving a surplus of 3,000 horse-power to be consumed by local manufacturing enterprises.

Digitized by Google

ELECTRIC LIGHTING.

WASHINGTON, OHIO—Fairbanks, Morse & Company are installing electric lighting plants in the towns of Shawnee and New Straitsville.

CARBON HILL, ALA.—The town board of Carbon Hill has accepted for the town the waterworks and electric light plant which has been completed at an approximate cost of $30,000.

CHICAGO, ILL.—D. W. Mead has prepared plans for a heat, light and power plant to be built at Channahon, Ill., for the Channahon Power Company, Chicago. It will cost $100,000.

BATAVIA, N. Y.—Stockholders of the Batavia Light and Power Company at their annual meeting elected B. B. Conable, George R. Howard, E. O. McNair and S. W. Warren, all of Buffalo, directors.

CENTREVILLE, MD.—At a special meeting of the town commissioners of Centreville, a perpetual franchise was granted to W. J. Peall, of Wilmington, Del., to erect an electric light, heat and power plant.

COUNCIL BLUFFS, IOWA—Essex has granted a franchise to Oscar Nelson to operate an electric light system for a term of twenty years. Nelson will not build a plant, but will secure the necessary current from Shenandoah.

CADILLAC, MICH.—The Wexford supervisors have voted to grant a franchise to the Electric Land and Development Company of Traverse City, to construct a dam on the Manistee river in Greenwood township. The dam will be located about ten miles from Sherman.

BEATRICE, NEB.—A number of Omaha capitalists have applied for a franchise to operate a gas and electric light plant at Wymore, this county. If a franchise is granted they intend to put in a plant that will cost about $50,000. The present lighting system is unsatisfactory.

HAMBURG, N. Y.—The board of trustees has closed a contract for lighting the village streets for a term of five years, beginning October 1, 1906, H. D. Pierce, of Water Valley, being the contractor. Forty lights are to be used and the price agreed upon is $74.50 for each light per year.

PITTSFORD, N. Y.—The streets of Pittsford are to be lighted by electricity by January 1. The trustees have entered into a contract with the Dispatch Heat, Light and Power Company to furnish twenty arc lights. The contract is for five years and the cost $58.85 for each light per year.

TOLEDO, OHIO—The Toledo Railways and Light Company has been given the contract for the street lighting in Toledo at a price of $45 for each arc light. This price is far below that which has been paid and will result in a saving of $60,000 to the city for each year of the ten-year contract.

COLUMBUS, OHIO—The ordinance providing for the issue of bonds in the sum of $140,000 for the electric light plant has been passed by the council under the agreement that only $90,000 shall be used for the purchase of equipment for the plant, the remaining $50,000 to be used in taking up defective bonds.

CANON CITY, COL.—A contract has been awarded for enlarging the Colorado Light and Power Company's plant at this place. The addition will practically double the capacity of the plant, making it one of the largest concerns of its kind in the state. The capacity of the engines and generators will be increased from 2,500 to 5,000 horse-power.

OGDEN, UTAH—A contract has been closed between the citizens of Huntsville, in Ogden Valley, and the Utah Light and Power Company, by which the latter company agrees to light the town, the work to start at once. The residents of Huntsville will erect the poles and the company is to string the wires, wire the business houses and the residences and furnish the electric current.

CONCORD, N. H.—The property of the Laconia Electric Light Company has been purchased by the Laconia Electric Railway Company. The former company has operated a plant that has supplied electricity for street lighting in Laconia and in the nearby towns of Lakeport, Weirs, Meredith and others. The system will be operated in conjunction with the street railway in the future.

MARQUETTE, MICH.—At the forced sale of the Marquette County Gas Light and Traction Company, conducted at Ishpeming, the property was disposed of to Granger Farwell, of Chicago, holder of the bonds, for $289,000. The company's holdings include a gas and electric light system and a street railway, all three serving the cities of Ishpeming and Negaunee. The only other bidder was R. C. Cornish, representing a Milwaukee concern.

OXNARD, CAL.—The Ventura County Power Company, which controls the gas, water and electric plants of the county, is showing activity in many ways. The corporation is about to build a transmission line to Castaic, at which point it will tap the Kern River line of the Edison company, and from there distribute electricity for light and power throughout the entire county. A new battery of boilers and a new engine have been ordered for the Oxnard plant, to be operated in case of accident to the transmission lines.

SALT LAKE CITY, UTAH—M. F. Pack, of Provo, is contemplating the erection of a power plant in Utah county to supply the people of Provo and other towns in the county with electric light and power. The water to provide the power is contained in the north fork of the Provo river, according to an application filed with the state engineer, and Mr. Pack desires to divert thirty second-feet thereof and convey it a distance of 15,000 feet, where the power plant will be established.

HOBOKEN, N. J.—Announcement is made by the Public Service Corporation that as a result of a reduction in the cost of production brought about by the consolidation of plants and the betterment of facilities, the board of directors has decided to readjust its rate for public and commercial electric and gas service, making a very considerable cut, and also to make a new regulation for its fare zone and transfer system on the trolley lines in this and adjacent counties. The change in railway fares went into effect on November 1. The change in electric service will be made on January 1, 1908.

WINDSOR LOCKS, CT.—The Northern Connecticut Power Company, which has taken over the Windsor Locks Electric Light Company, of this place, the Enfield Electric Light and Power Company, and the Enfield Gas Company, has perfected arrangements to consolidate the business of the two electric companies. The contract has been let for a consolidated plant, which will be located near the present Windsor Locks plant, and which will furnish electric light and power for Windsor Locks, Thompsonville and Enfield. The dimensions of the brick structure will be 52 by 125 feet, and the contract calls for the completion of the plant in January. The company is planning to develop an extensive electric light service in the towns of Windsor Locks, Enfield and East Windsor.

SALT LAKE CITY, UTAH—A franchise has been granted by the board of county commissioners to the Utah County Light and Power Company to erect and operate a pole-line system of wiring for the transmission of electricity over and across the roads and highways of the county outside of the incorporated towns and cities. Under the terms of the franchise, actual construction work is to be commenced by March 1, 1907, and one completed line is to be finished from the power plant to be erected at the mouth of American Fork canyon to Bingham Junction by way of Draper and Sandy. The company agrees to furnish Salt Lake county, free of charge, during the life of the franchise, twenty-five thirty-two-candle-power incandescent lamps, or an equal amount of energy in arc lamps.

SPOKANE, WASH.—The Chelan Electric Company, of which J. T. McChesney, of Everett, Wash., is president, has acquired riparian rights on the Chelan river between Chelan and Chelan Falls, west of Spokane, and will erect a power plant for the operation of an electric railroad from the town of Wenatchee northward along the Columbia river, with a branch to Lake Chelan, and up the Okanogan river to the northern boundary of the state. The power will also be utilized in supplying the town of Chelan with electric lights and water and in lighting the towns of Wenatchee, Waterville, Orondo, Brewster and points along the Columbia river; to pump water for irrigating purposes from the Columbia river, for the purpose of operating the line of the Great Northern from Wenatchee to Seattle, a distance of 160 miles, and for lighting the various towns along the way.

Digitized by Google

PERSONAL MENTION.

MR. H. B. KIRKLAND resigned his position as general sales manager of the American Circular Loom Company, Chelsea, Mass., on October 10.

MR. E. W. ROBERTS, superintendent of the Washington (Ind.) electric light plant, has tendered his resignation and will enter a general electric supply business in that city.

MR. H. B. PITCHER, of Freehold, N. J., has been appointed manager of the Manapalan Lighting Company, doing business at Englishtown and Freehold. He succeeds W. J. Lansley.

MR. HOMER E. NIESZ, the well-known managing director of the Electrical Trades Exposition Company, Chicago, Ill., has been elected Supreme Neptune for the coming Jovian year of the Rejuvenated Sons of Jove.

MR. GEORGE W. WILDER, Ph.D., has resigned his position as professor of telephone engineering at the Armour Institute of Technology and has opened an office in the Monadnock Building, Chicago, Ill., as a telephone engineer.

DR. C. J. H. WOODBURY was the speaker of the evening at the first monthly dinner of the season of the Boston Boot and Shoe Club, Wednesday evening, October 17, taking as his subject "The Development of the Telephone." Dr. Woodbury's presentation was greatly enjoyed. The address was illustrated by numerous lantern slides and by large models of telephone parts. On Thursday evening, October 25, Dr. Woodbury addressed the Lynn (Mass.) Board of Trade, his subject being "The Business Man and the Telephone."

PROFESSOR CHARLES F. BURGESS has been placed in charge of the department of chemical engineering at the College of Mechanics and Engineering, University of Wisconsin, to which department the courses in applied electrochemistry have been transferred. Among other changes at the university is the resignation of Professor George C. Shaad, who has resigned to take a position at the Massachusetts Institute of Technology; Professor Oliver W. Brown has accepted a professorship at the University of Indiana and is succeeded by Dr. Oliver P. Watts.

MR. ROBERT L. WARNER, who for several years has been New England manager of the Westinghouse Electric and Manufacturing Company, has resigned to enter the firm of Warner, Tucker & Company. Mr. D. Edgar Manson, who has been associated with the Boston (Mass.) office for several years, first as assistant manager, and for the past three years as manager, will have charge of the New England interests of the company, the scope of his office being enlarged to enable him to attend to many of the duties which have been performed by Mr. Warner.

DR. ANDREW FLEMING WEST has declined the invitation to accept the presidency of the Massachusetts Institute of Technology. Dr. West states that "the only reason I can not accept is the increasing clear conviction that I ought to abide by my special work here, a work which has claims upon me as it has upon no one else. This conviction has been emphasized anew by the friendly insistence of the alumni, of my colleagues and of the authorities of Princeton University that I am needed here to develop the growing interests of our graduate school, and by the demonstration of affection made by the students and residents of Princeton."

NEW PUBLICATIONS.

NIAGARA POWER—The Cataract Power and Conduit Company, Buffalo, N. Y., has published a handsome booklet in which are collected a series of testimonials which have been received from users of this power. The booklet is entitled "What the Users of Niagara Power in Buffalo Say of It."

REPORT OF NEW-BUSINESS METHODS TO THE AMERICAN GAS INSTITUTE—The report of new-business methods to the American Gas Institute, at its meeting at Chicago, Ill., October 17, 18 and 19, 1906, has been issued as a handsome volume. This volume is replete with interesting suggestions from the men who are doing the work. The book is made more interesting by the use of portraits of the contributors, and includes portraits of such prominent men in the lighting field as Emerson McMillin and Henry L. Doherty. There are also reproductions of numerous examples of gas advertising and illustrations of showroom display and window advertising.

ELECTRICAL SECURITIES.

A dull and irregular price movement last week gave way toward the close to a decided tendency to climbing and general speculative confidence. Ante-election bugaboos were less in evidence, and with a relief in the monetary condition there would in all probability have been greater advances. The increased dividend in Pennsylvania and the favorable report of earnings by United States Steel, with a new record of unfilled orders, offset any disappointment felt at the failure to increase the dividend on Steel common.

ELECTRICAL SECURITIES FOR WEEK ENDING NOVEMBER 3.

New York:	*Closing.*
Allis-Chalmers common	16¾
Allis-Chalmers preferred	44
Brooklyn Rapid Transit	80⅝
Consolidated Gas	139
General Electric	174
Interborough-Metropolitan common	38
Interborough-Metropolitan preferred	77⅝
Kings County Electric	155
Mackay Companies (Postal Telegraph and Cables) common	71½
Mackay Companies (Postal Telegraph and Cables) preferred	69
Manhattan Elevated	143
Metropolitan Street Railway	105
New York & New Jersey Telephone	124
Western Union	86
Westinghouse Manufacturing Company	154½

Boston:	*Closing.*
American Telephone and Telegraph	138
Edison Electric Illuminating	233
Massachusetts Electric	62½
New England Telephone	128
Western Telephone and Telegraph preferred	80

Philadelphia:	*Closing.*
Electric Company of America	11¾
Electric Storage Battery common	70
Electric Storage Battery preferred	70
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	28
United Gas Improvement	93⅞

Chicago:	*Closing.*
Chicago Telephone	116
Chicago Edison Light	140
Metropolitan Elevated preferred	65
National Carbon common	86
National Carbon preferred	120
Union Traction common	4¼
Union Traction preferred	14½

Chicago Telephone Company's October report showed telephones increased 2,163. Total in use, 165,995.

The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent on its preferred stock, payable November 15.

Both the Northwestern and the Metropolitan roads attained new high records for traffic during the month of October. At the same time the South Side Elevated showed only a slight gain in passenger receipts as compared with the same month last year. The reports are of added interest at this time because the roads are passing through especially important periods. A number of new and far-reaching influences are at work which will have a bearing on the future earnings of all the elevated lines. The turning into trolley lines of the North Side and the Cottage Grove Avenue cable lines and the introduction of the express service on the South Side Elevated appear for the first time as factors in traffic reports. With the Northwestern there was a loss of traffic for a few days after the passing of the cable lines. The trolley service, however, did not prove satisfactory and the elevated regained its lost patronage. The Metropolitan carried a daily average of 142,671, an increase of 10,681, or 8.10 per cent.

Digitized by Google

TELEPHONE AND TELEGRAPH.

JAMESTOWN, N. D.—The Independent Telephone Company has asked Jamestown for a thirty-year franchise.

KOKOMO, IND.—The Bell and the Citizens' Telephone Companies have merged and will be under one management hereafter.

SCRANTON, MISS.—The Western Union Telegraph Company has laid a new cable across the Pascagoula river from Scranton to West Side.

OMAHA, NEB.—The latest announcement of railroad improvements in Omaha is that the Illinois Central company will construct an independent telegraph and telephone system in Council Bluffs and Omaha.

FORT WAYNE, IND.—The Home Telephone Company is now using its new toll line board which requires the services of five operators instead of three, the former number. The board cost $6,000 and is entirely modern. The old board was sent to the Kendallville exchange.

BOSTON, MASS.—The Southern New England Telephone Company's statement for the three months ended August 31 shows gross receipts of $457,396, expenses of $356,871 and net earnings of $101,525, leaving a balance, after the payment of $82,500 in dividends, of $19,025.

COLDWATER, MICH.—The Southern Michigan Telephone Company, an independent system, has commenced the expenditure of $80,000 on a system to include underground wires in the business section and twenty miles of cable. Coldwater will be the distributing point for southern Michigan and northern Ohio and Indiana.

BRATTLEBORO, VT.—Patrons are being secured for new telephone lines in the towns of Newfane, Townshend, Wardsboro, Brookline and Dover by the New England Telephone and Telegraph Company. An exchange will be established in Newfane, which will be the central for the towns mentioned, and trunk lines will be run from Brattleboro.

COOPERSTOWN, N. Y.—The Rose-Davis Telephone Company is constructing a line from Westford to Maple Valley, a distance of four miles. The company also has a line partly constructed from Otsdawa to West Laurens, a distance of three miles. A line from Worcester to East Worcester is under consideration, but it is not probable that it will be built this fall.

SHELBURNE FALLS, MASS.—At the annual meeting of the Heath Telephone Company the following officers were elected: president, W. E. Kinsman, of Heath; clerk and treasurer, Herbert Newell, of Shelburne Falls; directors, W. E. Kinsman, D. G. Taylor, of Jacksonville; George E. Davis, of Shelburne Falls; F. L. Totman, of Conway; H. Newell and W. A. Barber, of Leyden; S. B. Crafts, of Whateley.

CLEVELAND, OHIO—The Cuyahoga Telephone Company has disposed of an additional $100,000 of preferred stock. The stock was taken by the Ohio telephone syndicate, better known as the Brailey syndicate. The proceeds of the loan will be used to reduce the floating debt of the Cuyahoga Telephone Company. The Cuyahoga Telephone Company has remaining about $100,000 preferred stock which it can sell at any time.

WASHINGTON, D. C.—The signal corps of the army has greatly increased the telegraphic facilities in Alaska and the Philippines the past year. Many wireless stations have been established in both countries, and the chief signal officer, in his annual report to the War Department, announces that they are being operated very successfully. Wireless stations have been established at Zamboanga and Jolo, in the Philippines.

BUTTE, MONT.—The Rocky Mountain Bell Telephone Company will expend $250,000 more in further enlarging and equipping its Butte system, says President George Y. Wallace of the company. Chief among the work to be carried out during the next few months is the erection of a handsome new three-story telephone building; the installation of a new switchboard to cost more than $100,000, and other improvements, including conduits, to cost $68,000.

REDDING, CAL.—Thirteen farmers living on Churn creek, in the Pacheco neighborhood, thirteen miles from Redding, have organized a rural telephone company and will build a telephone line that will connect with the Redding central. Money enough to build and equip the line has been paid into the treasury, and the wires and poles have been ordered. The officers of the corporation, which is called the Pacheco Telephone Company, are: D. W. Hampton, president; W. J. B. Martin, secretary, and W. H. Hill, treasurer.

DALLAS, TEX.—The Southwestern Telegraph and Telephone Company, which operates in Arkansas and Texas, reports as follows: total number subscribers, July 31, 1906, 105,463; gain exchanges, August, 1906, 1,619; gain sublicensees, August, 1906, 670; total number all kinds, August 31, 1906, 107,752; total gain all kinds, August 31, 1906, 2,289; total number exchange subscribers, August 31, 1906, 77,143; total number sublicensees, August 31, 1906, 30,609; total number subscribers, all kinds, 107,752. Total gain January 1 to August 31, 11,162.

CAMBRIDGE, MD.—Articles incorporating the Hoopers Island & Golden Hill Telephone Company have been filed in the office of the clerk of the Circuit Court for Dorchester county. The company proposes to construct a telephone line through Hoopers Island to Golden Hill, and to construct lines from Hoopers Island to other points in Dorchester. The capital stock is $2,500. The incorporators are: William F. Applegarth, Charles R. Mills, Henry A. Phillips, George W. Tyler, John M. Clayton, Alonzo Travers, Oscar A. Keene, John S. Boseman and Benjamin F. Travers.

NASHVILLE, TENN.—Reports have been received by the state comptroller showing the number of instruments now being operated in Tennessee by the Cumberland Telephone and Telegraph Company, the East Tennessee Telephone Company, the Citizens' Telephone and Construction Company, of Lawrence county, and the Benton County Telephone Company, which are subject to state privilege taxes. These reports give some interesting figures and show that there has been a marked increase in the telephone business of Tennessee since last year. Under the assessment laws of Tennessee the telephone companies are required to pay a privilege tax of forty cents per box or instrument in every county of the state having a population of 40,000 or over, a tax of twenty cents per box or instrument in every county having a population of under 40,000. The total number of instruments in the state is now 30,135.

ENGINEERING SOCIETY NOTE.

BOSTON BRANCH, ILLUMINATING ENGINEERING SOCIETY—The meeting held at the American House, October 15, was called to order by President Campbell. It was voted to change the date of regular meetings to the Tuesday following the second Friday of each month. Two papers read at the recent New York meeting were presented for reading and discussion. The first one, on "Application of Photometric Data to Indoor Illumination," by Earnest C. White, was read by A. J. Farnsworth. The second, entitled "Data on Indoor Illumination," by J. E. Woodwell, was read by G. H. Stickney. At the conclusion of the reading a discussion was held, which was participated in by the members. Dr. Louis Bell went into quite a lengthy discussion of these papers. He personally considers the polar diagram with slide rule, etc., a very convenient combination for measuring illuminating effects at different angles. He also spoke of the relatively small value which could be attached to the law of cosines and made a number of practical demonstrations along these lines, illustrating that the useful light must largely fall on the object illuminated upon a normal plane. G. H. Stickney spoke of many experiments along the line of increasing the light sources and utilizing reflectors of such shapes as to lower the intrinsic brilliancy and spread the illumination over larger surfaces, reflected at suitable angles to the space illuminated. Dr. Charles Williams spoke of the injurious effects of general illumination upon the human eye, and criticized the general tendency to have a strong light, too closely concentrated, especially when located in the normal range of sight. He emphasized the necessity of greater diffusion and lower intrinsic brilliancy. He mentioned several experiments for determining the amount and location of light for certain classes of work. J. S. Codman demonstrated the method of calculating illumination, using a set of curves which he had personally plotted and which give a rapid way of determining the amount of illumination necessary. He regarded the paper of Mr. Woodwell as very practical and valuable. The discussion was further entered into by A. J. Farnsworth, C. J. Hatch, Edison Cowles and W. E. Clarke.

Digitized by Google

NEW MANUFACTURING COMPANIES.

HARRISBURG, PA.—A charter has been granted to the Philadelphia Electrical and Manufacturing Company, with a capital of $75,000.

NEW YORK, N. Y.—The Hudson Electric Specialty Company has been incorporated to manufacture electrical machinery and appliances. The capital is $15,000. The incorporators are Wilfred A. Hennessy, Walter G. Hocke and James J. Underwood, all of New York city.

WORCESTER, MASS.—The Worcester Electrical Contracting Company has been incorporated under the laws of Massachusetts to do a general electrical contracting business and to deal in electrical supplies in Worcester. The capitalization is $10,000. Roger T. Williams is president and Clarence W. Hobbs, Jr., treasurer and clerk. They, with Dr. Lamson Allen, comprise the directors.

NEW INCORPORATIONS.

LANSING, MICH.—Western Michigan Light and Power Company, Manistee. $500,000.

OLYMPIA, WASH.—Northwest Light and Power Company, of Spokane. Increase of capital stock to $600,000.

BAKER CITY, ORE.—Baker Valley Land Company. $10,000, all subscribed and paid. To buy and sell real estate, water and power plants, etc. Incorporators: Davis Wilcox, of Haines; J. K. Romig, of Baker City, and N. U. Carpenter, cashier of the Citizens' National Bank, Baker City.

ALBANY, N. Y.—The Lake Erie Electric Traction Company. $400,000. To take over the property and franchises of the Lake Erie Traction Company and the South Shore Suburban Railway Company. Principal office: Westfield, Chautauqua county. Directors: Alexander Keogh, Ashley T. Cole, James A. Byrne, R. W. Yates, J. S. Cloonan, W. J. Bagnell, Arthur McCausland, D. P. Bergheimer, and C. H. Wener, of New York city.

ALBANY, N. Y.—West Shore Traction Company. $2,500,000. To operate a surface line between Orangetown, Piermont, Grand View, South Nyack, Upper Nyack, Congress, Haverstraw and other places in Rockland county. Directors: Frank J. Whan, A. H. Whan, E. J. Welsh, M. C. Heine, G. P. Fall, G. S. Fulton, of New York city; A. S. Brown, Brooklyn, E. G. Roff, Jr., Orange, N. J.; E. A. Hilton, Paterson, N. J.

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1508 describes and illustrates Christensen straight air-brake equipments.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has established a new Canadian branch in Montreal, Canada, at Lagauchetiere and Cote streets.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued from its supply department a very complete catalogue of railway supplies. This is designated as catalogue No. 7601.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., will be pleased to send to anyone interested upon request its new pamphlet entitled "Small Motors and Motor Applications."

THE H. T. PAISTE COMPANY, Philadelphia, Pa., has ready for distribution a new bulletin describing and illustrating Fielding receptacles. There is also a new discount sheet and new prices on cartridge cutouts.

A. GROTHWELL, 2517 Castro street, San Francisco, Cal., is calling attention to the "Mogul" products. These include armature varnishes, driers, acid and alkali-proof compounds, and insulating oils and varnishes.

M. W. DUNTON & COMPANY, Providence, R. I., announce that they are making a special offer on their regular cotton sleevings for electrical purposes. Notwithstanding a high cotton market, the company announces a very attractive proposition.

THE H. KRANTZ MANUFACTURING COMPANY, Brooklyn, N. Y., has published a handsome panel-board catalogue for architects and engineers. In addition to a number of striking half-tone reproductions there are given full data concerning the physical characteristics of this apparatus.

THE CENTRAL ELECTRIC MANUFACTURING COMPANY, Rock Island, Ill., is calling attention to the "Black Hawk" dry battery. This battery has a corrugated zinc cell giving a large surface, and it is claimed that it has an initial high voltage, high amperage, great recuperative powers and long life.

THE FOSTORIA GLASS SPECIALTY COMPANY, Fostoria, Ohio, has issued a handsome catalogue devoted to "Noblac" inner globes for enclosed arc lamps. In addition to the text, which is very carefully arranged, there are numerous line drawings showing the various forms of inner globes manufactured by this company.

THE ELECTRIC SERVICE SUPPLIES COMPANY, Chicago, Ill., has published an attractive booklet, designated as the "Keystone Traveler," calling attention to a number of the company's specialties. A very interesting group of the company's representatives, taken at Columbus, Ohio, during the recent street-railway convention, is shown.

THE CINCINNATI MILLING MACHINE COMPANY, Cincinnati, Ohio, has published a catalogue devoted to examples of rapid milling. The text is supplemented by many half-tone reproductions showing belted and motor-driven millers in service applications. Altogether, the volume comprises sixty examples of machining of this character.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, manufacturers of incandescent lamps, has issued recently a special bulletin devoted to each of the following new types of lamps: the Buckeye "Gem Focul" lamp, the Buckeye "Gem" lamp and the Buckeye "Tantalum" lamp. In addition to this the company has issued a bulletin descriptive of the "Standard" Buckeye type of incandescent lamp.

THE ELECTRO-DYNAMIC COMPANY, Bayonne, N. J., has ready for distribution several new bulletins dealing with the "Inter-Pole" motor. One of these bulletins is devoted to reproductions of testimonials from users of this apparatus and another is a reprint of the American Institute of Electrical Engineers paper by C. H. Bedell, entitled "Direct-Current Motor Design as Influenced by the Use of the Inter-Pole."

THE GENERAL STORAGE BATTERY COMPANY, 42 Broadway, New York city, has increased its business to such an extent that it has been obliged to enlarge its present works at Boonton, N. J. Additional generating units are being installed, and the additional switchboard equipment consists of twenty-one generator and feeder panels. The new building which is being added will be a structure of five stories and basement, for which a separate power station will be erected.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has shipped within the last few months nine carloads of electrical machinery, exclusive of other smaller shipments, to the following large companies: four carloads to the National Tube Company, including motors of various sizes; two carloads to the Lehigh Portland Cement Company, one of direct-current generators and a number of motors of various sizes; two carloads of alternating-current generators to the Snow Steam Pump Company, and one carload of form L small motors to the Crocker-Wheeler Company's San Francisco office. This last shipment is to fill part of the company's orders taken since the fire.

THE HOOVEN, OWENS, RENTSCHLER COMPANY, Hamilton, Ohio, has licensed the Felten-Guilleaume, Lahmeyer Werke, Frankfort-on-Main, Germany, to build the Hamilton-Holzwarth turbine throughout Germany. This German company is one of the largest electrical concerns in that country. It has a capital of $20,000,000, and manufactures both water and steam turbines, wire cables, generators, motors and all classes of electrical machinery. It has recently secured control of Escher, Wyss & Company, of Zurich, Switzerland, thus controlling the Zoelly steam turbine syndicate of Germany. The manufacture of the Hamilton-Holzwarth turbine has been taken up after a careful investigation and after an exhaustive series of tests made at the University of Darmstadt.

THE DOWNWARD LIGHT ELECTRIC COMPANY, Union square (east), New York, is pressing the introduction of its new forty-watt downward lamp. For this lamp the claim is made that

Digitized by Google

it reaches the highest efficiency in light distribution, economy, current consumption and useful life. The company also claims for this lamp that, compared with the most efficient 3.1-watt ordinary sixteen-candle-power lamp, it shows twenty per cent less current consumption, seventy-one per cent more downward light and 145 per cent longer life. In connection with this lamp, the company publishes the following statement: "In your search for higher efficiency, do not forget that light rays travel in straight courses and that illumination means light actually used, not light distributed where it is not required. What you should figure is the efficiency of light used—illumination."

THE SARCO COMPANY, 906 Sixth avenue, New York city, reports excellent success in the introduction of its electric lighting specialties, particularly the Sarco pendant switch. This switch is only about two inches in size and conforms to the National Electrical Code standard. It was patented in the early part of the present year, yet the manufacturers report that the demand for it is almost universal. Among some of the other specialties made by this company are the "Noscru" push button, the Sarco swiveling and separable attachment plug, the "Noscru" key-arm switch and the Sarco outlet box. The Sarco company is one of the younger manufacturing companies producing and introducing electrical specialties, yet under the personal direction of Ralph A. Schoenberg its growth has been rapid and substantial. Its success may perhaps be attributed to the fact that Mr. Schoenberg is at the head of a large electrical contracting business, contact with which has given him practical ideas as to the requirements in practical design and operation for such specialties as the company offers.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the Second Issue of Each Month.)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Ct.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Sadtler, 59 South Tenth street, Philadelphia.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty street, New York. Meetings, fourth Friday of each month.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnston, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Professor Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 12 West Thirty-first street, New York. Annual meeting, December 4-7, 1906.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, 60 Wall street, New York.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, S. W. Mower, London, Canada.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Ernest H. Davis, Williamsport, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Annual meeting, Atlantic City, N. J., June 19, 1907.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington street, Newton, Mass. Annual meetings held in Boston on third Wednesday in March.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Ontario.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. F. Dostal, Denver, Col.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Ct. Annual meeting in November, 1906.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt street, New York.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water street, Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine street, St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary-Treasurer, George H. Erich, 401 Monadnock Block, Chicago. Next annual meeting, Chicago, January, 1907.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada. Next annual meeting, January 14, 1907.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliot, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall street, New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, Rolland A. Davidson, 58 William street, New York city, N. Y.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Dr. Arthur H. Elliot, 4 Irving place, New York. Meetings in New York, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.; assistant secretary, J. A. Harney, Electric Building, Cleveland, Ohio.

IOWA ELECTRICAL ASSOCIATION. Secretary, L. B. Spinney, Iowa State College, Ames, Iowa.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Iowa.

Digitized by Google

KANSAS GAS, WATER AND ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kas., October 16, 1907.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. W. Chambers, Winchester, Ky.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James F. Barnett.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee street, Utica, N. Y. Next meeting, New York city, 1907.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, 136 Liberty street, New York city.

NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION. Annual meeting, New York city, October 23-24.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State street, Boston, Mass.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty street, New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, B. C. Adams, Madison, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.

OHIO SOCIETY OF MECHANICAL ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Bullard, Cleveland, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York city.

ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Annual meeting, Milwaukee, Wis., October 14, 1907.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Secretary, T. H. Stuart, Waco, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. B. Fairchild, Jr., 114 Liberty street, New York city.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electrical Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, Chicago.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

DATES AHEAD.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.

Northwestern Electrical Association. Milwaukee, Wis., January 16, 1907.

American Society of Mechanical Engineers. New York city, December 4-7.

Record of Electrical Patents.

Week of October 30.

834,264. TIME-RELEASING DEVICE FOR LEVERS CONTROLLING RAILWAY APPLIANCES. John P. Coleman, Edgewood, Park, Pa., assignor to The Union Switch and Signal Company, Swissvale, Pa. Filed July 16, 1906. The final movement of the dash-pot piston releases the lock.

834,272. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed December 29, 1902. A common battery system with diagonally connected cord circuits for signaling one or the other of two stations.

834,274. ELECTRIC-PUMP GOVERNOR. Edward H. Dewson, Edgewood Park, Pa., assignor to The Westinghouse Air Brake Company, Pittsburg, Pa. Filed August 22, 1905. Makes use of an electromagnet opposing the fluid pressure.

834,302. TROLLEY WHEEL. Henry L. Humphrey, Monroe, Mich. Filed November 13, 1905. A split wheel is mounted on a fixed spherical pinion.

834,336. AUTOMATIC ELECTRIC BRAKING. Louis H. Thullen, Edgewood, Pa., assignor to The Union Switch and Signal Company, Swissvale, Pa. Filed December 22, 1903. A stop placed beside the track short-circuits the motor through a switch on the car.

834,352. CASE FOR LOADING-COILS. Henry F. Albright, New York, N. Y., assignor to Western Electric Company, Chicago, Ill. Filed April 22, 1905. The telephone loading-coils are supported on a spider carried by the inner wall of the case.

834,355. MAGNETIC POWER CONTROL. Daniel Bacon, Brooklyn, N. Y., assignor to Magnetic Control Company, New York, N. Y. Filed January 28, 1905. A variable-speed magnetic gear.

834,392. STRAIN-INSULATOR. George A. Mead, Mansfield, Ohio. Filed April 22, 1905. Allows the strain to be adjusted.

834,404. SIGNALING SYSTEM. Frank B. Rae, Ridgewood, N. J., assignor to Rae Electric and Manufacturing Company. Filed August 5, 1901. An automatic signaling system controlled by the position of the car.

834,406. LAMP-SOCKET FOR CEILINGS. William H. Rattenbury, Chicago, Ill. Filed September 30, 1905. A countersunk socket.

834,424. RESISTANCE DEVICE. William L. Waters, Milwaukee, Wis., assignor to National Brake and Electric Company, Milwaukee, Wis. Filed April 28, 1905. The resistance units are supported on a frame submerged in an insulating fluid.

834,449. ELECTRIC LIGHT HANGER. James W. Carter, Abilene, Tex. Filed May 11, 1906. An adjuster for cord drop lights.

834,480. COIL-FORMER. Julius W. Lundskog, Lynn, Mass., assignor to General Electric Company. Filed March 25, 1904. A former composed of a number of superimposed laterally displaced slabs.

834,496. OSCILLATING-CURRENT LAMP. James E. Seeley, Los Angeles, Cal., assignor to Synchronous Static Company, Los Angeles, Cal. Filed July 12, 1905. The secondary coil is enclosed within the primary and is connected to the discharge electrodes.

834,497. TRANSMITTING APPARATUS. Harry Shoemaker, Jersey City, N. J., assignor to International Telegraph Construction Company. Filed January 2, 1906. The alternating current employed holds the key closed until it falls nearly to its minimum value.

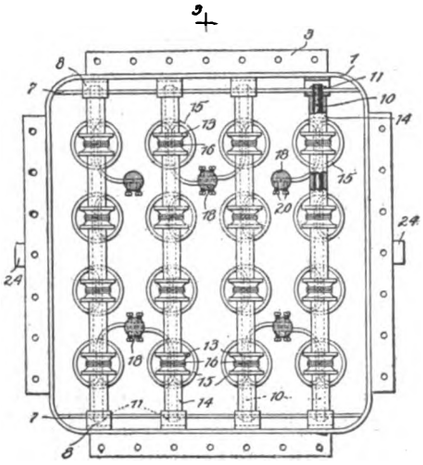
834,525. VOLTAGE REGULATOR. Ray P. Jackson, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Com-

Digitized by Google

pany. Filed June 12, 1905. Renewed April 28, 1906. A variable voltage transformer, the connections of which are controlled through electromagnet switches.

834,533. INSULATOR. James F. Nichols, Plainfield, Ark., assignor of one-half to C. D. Stevens, Magnolia, Ark. Filed September 11, 1905. A split insulator held together by the holding bolts and a strap.

834,538. SYSTEM AND APPARATUS FOR MEASURING TELEPHONE SERVICE. Harold D. Stroud, Chicago, Ill., assignor to The Stroud International Measured Service Company, St.



834,424. RESISTANCE DEVICE.

Louis, Mo. Filed May 13, 1904. The user registers a charge, but the operator can set the instrument so that it will not charge for the next call.

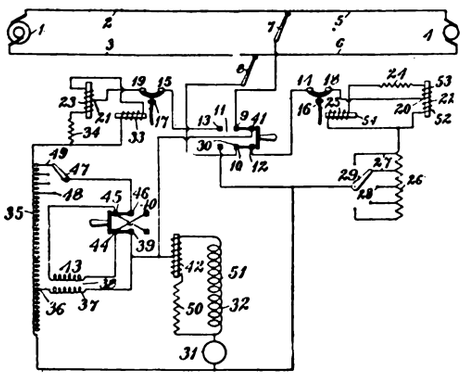
834,563. ELECTRIC MOTOR-CONTROL SYSTEM. William Cooper, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed May 22, 1905. A system for controlling a group of two or more electric motors.

834,567. INSULATOR. Richard A. Falkenberg and Solomon S. Simon, San Francisco, Cal. Filed August 29, 1905. An insulator with a peculiarly shaped slot.

834,570. SYSTEM OF TRANSMITTING POWER. George P. Finnigan, Greene, N. Y., and George T. Hanchett, Hackensack, N. J.; said Hanchett assignor to said Finnigan. Filed August 30, 1905. Makes use of a step-by-step motor.

834,580. SPARKING PLUG. Jere G. Kingsbury, West Orange, N. J. Filed May 3, 1905. A method of construction.

834,582. CONTROLLING DEVICE. Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed January 3, 1905. A system for use on alternating or direct currents with means for automatically disconnecting each circuit when the energy supplied to it is not of the kind for which it is adapted.



834,582. CONTROLLING DEVICE.

834,626. UNLOADER FOR SINGLE-ACTING COMPRESSORS. Frederick Van Duzer Longacre, New York, N. Y., assignor to Ingersoll-Rand Company, New York, N. Y. Filed November 23, 1904. A discharge valve, opened by an electromagnet.

834,636. ELECTRICAL CONTACT FOR TROLLEY SYSTEMS OF ELECTRIC RAILWAYS. Wesley T. Oviatt, Stratford, Ct., assignor to William Grunow, Jr., Bridgeport, Ct. Filed August 29, 1905. A similar device adapted for a compound compressor.

834,659. TELEGRAPH CUT-OUT. Fred A. Clogston, Bridger, Mont. Filed November 11, 1905. A cut-out for a common return with means for disconnecting any circuit from it.

834,664. BASKET FOR INCANDESCENT ELECTRIC LIGHT BULBS. Charles Duncan, Montreal, Quebec, Canada, assignor to The Duncan Electrical Company, Limited, Montreal, Canada. Filed December 7, 1905. A wire lamp-guard.

834,669. TEST AND WIRE-CONNECTOR. William A. Fricke, Chicago, Ill. Filed October 24, 1904. A clamp formed of a bolt and several plates.

834,684. CONNECTOR FOR CONDUITS FOR ELECTRIC WIRES. Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. Filed July 18, 1904. A device for locking conduits in the boxes.

834,685. CONDUIT FOR ELECTRIC WIRES. Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. Filed October 26, 1905. A rectangular conduit with removable cover.

834,686. BASE FOR SUPPORTING SWITCHES AND THE LIKE UPON CONDUITS. Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. Filed October 26, 1905. A base suited to be attached to conduits.

834,687. ELBOW FOR CONDUITS. Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. Filed October 26, 1905. An elbow with a sharp corner.

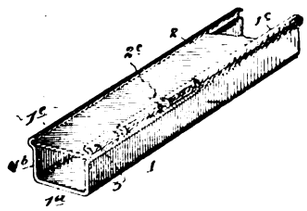
834,689. RAIL-BOND. Charles R. Sturdevant, Worcester, Mass., assignor to American Steel and Wire Company, Worcester, Mass. Filed July 7, 1905. The solid bond-head is provided with the boss on its outer face.

834,690. RAIL-BOND. Charles R. Sturdevant, Worcester, Mass., assignor to American Steel and Wire Company, Worcester, Mass. Filed July 7, 1905. The bond-stud is caulked in position.

834,695. FAN-MOTOR SUPPORT. Harold R. Wellman, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. Filed April 22, 1905. A stand admitting of considerable adjustment of the motor.

834,708. SECONDARY ELECTRIC CLOCK. Henri Campiche, Geneva, Switzerland. Filed May 24, 1905. The clock is driven by an electromagnet through a ratchet wheel.

834,742. CONDUIT FOR ELECTRIC CONDUCTORS. George A. Lutz, New York, N. Y. Filed October 26, 1905. A rectangular conduit with removable cover.



834,742. CONDUIT FOR ELECTRIC CONDUCTORS.

834,750. VOLTAGE-REGULATOR. Thomas M. Pusey, Kennett Square, Pa. Filed July 19, 1904. The regulating rheostat is operated by a motor controlled by an electromagnet.

834,787. METER. Joseph Wills and Lorin E. Imlay, Niagara Falls, N. Y., assignors of one-third to The Niagara Falls Power Company, Niagara Falls, N. Y. Filed June 21, 1904. A registering wattmeter.

834,829. MEANS FOR HOLDING RECEPTACLES AND THE LIKE TO CONDUITS. George A. Lutz, New York, N. Y. Filed September 14, 1905. A cap of insulating material for attaching to conduits.

834,832. MEANS FOR CHARGING STORAGE BATTERIES OF TELEPHONE SYSTEMS. Talbot G. Martin, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed February 3, 1905. A system of charging the storage batteries at one automatic telephone exchange from a second.

834,844. WIRE-COUPLING. Alfred Oskamp, Wyoming, Ohio, assignor to The Kisinger-Ison Company, Cincinnati, Ohio. Filed September 18, 1903. A sleeve with one side thickened against which the locking keys press.

834,869. TELEPHONE SIGNALING APPARATUS. William E. Butler and Morgan L. Lane, David City, Neb. Filed January 3, 1906. A selective signaling device.

834,870. AUTOMATIC CONTROLLING MEANS FOR FLUID-PRESSURE SYSTEMS. Jacob C. Chamberlain, New York, and Albert T. Marshall, New Rochelle, N. Y., assignors, by direct and mesne assignments to The Automatic Refrigerating Company, New York, N. Y. Filed June 21, 1905. A fluid-pressure expansion tube operates the motor starting switch.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 20. NEW YORK, SATURDAY, NOVEMBER 17, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW
CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING
BOSTON
NEW ENGLAND OFFICE, ... 95 MILK STREET
LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE
TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS
One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING
CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
The Birmingham, England, Power Station . . . 793
The Inverse Square Law and Reflectors . . . 794
Electrical Students in a Municipal Power-House . . . 795
An Uplifting of Commercialism . . . 795
Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw. 796
Electrical Trades Association of Chicago . . . 799
Kelvin on Wireless Telegraphy . . . 799
A Dynamometer for Small Motors . . . 799
The New Generating Station at Birmingham, England . . . 800
"Seeing Electrically" . . . 804
Some Points About Single-Phase Motors, by W. Langdon-Davies and F. B. O. Hawes . . . 805
The Rochester, Syracuse & Eastern Railway . . . 807
Electrical Equipment of the Bath Portland Cement Company, Bath, Pa. 808
A New Method of Testing Magnetic Metals . . . 812
Motor Mail Wagons . . . 812
Illuminating Engineering Society . . . 812
Location of Lamps and Illuminating Efficiency, by Preston S. Millar . . 814
Testing Alternating-Current Apparatus . . . 816
Manchester (England) Section of the Institution of Electrical Engineers . . . 817
Northwestern Electrical Association . . . 817
The Reflection and Transmission of Electric Waves by Screens of Resonators and by Grids . . . 818
An Interesting Use of the Telephone . . . 818
Music by Electricity . . . 818
Gold Medal for the Brooklyn Rapid Transit Company . . . 818
Street Opening Stopped in New York City . . . 819
Turbine Water-Wheel Tests . . . 819
Communication from the Secretary of the American Electrochemical Society . . . 819
The Western Electric Company . . . 819
Advancing Market in Electrical Apparatus and Supplies . . . 819
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 820
METHODS OF GETTING NEW BUSINESS . . . 822
The Long Acre Electric Light and Power Company . . . 824
Report of the President of Cornell University . . . 824
Wisconsin Electric and Interurban Railway Association . . . 824
INDUSTRIAL SECTION:
The Buckeye Electric Blue-Printing Machine . . . 825
A Rubber Show at Peradeniya . . . 825
A Commercial Type of Automatic Time Switch . . . 826
The Oaxaca Smelting and Refining Company Equipped with Westinghouse Electrical Apparatus . . . 826
National Alternators in the Plant of the Merchants' Heat, Light and Power Company, Canton, Ohio . . . 826
The Improved G. D. Telephone Drop . . . 827
Electric Motor-Driven Pumps for Fire Protection in Large Buildings . . . 827
Small Light and Power Plant Wanted . . . 827
CURRENT ELECTRICAL NEWS . . . 828
RECORD OF ELECTRICAL PATENTS . . . 833

Copyright, 1906, by Electrical Review Publishing Co.

THE BIRMINGHAM (ENGLAND), POWER STATION.

The new power station opened by the city of Birmingham (England), is one of the latest additions to the list of important British municipal plants. An excellent description of this plant will be found on another page of this issue.

In the design of the station no radical departures have been taken, but in the details of the equipment there are some interesting features. The power-house is divided into three sections—generating room, boiler house and economizers, each being placed in a separate bay. The generating equipment consists of direct-current and alternating-current machines, driven by vertical, compound, condensing engines; and there are, in addition, two direct-current generators driven by steam turbines. The total output of the plant at present amounts to about 12,000 kilowatts, and the plans contemplate an ultimate output of something more than twice this.

The interesting features of the plant, aside from the mere details of the apparatus and its arrangement, are due to the character of the load on the station. It must supply 220 and 440-volt systems for light and private power purposes near the station, and it must supply a 440-volt, direct-current system distributing through the switchboards of two older generating stations. The local electric railway calls for a supply at 550 volts, and for reaching the suburbs of the city alternating currents are employed, the system selected being three-phase at 5,000 volts.

To meet these conditions the generators have been wound to be operated at the various voltages demanded. There are two sets of bus-bars for the light and power circuit, and another set for the railway circuit. Switches are provided, enabling any of the engine-driven generators to be thrown on any set. To accomplish this without involving any risk of connecting the three sets of bus-bars together, two double-throw switches are employed. One of these places the generator directly on one lighting set of bus-bars, or, when thrown the other way, connects to a second double-throw switch which enables the generator to be connected to the other lighting set or to the railway set. The requirements naturally make the direct-current switchboard somewhat complicated, a feature which was not helped by the necessity of placing the switchboard at one end of the station unsymmetrically with respect to the generating units. In addition to the generating apparatus there are required boosting sets for taking care of the long feeders, and balancing sets for the three-wire system. The alternating-current switchboard presents no unusual features.

The switchboard of a modern power-house, such as is here described, is not only a complex part of the equipment, but is

Digitized by Google

as well, expensive. Large amounts of copper are required, the instruments and appliances are numerous and costly, and the larger the station the more important the switchboard seems to become in every respect. In a way this might be expected, because it is here that the control of the station centres, and upon the switchboard depends largely the reliability of the system. But it is nevertheless regrettable that in order to get the electric power from a generator to the distributing wires it is necessary to go through so many supplementary devices. It seems probable, arguing from experience in other lines, that wider experience in the operation of large plants will enable us to simplify somewhat the switchboard equipment. This certainly is a phase of development greatly to be desired.

THE INVERSE SQUARE LAW AND REFLECTORS.

At the recent meeting of the Illuminating Engineering Society, a report of which is given on another page of this issue, an interesting part of the discussion turned upon the application of the law of inverse squares to lighting problems when reflectors are employed. This law is based on the assumption that the source of light is a point, but, in practice, it holds with sufficient accuracy for ordinary sources of light in which the luminous surface has an appreciable area, if precaution be taken that the measurements be made not too close to the source. With respect to an incandescent lamp there are two sources of error, for not only has the filament an appreciable area, but the reflection from the surrounding globe of glass gives rise to secondary sources of illumination. Practically, however, on the ordinary photometer bench these errors are negligible; and it is just as well to remember in this connection that in the use of a photometer so much depends upon the observer, and there are so many opportunities for mistakes, that that due to the area of the source of light would, in general, be not detected.

When the source of light can not be treated as a point, the law of inverse squares does not hold. If it be a luminous tube, such as a mercury vapor lamp or a Moore vacuum tube, any measurement made within the neighborhood of the source of light will show the intensity to vary inversely as the distance, and not as the square of the distance. This is simply a law of physics, and its reason is apparent when one considers that if the measurement be made close to the light but a comparatively short length of the lamp is effective, and the further away the measurement be made, the greater will be the effective length of the lamp. The inverse square law will apply for each small length of the lamp, but the resulting illumination will be proportional to the number of these little divisions which are effective, and this will introduce a factor varying directly as the distance from the lamp. This law holds as long as the length of the source is great as compared with the distance. The same law will apply to a row of incandescent lamps set close together, and will apply more or less approximately to such a row of lamps when they are separated from one another by short distances.

If the area of the source of light be so great that it can not be treated as a line, then neither the inverse square law nor the inverse law will apply, and the illumination will be independent of the distance from the source as long as the area of the source be great as compared with the distance. Here again the inverse square law applies to each little area of the luminous surface, but the further away from the surface the measurement be made, the more of these little areas will be effective in lighting it. If the entire surface of the ceiling of a room be made luminous, this law of the independence of the illumination of the distance from the source will apply, and it probably will be found to apply fairly closely to that method of lighting in which a large number of small units is distributed uniformly on the ceiling. Where the distribution is not uniform, but in groups, it is probable that the illumination will be intermediate between that indicated by the inverse square law and that which would be due to a luminous surface, the former law being more or less applicable to each group of lamps, but the total effect being due to the summation of the effect from all the groups.

The use of reflectors to change the character of distribution of light from a lamp naturally brings up the question of the applicability of the inverse square law. The point turns upon the character of the reflector. In general, a reflector gives rise to one or more images of the source of light, so that the illumination received at any point practically comes from at least two sources—the true source and the image. The law of inverse squares will apply to the light delivered from each of these, but the result is, of course, the summation of the two. If, on the other hand, the measurements be made at a distance such that the distance between the true source and its image produced by the reflector may be neglected, the law of inverse squares may be applied just as though the light came from a single source having an intensity equal to that of the true source plus that of the image. This reasoning holds for those reflectors which produce a number of images. The measurements must, of course, be made at a distance sufficiently great to allow of this assumption, and this limiting distance will vary according to the character of the reflector. The extreme case, as was pointed out at the meeting, is that of the searchlight, where the source of light is comparatively small in area and the reflector is parabolic. Nevertheless, the beam of light thrown in this way will diverge, so that the law of inverse squares holds, provided, of course, the point at which measurements be taken be sufficiently far away to warrant the assumption that the image produced by the reflector coincides with the true source of light; or, if the source itself be screened, light being thrown simply from the reflector, then the law will apply, but will refer to the position of the image, and not to that of the source. It must be remembered in this connection that with such reflectors nearly all of the light emitted by the source is caught and sent out through a comparatively small angle, and measurements made under such conditions are not comparable with those made when the source is free to throw out light in all directions. A definition of the power of a light when secured by such means should always be accompanied with a definite statement of the conditions and the distance for which the figure

Digitized by Google

holds. Such ratings are not in true candle-power, but merely in apparent candle-power.

Another point in this question should be borne in mind. Although the inverse square law may be found sufficiently accurate for problems in illumination, it does not hold that it may be applied when making a comparison of different reflectors. When such measurements are made, the conditions must be described accurately, for it is very possible that one reflector will show a better effect at a distance of three feet, and another at a distance of nine feet. Fortunately, in illumination problems great accuracy is not necessary, even if it were obtainable, because of the adaptability of the eye to the great variety of influencing conditions, the effect of which can not be predetermined.

ELECTRICAL STUDENTS IN A MUNICIPAL POWER-HOUSE.

In the address delivered by F. W. Taylor, president of the American Society of Mechanical Engineers, on the occasion of the dedication of the new engineering building of the University of Pennsylvania, the speaker urged the desirability of giving engineering students at least a few months' experience in actual work during the early part of their course. It is thought that six months' practice would work most beneficially in steadying the man in his subsequent studies. Such a programme would be rather difficult to carry out, and, in some cases at least, would result in his abandoning the technical course. There is no doubt, however, that if it could be carried through as proposed, without too much interference with the work of the school, the plan would be beneficial.

With this recent suggestion in mind, a plan just put into operation in England is interesting. The city of Manchester is the site of one of the leading English technical schools, and it has also an important municipal electric light and power station. The city authorities of Manchester have just decided to admit a certain number of students from the school of technology to the power station after completing their course. They are to be given three years' training in the actual operation of a plant, and during this time are to be paid not much, it is true, but something, and the rate is to increase with the length of service. It is thought that this suggestion will help to solve the problem of combining work and study; and, moreover, it may get around the difficulty frequently met by English students of getting such experience without being called upon to pay a considerable fee.

The practical experience in this case is given after completing the college work. The arrangement reminds one forcibly of the custom of requiring medical students to gain what experience they may from the hospital attached to the college. Manchester has not only a school for engineers, but a fine central station where the finishing touches may be given to the young engineer.

It should be noted, however, that while the result will certainly be good, the end sought by Mr. Taylor is lacking, for since the work comes after the school there will not be that steadying effect upon the latter which is needed, unless positions in the central station be looked upon somewhat as scholarships to be secured only by those who most deserve them.

AN UPLIFTING OF COMMERCIALISM.

The direct economic benefits resulting from electrical applications are so extensive in their scope and so impressive in their realism as to command attention as a development of civilization. The indirect benefits are slower in revealing their origin, but from time to time unexpected conditions make contributions to this end.

These applications from the first have been for the most part in the nature of public utilities and to that extent require those contributions both of capital and effort to serve for an indefinite time in the future, and this permanence necessitated the corporation rather than the partnership, for it looks to a permanency not broken by the administration of estates, for the corporation does not share in the mutations of life of the stockholders any more than it does in their life to come.

While these corporations were of the usual form in their legal status, their administration must be after the new order of things involved in the unprecedented work which they aimed to accomplish. New apparatus, new supplies and new purposes meant new thoughts by new men, which reached out to all functions of the undertaking. The method of accounting and the exploitation of the business shared in the originality which marked that of the generating plant.

There may have been no one of marked genius like Alexander Hamilton who laid out the method of bookkeeping of the Federal government, which has proved equal to the demands of the present day, and in turn has served as a copy for the accounts of the other republics of the world; nor was there one like Francis C. Lowell, who made the first complete cotton mill in this country at Waltham, Mass., just after the war of 1812, where, in addition to inventing the power loom, and other textile machinery, he devised the organization for administering the operation of the modern cotton mill and for selling the product as it prevails to-day.

The corresponding lines of electrical enterprises have been established on even a broader basis and one which may confidently be expected to be quite as permanent, in that the methods are a composite of cooperative effort by many different people.

In the function of presenting the facts pertaining to the advantage of prospective customers, the electrical interests have enlisted the service of brilliant writers of technical skill, whose other productions have a standing in fields of literary effort, the illustrations portray the subject with artistic merit, and letter-press is issued in comparably attractive form. In a personal way, those employed in canvassing are selected for their intelligence as well as their tact.

In short, the successful promotion of the sale of the product of an electric enterprise is accomplished by the close relations established between the company and the intelligent public who furnish the patronage, and intelligent people can be influenced only by intelligent methods.

Digitized by Google

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW.

X—The Approximate Analysis of the Waste Gases.

Having obtained a satisfactory sample of the waste gases by one of the methods described in the previous article, the sample is brought to the laboratory for further examination. As a general rule it is advisable to test the gas sample as soon as possible after its withdrawal from the flues or from the collecting vessel, since there is always some danger of air leakage at the glass cocks or clips of the retaining vessel. It is also best to make the chemical tests in the laboratory, away from the dust and heat of the boiler house, since no gas-testing apparatus will give accurate results when covered with dirt and subjected to rapid changes of temperature. Each of the sampling methods described in Article IX permits the final sample to be transferred to the laboratory for the chemical examination; the Stead gas-sampling vessel shown in Fig. 34 being used to withdraw a sample from the larger vessel shown in Fig. 35, by placing it upon the bracket H, and by connecting it to the tube K, while the clip at G is closed and the bottle B is raised to relieve the suction in A.

It is important to note that neither the soot nor the moisture in the waste gases is estimated by the ordinary methods of analysis; and that special apparatus is required when the amounts of these are to be separately determined.

The soot and moisture collect to a large extent upon the inner walls of the glass tubes and vessels through which the gases are drawn from the flues—and the water used in the measuring burette during the test of the sample of course condenses the remaining moisture.

To prevent any soot from getting into the gas-testing apparatus, it is usual to place a plug of glass wool in one of the connecting tubes, and to renew this as often as required.

Two methods of testing the samples of waste gases will now be described in detail:

1—Tests with the Honigman Gas Burette—(See Fig. 33, Article IX)—The burette A is first immersed for two minutes in the trough F, which is four-fifths filled with water in order to bring the gas contents of the burette to a standard temperature. The spring clip on the zero end of the burette is then removed, and the burette is held upright in a vertical position with its lower end immersed in the water contained in the glass jar E. The zero mark of the burette is placed level with the brim of E and the upper clip is opened to allow the excess of gas to escape into the air, water being poured into E from the trough, until the gas contents of A measure exactly 100 cubic centimetres.

The burette is then removed from the jar E and is placed in a slanting position in the trough, with its upper end resting on one of the ends of the same. A one-gramme piece of solid caustic potash is taken in the forceps provided for the purpose, and is inserted in the rubber tube at the lower end of the burette. It is then pushed up into the same by the short length of glass rod, this being left in the rubber tube as a stopper.

The burette is now removed from the

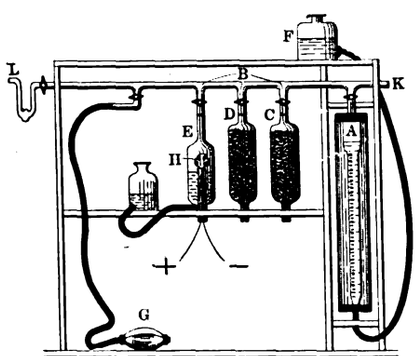


Fig. 36.—Improved Orsat Gas-Testing Apparatus.

trough and is gently shaken, the purpose being to dissolve the small lump of caustic potash in the water contained in the burette, and to bring the resultant solution into use as an absorbing liquid.

Two minutes' agitation is usually sufficient for this purpose and the burette is then again immersed in the water contained in the zinc trough, in order to bring back the contents to the original temperature. The final operation is to withdraw the glass rod from the rubber tube on the lower end of the burette, to hold the latter in a vertical position in the glass jar, and to read off the volume of gas after leveling the liquid within and outside the burette. The loss in volume equals the percentage by volume of CO_2 contained in the gas sample.

This apparatus yields accurate results, and tests with it can be completed within five minutes; but some little practice is necessary to obtain this accuracy and speed. The precautions necessary in its use are as follows:

(1) The rubber tubing at the upper end of the burette must not be immersed in the water, since if any liquid collects inside it, the expulsion of the excess gas above 100 cubic centimetres is rendered exceedingly difficult.

(2) No air must be allowed to enter the burette at the lower end when removing the spring clip. To expel the air in the rubber tube, it is advisable to compress the rubber tube along towards the open end before the clip is opened, keeping the end of the rubber tube meanwhile, under water.

(3) Both before and after the absorption of CO_2, the gases must be reduced to the standard temperature—that of the water in the trough.

(4) No air must be allowed to enter the tube and burette when it is being placed in the jar for leveling purposes, or when inserting the caustic potash in the solid form. This last operation must be carried out under water; and speed is necessary, as this chemical dissolves very rapidly in water.

(5) After each test the burette, jar and trough must be thoroughly washed out with clean water, in order to remove all the caustic potash solution. The burette itself should be filled and emptied three times, the simplest method of filling being to immerse it in a slanting position in the zinc trough after the latter has been emptied and refilled with clean water. The burette must be well drained before using for another test of the flue gases.

By using the tabloids of pyrogallic acid which are now prepared and sold for photographic purposes, the use of the Honigman burette can be extended to tests for oxygen. These tests are made by pushing the tabloid of pyrogallic acid and one additional piece of caustic potash into the burette from below, after absorption of the carbonic acid gas. The remainder of the test is then carried out as before.

2—Tests with the Improved Form of Orsat Apparatus—When the percentages of oxygen and of carbonic oxide are required in addition to that of carbonic acid gas, the Orsat apparatus shown in Figs. 36 and 37 is the most convenient for general use. The writer does not recommend that this apparatus should be carried to the boilers and the sample of gas drawn directly into it from the flues, by use of the finger pump G. For snap samples and tests of this kind, the Honigman burette is the most useful apparatus. The Orsat apparatus yields the most trustworthy results when kept in the laboratory at one temperature, with all its parts scrupulously clean. The sample of gas collected in the gas sample tube D (Fig. 33), or in the Stead gas sampler (Fig.

[1] All rights of reproduction and translation reserved. Copyright 1906, by John B. C. Kershaw

Digitized by Google

34), is transferred to the measuring burette of the Orsat apparatus by mercury displacement. For this purpose the upper end of the tube or vessel containing the sample of gas is connected by thick rubber tubing to the U-tube marked L in Fig. 36. By raising the mercury reservoir and opening the cocks, the gas is caused to flow out of the sampling vessel along the glass T-piece, B, K in Fig. 36. The U-tube L contains wool-glass, and this serves to remove the last traces of soot from the waste gases. When all air has been expelled from the tube B, K the free end at K is closed, the cock on the measuring burette A is opened, and by lowering the reservoir bottle F 100 cubic centimetres of the gases is drawn into A. The cock at L is now closed, and the final adjustment is made by raising the bottle F cautiously and allowing the excess of gas to escape by K. It is advisable to allow the gas sample to remain under pressure in the gas burette A for two minutes before commencing the test. This gives time for the last traces of moisture and sulphuric acid gas to be removed from the sample, and prevents error from these causes in the CO_2 test. Any leakage at the taps or joints can also be discovered by this means before the test is made.

The Orsat apparatus comprises a measuring burette A, holding 100 cubic centimetres, and graduated in tenths of a cubic centimetre for the first twenty-five cubic centimetres of its contents; a glass T-piece B, with three glass stop-cocks; two absorption pipettes C, D, filled with caustic potash and pyrogallic acid solution, respectively; and a modified form of Winkler's combustion pipette E, for determining the carbonic oxide, methane, and other combustible gases. The water aspirator-bottle F, and the rubber finger-pump G, are the remaining accessories of the apparatus.

The measuring burette A is enclosed in a water-jacket to preserve the gas from temperature charges during the test; and the absorption pipettes C and D should have caoutchouc balloons fixed on their free limbs, to preserve the contents from contact with the outside air. The pipettes C and D are filled with narrow glass tubes, in order to provide a large surface moistened with the absorbing reagent when the gas is passed into them, and the caustic potash or pyrogallic acid solution is displaced. The method of using this apparatus is simple in principle, but details of manipulation, which can only be understood by actual practice with it, require to be attended to in order to obtain accurate results. After 100 cubic centimetres of the gas has been carefully measured in A, and time has been given for this to assume the temperature of the surrounding water, note being taken of any alteration in volume during this interval, connection is made between A and C, and the gas is made to travel backwards and forwards three times, by alternately raising and lowering the reservoir bottle F. The liquid in C is finally drawn up to the mark, the cock is closed, and the reduction in volume of the 100 cubic centimetres represents the per cent of carbon dioxide gas in the gas sample. With fresh caustic potash solution the absorption in C is rapid; with a solution containing thirty or more per cent of carbonate, the absorption of CO_2 is slow. It is necessary, therefore, to repeat the absorption procedure, and to make two measurements of the residual gas, in order to be certain that all the CO_2 is removed. The caustic potash solution must also be renewed when its absorption power for CO_2 has become too slow for quick work.

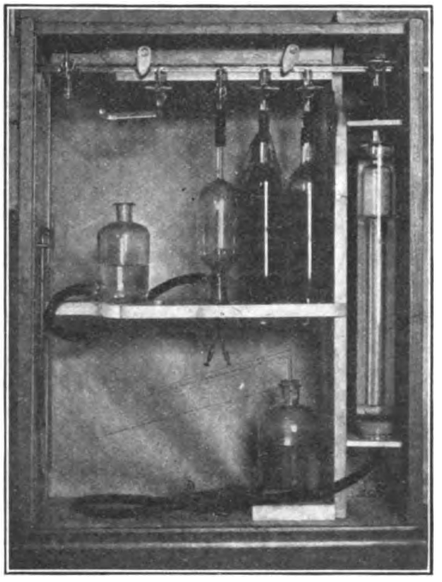


FIG. 37.—IMPROVED ORSAT GAS-TESTING APPARATUS.

For the determination of the oxygen the same process is repeated in the absorption pipette D, which contains an alkaline solution of pyrogallic acid. Here again at least two absorptions and measurements of the residual gas must be made, in order to be certain that all the oxygen has been removed by the pyrogallic acid solution.

The volume of the residual gas should now be about eighty-one cubic centimetres. If more than this, there is reason to suspect the presence of carbonic oxide gas, or of unconsumed hydrogen and hydrocarbon gases of the methane or ethylene type. The amount of these gases is determined by burning in the combustion pipette E with an excess of oxygen. For this purpose fifty cubic centimetres only of the residual gas is used, and are mixed with fifty cubic centimetres of the outside air drawn in by K, care being taken that these gas measurements are correct. This air provides the oxygen required for the further combustion of the carbonic oxide, hydrogen and hydrocarbons. The total volume of gas is carefully measured, and the gas is drawn over into the combustion pipette E, the platinum coil meanwhile being kept at a bright red heat by means of an electric current of two amperes at ten volts, from any convenient source of electric energy. As the combustible gases pass over this coil they are burnt to CO_2 and H_2O respectively. The gas is now drawn back into the measuring burette, and the diminution in volume is recorded. If no diminution occurs it signifies that no carbonic oxide, hydrogen or hydrocarbons have been present. Should any diminution have occurred it is necessary to distinguish between that due to carbonic oxide and that due to hydrogen or hydrocarbons. For this purpose the residual gas is first passed over into the absorption pipette C, and the carbon dioxide gas produced by the combustion of the carbon monoxide is determined as before by the loss of volume. As one unit volume of carbon monoxide produces the same volume of carbon dioxide, the decrease in volume due to CO_2 absorption in C, multiplied by two, represents directly the percentage of carbonic oxide in the original gas sample. The percentage of hydrogen is now found by calculation according to the following method:

Contraction on combustion = 2.3 cubic centimetres.

Carbon monoxide found by CO_2 absorption = 1.6 cubic centimetres.

$\frac{1.6}{2}$ = 0.8 cubic centimetres, or oxygen corresponding to 1.6 cubic centimetres carbon monoxide.

2.3 — 0.8 = 1.5 cubic centimetres, or contraction corresponding to the unknown percentage of hydrogen and hydrocarbons.

But this contraction was due to the union of two volumes of hydrogen and one volume of oxygen, or three volumes of gas, and therefore the percentage of hydrogen in the original gas sample must have been: $1.5 \times \frac{2}{3} \times 1 = 1$ per cent.

This method of determining the amount of the combustible gases was first used by Coquillon, but his original apparatus has been modified as shown above by Winkler and by Sodeau; and full details of the procedure to be followed will be found in the original article by the last-named

Digitized by Google

chemist, published in the paper named below.[1] This method of testing for carbonic oxide and other combustible gases is much to be preferred to the more familiar method of using an acid or ammoniacal solution of cuprous chloride for their absorption in the ordinary form of pipette, since such a solution does not yield accurate results unless freshly made for each test. This precaution is troublesome and is seldom taken by users of the ordinary Orsat apparatus; hence the carbonic oxide tests recorded for flue gases are seldom correct.

The Orsat apparatus, as modified by Sodeau, is the most convenient and practical form of gas-testing apparatus for works use; and when in charge of a man having experience in its use, the results obtained are sufficiently accurate for all technical purposes.

Only two solutions are required for this modified Orsat apparatus, namely, caustic

FIG. 38.—SOOT FILTER.

potash of 1.20 Sp. G., and an alkaline solution of pyrogallic acid.

The former solution is best made as required by dissolving twenty-three grammes or one and one-half sticks of the usual make of pure caustic potash in 140 cubic centimetres of distilled water. This solution should be transferred to the absorption pipette, which holds about 150 cubic centimetres, without delay or exposure to the air. It is not advisable to make large quantities of caustic potash solution at one time. If stored in corked bottles it rots the corks and absorbs CO_2 from the atmosphere; while if kept in stoppered bottles it causes the stoppers to bind themselves fast in the necks.

The pyrogallic acid solution is made by dissolving twenty grammes of pyrogallic acid in a caustic potash solution of 1.20 Sp. G. The caustic potash solution (150 cubic centimetres) is first prepared as above, and, when cold, is poured upon the weighed amount of pyrogallic acid contained in a small flask. This must be kept corked while solution occurs, and the solution must then be quickly transferred to the second absorption pipette.

The solution of pyrogallic acid in caustic potash is of a dark brown tint, and deepens rapidly in color as it becomes further oxidized. It absorbs oxygen rapidly when warm, but only slowly in the cold, and the Orsat apparatus should therefore be kept in a room rather above the normal temperature.

The Orsat apparatus will yield correct results only when kept clean and in good order, with all the stop-cocks and joints well attended to. At monthly intervals the glass stop-cocks ought to be removed from their sockets and thoroughly cleaned with soft paper. A thin coating of refined lard or other suitable lubricant, may be employed to make them turn easily after cleaning. Any mishap with the 1.20 Sp. G. caustic potash solution in C, whereby it is drawn up past the stop-cock, must be followed by the removal and washing of this. Inattention to this precaution may result in much delay and expense, owing to the stop-cock sticking fast in its seat, as a result of the wetting with caustic potash solution.

3—Tests for Moisture and Soot—Owing to the high specific heat of aqueous vapor (see Article IX) the percentage of moisture present in the waste gases from boilers is of more importance than is generally recognized, and it is unfortunate that so little accurate information is available relating to this constituent. This absence of accurate data is partly accounted for by the difficulty of obtaining correct results in the tests made for moisture. Condensation of the moisture occurs upon the inner walls of the sampling tubes before the weighed absorption apparatus is reached, and the soot and dust present in the chimney gases also add to the difficulty of the determination.

The following method is as satisfactory as any that can be desired, the soot and dust being determined at the same time by actual weighing in the filter tube, shown in Fig. 38. The glass tube shown is of hard potash glass nine inches in length, and about one-fourth inch in internal diameter. The lower end is rounded off and is provided with an opening one-eighth inch in diameter. The upper end is provided with a tubulus and ring, by the aid of which it is firmly attached to a threaded three-fourths-inch wrought-iron pipe by means of a cap, which holds the glass ring firmly against the end of the iron pipe. Asbestos packing may be used to render this joint gas tight. The glass tube is filled through the lower opening with long and silky asbestos fibre, excluding all fine dust, and after heating carefully over a Bunsen burner flame, the tube and its contents are allowed to cool, and are weighed as accurately as possible on a balance or scales reading to one-hundredth of a gramme.

The filter tube is now attached by the screwed cap to the wrought-iron carrier, and this is fixed in the sampling hole of the flue in such a position that the lower opening of the filter tube is at about the centre of the flue and of the passing gases. From the increase in the weight of this tube the amount of soot and dust can be calculated. Care must, of course, be taken to clean the exterior of the tube thoroughly before the second weighing.

The projecting end of the iron carrier

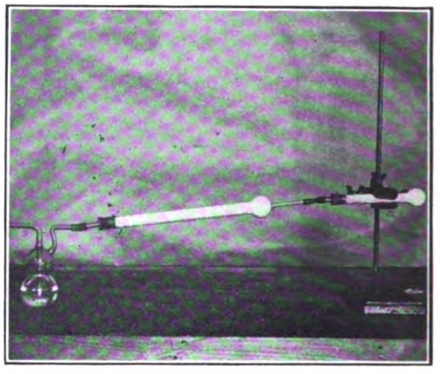


FIG. 39.—MOISTURE ABSORPTION APPARATUS.

tube is attached by thick rubber tubing to the moisture absorption apparatus shown in Fig. 39. The wash bottle contains 150 cubic centimetres of cold water and serves to condense the main portion of the moisture, while the two calcium chloride tubes retain the remaining portions of moisture present in the waste gases. The complete apparatus is weighed before and after making the test, with as much accuracy as the scales allow, and from the gain in weight the moisture present per cubic foot of waste gas is calculated. If any condensation of moisture occurs between the soot filter and the water absorption apparatus, both tests will be spoiled. For this reason it is necessary to have the wrought-iron pipe carrying the filter entirely sunk in the flue, and to use only a very short length of rubber tube for connecting it to the second apparatus.

The aspiration of gas through the smoke filter and water-absorption apparatus is best effected by a water aspirator of simple design (shown in Fig. 40), the volume

[1] *Chemical News*, February 5, 1904.

Digitized by Google

of gas which has passed being calculated from the volume or weight of water which is collected in the lower vessel.

The degree of accuracy which can be obtained with the apparatus described above depends largely upon the carefulness with which the measuring and weighing operations are carried out; and a special balance will be required if many tests of this kind are to be made. A large water aspirator and a fairly rapid current of gas through the apparatus are the other conditions of success.

The solid matter retained in the filter tube will consist partly of unconsumed carbon and partly of fine particles of ash and other inorganic matter.

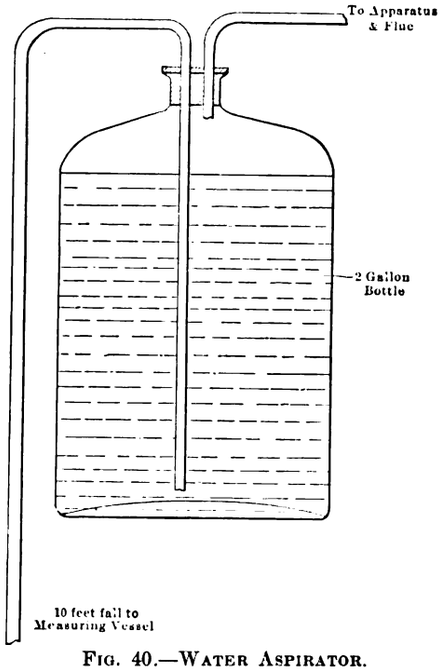


FIG. 40.—WATER ASPIRATOR.

If it be desired to determine the proportion of each of these, it will be necessary to place the tube in a special form of combustion furnace, and to burn the carbon of the soot to CO_2, by heating in an atmosphere of oxygen. This CO_2 is then absorbed by caustic potash and by caustic lime, and from the increase in weight of the absorption apparatus, the percentage of carbon in the soot is calculated. Details of the method will be found in any text-book dealing with the analysis of organic substances; but it is one which is obviously beyond the scope of the present work, and requires a trained chemist for its successful operation.

Electrical Trades Association of Chicago.

The annual meeting and dinner of the Electrical Trades Association of Chicago was held at the Grand Pacific Hotel, Chicago, Ill., at seven o'clock, Friday evening, November 16.

Kelvin on Wireless Telegraphy.

The following letter from Lord Kelvin appeared in the London *Times* of October 16:

SIR: The letters of Professor Silvanus Thompson and Sir William Preece in the *Times* of yesterday will, I am sure, interest many of your readers who are unable to follow the very important questions of international policy at present under consideration by the Berlin Congress on Wireless Telegraphy. The statement of historical facts and of scientific truths which they contain go far towards a complete history of the origin of one of the greatest wonders and triumphs of science in the nineteenth century—wireless telegraphy—due to the scientific discoveries of many workers and practically realized by Mr. Marconi in 1896. Sir Oliver Lodge's Royal Institution lecture on Friday, March 8, 1889, on "The Discharge of a Leyden Jar," was full of the origins of wireless telegraphy. It included a startling case of "telefunken," discovered by some of the audience, between gilt patches on the wall of the lecture-room. The lecturer gave a quotation from "Scientific Writings of Joseph Henry" (Vol. I., page 203), of which the following is a part describing electrical experiments made by him about 1830, when he was Professor of Mathematics and Natural Philosophy in Albany: "A remarkable result was obtained in regard to the distance at which inductive effects are produced by a very small quantity of electricity. A single spark from the prime conductor of the machine of about an inch long, thrown on the end of a circuit of wire in an upper room, produced an induction sufficiently powerful to magnetize needles in a parallel circuit of wire placed in the cellar beneath at a perpendicular distance of thirty feet, with two floors and ceilings, each fourteen inches thick, intervening."

This is the nearest approach to wireless telegraphy given to the world before practical proof of electrical waves through ether and of their wonderful energy-carrying quality was given in Hertz's magnificent experiments inspired by Helmholtz. Lodge himself made in 1894, as described in Professor Thompson's letter in the *Times* of yesterday, very important steps towards the wireless telegraphy publicly realized by Marconi two years later. Lodge had got signals successfully through a distance of 150 yards; Marconi, in 1896, had signals through three-quarters of a mile; and very soon after, with aid given by our post-office, this was extended to nine miles across the Bristol Channel. As early as the beginning of June, 1893, I was taken by Lord Tennyson to Marconi's telegraph station at Alum Bay, in the Isle of Wight, then in successful wireless communication with Bournemouth; and I had the great pleasure of sending messages through fifteen miles of ether, and on by our postal land telegraphs to Sir George Stokes at Cambridge and other friends in England and Scotland. I believe that up to that time, or at all events up to the time of Marconi's success across the Bristol Channel, there had been no other practical advance upon Lodge's wireless telegraphy through 150 yards in 1894.

Sir William Preece tells us that the post-office had been actively engaged in developing wireless telegraphy since 1884, and that in 1895 communication between Oban and Mull was successfully made by wireless telegraphy. That was a most interesting and successful experiment carried out by Sir William Preece himself. It was by induction between parallel lines of telegraph wire on the two coasts and was practically valuable because by it the communication was kept up until the ruptured cable between the island and mainland could be repaired. That was the best that could be done in 1895. It well illustrates the greatness of the boon brought by Marconi a year later and thoroughly appreciated by the engineers of our postal service as was shown by the assistance wisely given by the post-office in the early development of Marconi's system.

A Dynamometer for Small Motors.

A report was submitted recently by Georg Nicolaus to the telegraph section of the Elektrotechnischen Verein, dealing with the testing of small motors such as are used in telegraph and other similar work. The dynamometer is of the air-vane type, and consists simply of a split sleeve which may be slipped over the end of the motor shaft and clamped in place. The outer end of this sleeve carries a rod at right angles to the motor axis, which forms arms upon which are placed two circular discs fitted with clamps for holding them in any position on the two arms. Definite positions are marked on the arms, and by means of curves the power developed by the motor with the vanes in any position and at any given speed can be read off directly. The dynamometer is calibrated by means of a cradle dynamometer, upon which the test motor is placed. The apparatus is simple and gives a steady load, besides being cleanly and easy to control.

Digitized by Google

The New Generating Station at Birmingham, England.

(From Our British Correspondent.)

A BRIEF reference has already appeared in the ELECTRICAL REVIEW concerning the new generating station that has been completed at Birmingham, England, in extension of the already existing very limited facilities for electric light and power supply. R. A. Chattock, M.I.E.E., the corporation electrical engineer and manager, was entirely responsible for the design of the station, and it is to him that we are indebted for assistance in preparing this description as well as for the accompanying drawings and illustrations.

There are three bays in the building: engine house, 275 feet long by 100 feet wide in one span; boiler house, 275 feet long by 89 feet wide; economizer house, 275 feet long by 47 feet wide. There are also workshops, battery room, mess room and centrifugal pump-house.

The purposes for which the Summer Lane station has been designed are:

(1) 220 and 440-volt direct-current supply for lighting and private power purposes near the station.

(2) 440-volt direct-current supply through a system of trunk mains to the distributing switchboards at the old generating stations at Dale End and Water street; this is to meet increase in private supply.

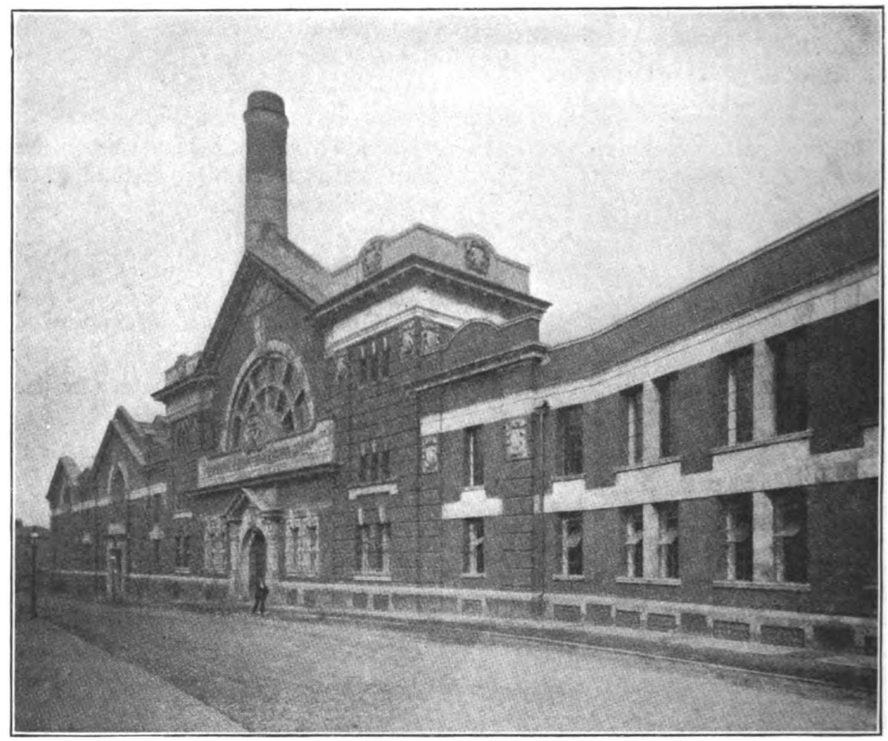
(3) 550-volt direct-current supply to overhead trolley lines within a radius of about two miles from the generating station.

(4) 5,000-volt, extra high-tension, three-phase, alternating-current supply to substations in outlying districts of the city.

The first equipment of the new station consists of 7,000-kilowatt, direct-current and 4,500-kilowatt, alternating-current sets. Later the former will be increased to 13,000 kilowatts and the latter to 13,500 kilowatts.

There are now erected, or constructing, four Belliss self-lubricating type steam engines of 3,000 indicated horse-power, operating 1,500-1,875 kilowatt Dick-Kerr direct-current generators. The cylinders are twenty-five inches, thirty-six and one-half inches, and fifty-five inches by thirty-three-inch stroke; and steam is supplied at 180 pounds pressure, superheated 100 to 150 degrees Fahrenheit. The generator fields have sixteen poles, compound wound; the armatures are of very massive construction, and are fitted with a very large commutator. The spider of the armature is extended and bolted direct to the fly-wheel of the engine. It is intended to use these machines as ordinary shunt machines for the lighting supply, and as compound machines for the traction supply, the necessary alterations in the connections being effected on the direct-current switchboard.

There are also two Belliss engines of the same dimensions, operating alternating-current generators of the same capacity, built by the British Westinghouse Company. Three other Belliss engines of 1,000 indicated horse-power operate 500-625 Westinghouse alternators.



SUMMER LANE GENERATING STATION—BIRMINGHAM (ENGLAND) DISTRICT ELECTRICITY SUPPLY.

The engines for the direct and alternating-current sets are strictly in duplicate, the only variation being a slightly higher rate of revolution in the alternating-current sets to correspond to twenty-five alternations per second. The direct-current sets run at 160 revolutions per minute, and the alternating-current sets at 166⅔ revolutions per minute.

The engines have been arranged to run under condensing conditions, but provision has been made for exhausting to the atmosphere on emergency through automatic exhaust valves on a new principle. Each main engine has its own surface condensing plant arranged alongside it. The cooling water is obtained from an adjacent canal, there being a large independent pumping installation for this purpose.

The main generator sets are disposed in rows along either side of the engine room, with the generators placed toward the centre. There is an interconnecting side gallery carried alongside the engine house walls giving ready access from the switchboard gallery to each engine platform.

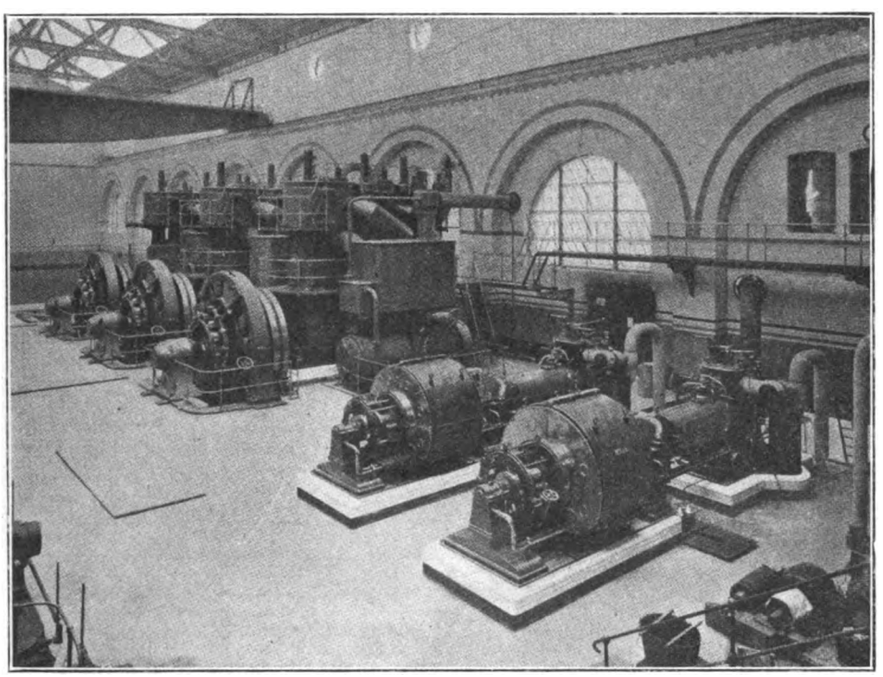
For exciting purposes there are two 180-indicated-horse-power Belliss-General Electric steam-driven dynamos, the engine-speed being 450 revolutions per minute.

The three 500-kilowatt engines which drive the alternating-current machines run at a speed of 250 revolutions per minute, and they all exhaust into a common surface condenser, a duplicate of the plants supplied for the larger engines.

There are two 500-kilowatt steam turbo-generators (C. A. Parsons and Company) whose turbines, together with the two exciter engines, are coupled direct to a surface condenser and set of motor-driven air-pumps. The generators are shunt-wound direct-current machines giving a pressure of 460 to 520 volts. The 1,500-kilowatt Westinghouse machines are of the standard engine-type, alternating-current, revolving field, horizontally divided

Digitized by Google

generators, three-phase, twenty-five periods, 5,000 volts, and the three 500-kilowatt sets are similar in type. There are two 100-kilowatt exciters, and also two motor-driven balancers (Phœnix, 100 kilowatts each), the latter being installed to deal with the out-of-balance current on the local lighting network. Two twenty-five-kilowatt Phœnix motor-driven three-wire boosters give the necessary increase in pressure on the trunk main supply to the two original generating stations already mentioned. A 200-kilowatt Phœnix motor-generator gives a direct-current supply to the tramway system off the direct-current lighting bus-bars during light load at night-time after the main traffic has ceased. It is intended to install a 200-kilowatt rotary converter and bank of transformers to enable the high-tension alternating-current supply to be coupled to the low-tension, direct-current supply, in order to avoid running steam plant on both classes of supply at times of light load. A large storage battery is also to be installed, together with a reversible booster for equalizing the load upon the direct-current generators used for supplying the electric tramways.



SUMMER LANE GENERATING STATION—BIRMINGHAM (ENGLAND) DISTRICT ELECTRICITY SUPPLY.

There is a large overhead four-motor electric traveling crane in the engine room; it will lift forty tons on one lift and ten tons on a second lift. The span between the crane rails is ninety-seven feet six inches. The crab which runs on the two main girders is equipped with two distinct lifts operated by separate motors. The motors are Westinghouse, series wound, and they are operated by liquid type controllers.

The direct-current switchgear at the Summer Lane station is of particular interest. The problem of handling the direct current is unusual, because of the future proposed magnitude of the station, which will render any fault comparatively disastrous locally, and serious in its widespread effect in case it causes a temporary cessation of the supply. The problem is also greatly complicated by the delivery of both a local supply to the network in the neighborhood of the station, and at the same time a bulk supply, *via* groups of heavy trunk feeders, to old centres of distribution in the existing power-houses. It is not essential to here enumerate all the various units and loads which have to be dealt with by this switchgear, but they would convince any central station man of the difficulty experienced in designing a suitable gear for their reliable and flexible operation, without such complications that would cause troubles to be aggravated by errors in time of emergency. The problem which Mr. Chattock and his staff had to meet in this connection was further complicated by the nature of the site of the power-house, which necessitates locating the switchgear across one end of the building in order to bring out the large number of feeders properly to the distributing conduits, the space available in plan being so limited compared with the amount of gear required, that the switchboards must be double-decked, and in part mounted in two rows facing each other. In spite of this, such care was taken in the relative locations of the different gear that the heavy cable runs are remarkably clear of entanglements with each other, or with bus-bars, heavy connection strips, rheostats, gallery steel work or window interferences, everything considered.

The direct-current switchgear in detail is as follows:

Each of the main 1,500-kilowatt generators is connected to its panel in the switchboard gallery by nine 91-7/17 cables, three positives, three equalizers or lighting negatives, and three traction negatives. All switches are mounted on the generator panel, which is seven feet six inches in height, and built up of three sections of two and one-half-inch black enameled slate. Each of these panels has the somewhat unusual width of four feet six inches. These heavy panels are mounted on five-inch by three-inch rolled steel H-stanchions, with horizontal T-iron laterals bolted to and supporting the several sections of the panels. All of the heavy leads from each of the large generators, are carried about the panel in the form of three five-inch by three-eighths-inch rolled copper bars in parallel, giving a cross section of over five square inches, and a current density of only 700 amperes per square inch at an overload of 4,000 amperes per machine. These three bars are separated by three-fourths-inch air spaces to add to the ventilation and to give room for three-fourths-inch contact nuts on all switch and circuit breaker studs and other connections. These studs are all two and one-half inches in diameter, with four nuts per stud, five inches across corners, giving a very low contact density.

All switches and circuit breaking devices for these heavy currents, as well as for all currents on this board from 2,000 to 10,000 amperes, are of the contracting company's laminated lever or brush toggle types, with finely laminated copper leaf contacts firmly bedded on the opposing surfaces by heavy pressure generally set up by powerful toggle action. When arcing may occur on opening the switch, these brush contacts are protected by solid copper to copper auxiliary contacts, further protected in the case of the circuit breakers by the usual quick opening wide break carbon to carbon contacts.

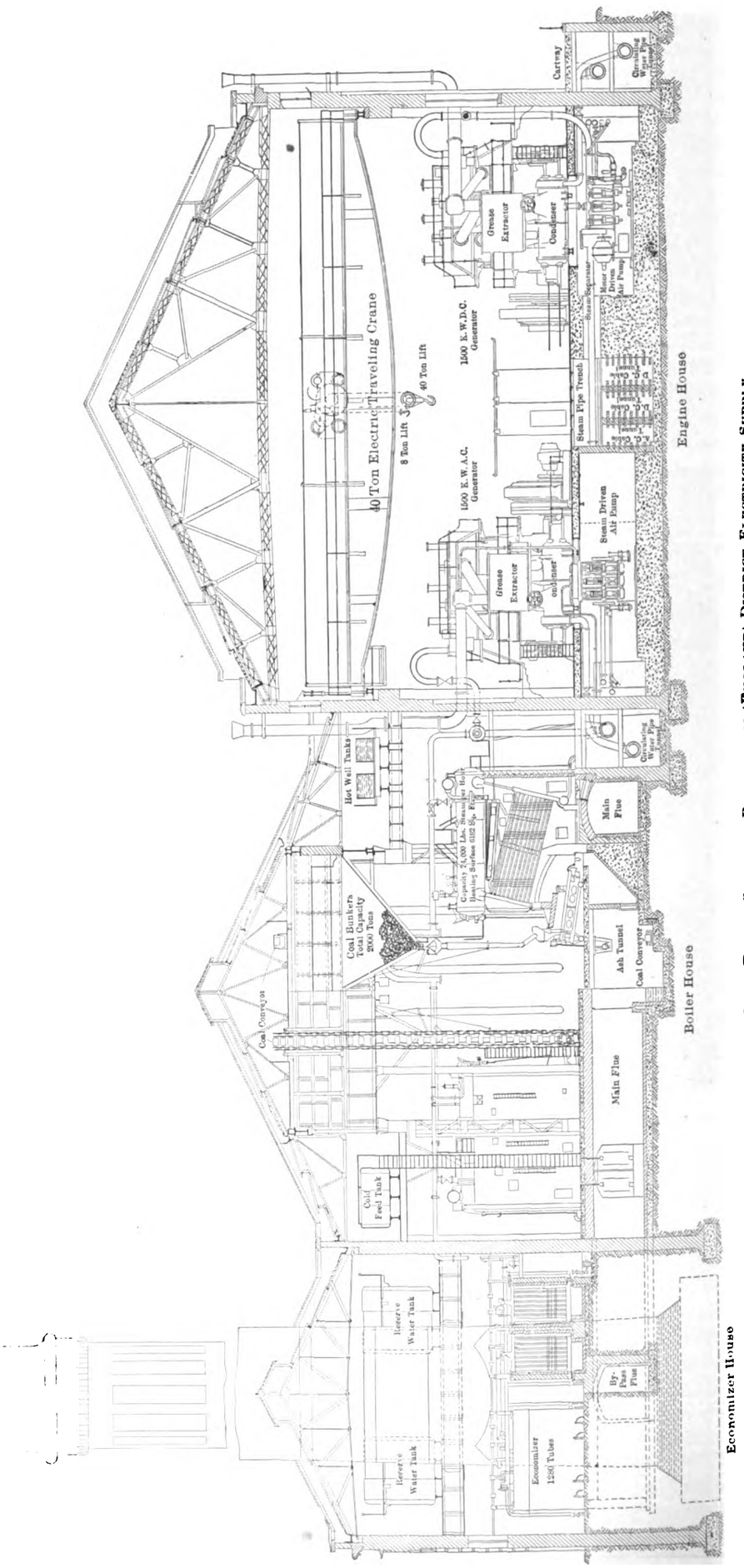
The main positive lead from each generator passes through a carbon break circuit-breaker without overload, but with reverse current attachment. The main positive lead also passes through a 5,000-ampere ammeter shunt with laminations

Digitized by Google

in a vertical plane to give maximum cooling effect, and with ends on the same horizontal line to minimize temperature errors. The shunts are all adjusted to the same drop at full load, so that all ammeters become essentially milli-voltmeters and can be calibrated as such. All indicating instruments throughout this switchgear are of the vertical edgewise type, with twelve-inch scales, heavy figures, large pointers, and illuminated dials. These instruments are mounted at three elevations according to other requirements of the panels. First at the top of panel looking down; second about shoulder high looking straight out, and third on the sub-base looking up, the latter position being used where the upper parts of the panel are occupied by circuit-breaking or switching devices or other instruments.

No voltmeters are used across any generators for comparing the voltage of any unit with that of the bars or of any other unit. Each main bus-bar has its voltmeter or meters, these being of the seventeen-inch illuminated-dial, sector type with limited open scales (440 to 550 for example) and with running index. Each machine is paralleled on the zero method by a twelve-inch vertical edgewise illuminated-dial voltmeter connected across the last switch closed in paralleling.

Each main generator is provided with multi-pole switches for simultaneously transferring both the positive and the negative from the traction to either of the lighting bars. Two such switches are required on account of the use of three sets of bus-bars, and these are connected in tandem, that is, the up-throw of the first transfer switch connects to the traction bus-bars, while the down-throw connects to the centre studs of the other multi-pole switch, which, when thrown up connects to the upper lighting bus-bars, and when thrown down to lower lighting bus-bars. On this account it is impossible to parallel either pole of the traction with any of the lighting bars. The transfer switches being multi-pole, it is impossible to get a machine coupled by accident between a lighting and a traction bar. The first of these tandem switches must of course be triple-pole in order to close the positive, equalizer and negative to the traction bars. The second switch is double-pole, the series field connection going to a dead stud on the down-throw of the traction transfer switch. In order to avoid closing the armature circuit on the breaker, or closing the armature at the same time as the series field to the traction bars, there is in series with the breaker in the positive lead, a further single-pole



Elevation of Summer Lane Power Station—Birmingham (England) District Electricity Supply.

Digitized by Google

switch known as the paralleling switch; this to be closed after the transfer switches and the breaker are closed. The paralleling voltmeter is bridged around this switch, and its calibration is of the very simplest character as it should always read zero when the switch is closed; the external zero adjustment enables it to be corrected at any time.

For the sake of clearance and accessibility the field-control gear has been kept clear of the panels, all rheostats being of the "slider" type with screw actuated contacts operated by hand wheels on vertical shafts mounted on pedestals in front of the corresponding panels.

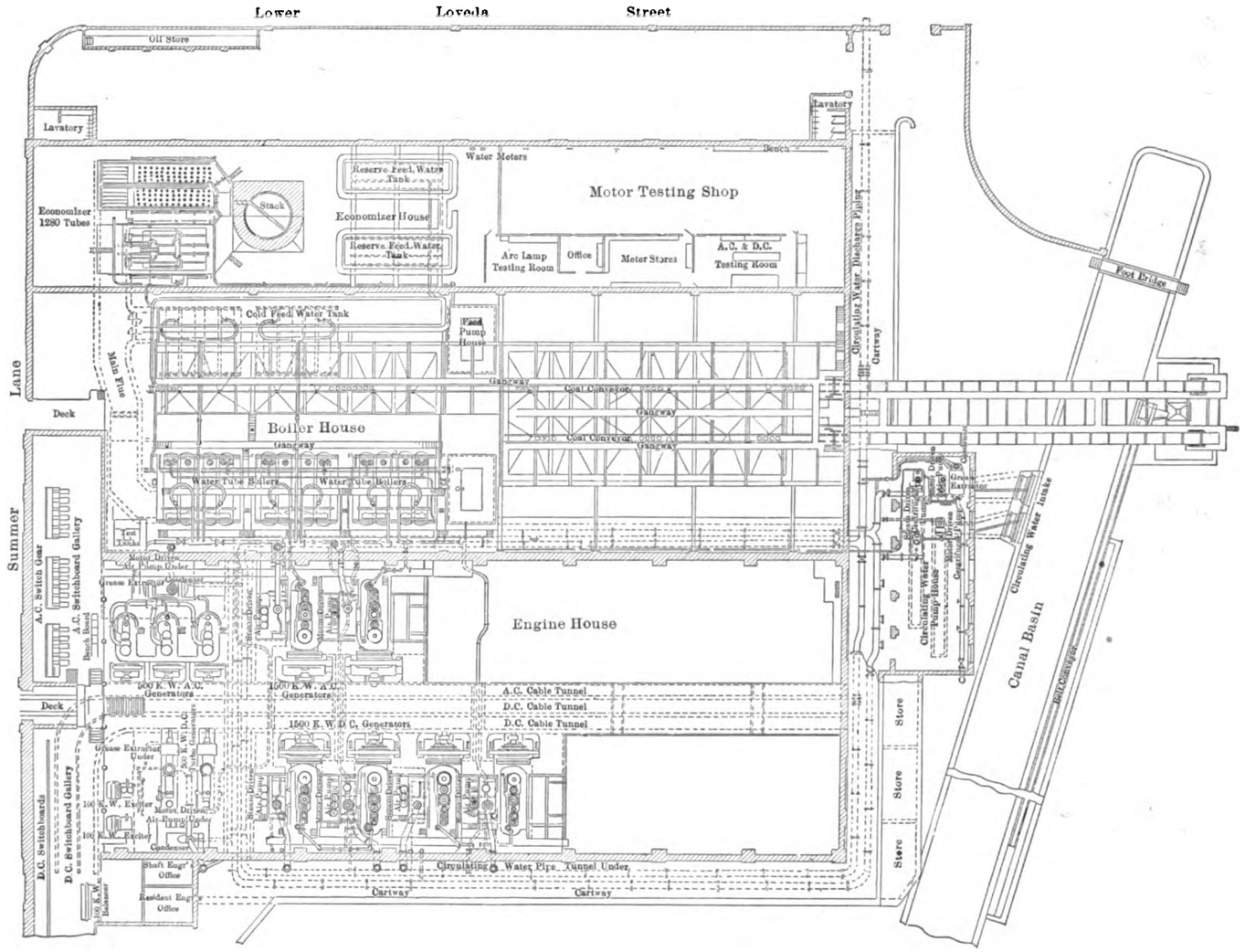
The main bus-bars are built up of five by three-eighths-inch copper, the largest at the present time consisting of six such bars per pole, but provision has been made for extending several of the bars up to fifteen square inches.

The two main lighting bus-bars may be connected together by two 10,000 amperes bus junction switches of the brush toggle type for use when two lighting voltages independently generated are unnecessary. One set of the main bus-bars, *viz.*, that running to the trunk main section of the board is sectionalized by bus-bar section switches, with an alternative route from the two 500-kilowatt turbo-driven generators to the trunk main bus-bars through two one square inch cables per pole, thus enabling the main length of these bus-bars to be shut down at times of light load, for extensions or alterations of any kind. Two of the lighting feeding boosters are supplied from one side of the above-mentioned bus section switches, and two from the other side, so that at times of light load the local lighting may be supplied from the turbo-generators through these boosters, and the main local lighting bus-bars may be shut down for extensions or alterations.

In addition to the above-mentioned gear there is the necessary equipment of Board of Trade test and recording apparatus for both traction and lighting work, also a Grove ohmeter and earth testing equipment, together with the requisite switchgear and resistances for clearing faults to earth on the lighting network.

All of the lighting feeders, including the trunk supply to the other stations, are protected by automatic cut-outs. No fuses were found on the market which were considered suitable for this heavy service.

The alternating-current switchgear is far simpler, owing to the comparatively small amount of current required for the same power, the much simpler conditions of distribution to be met, and the consequent absence of boosters, simplicity of the bus-bars, and so forth. The alternating-current transmission work at Birmingham is unusually free from complications. There are to be seven substations, each to contain converters feeding the lighting and traction system. To each substation three fifteen-square-inch, three-core, extra high-tension feeders will be run, one for lighting, one for traction service, and the third as a spare for either lighting or traction. In the generating station there are three feeder bus-bars,



. PLAN OF SUMMER LANE POWER STATION—BIRMINGHAM (ENGLAND) DISTRICT ELECTRICITY SUPPLY.

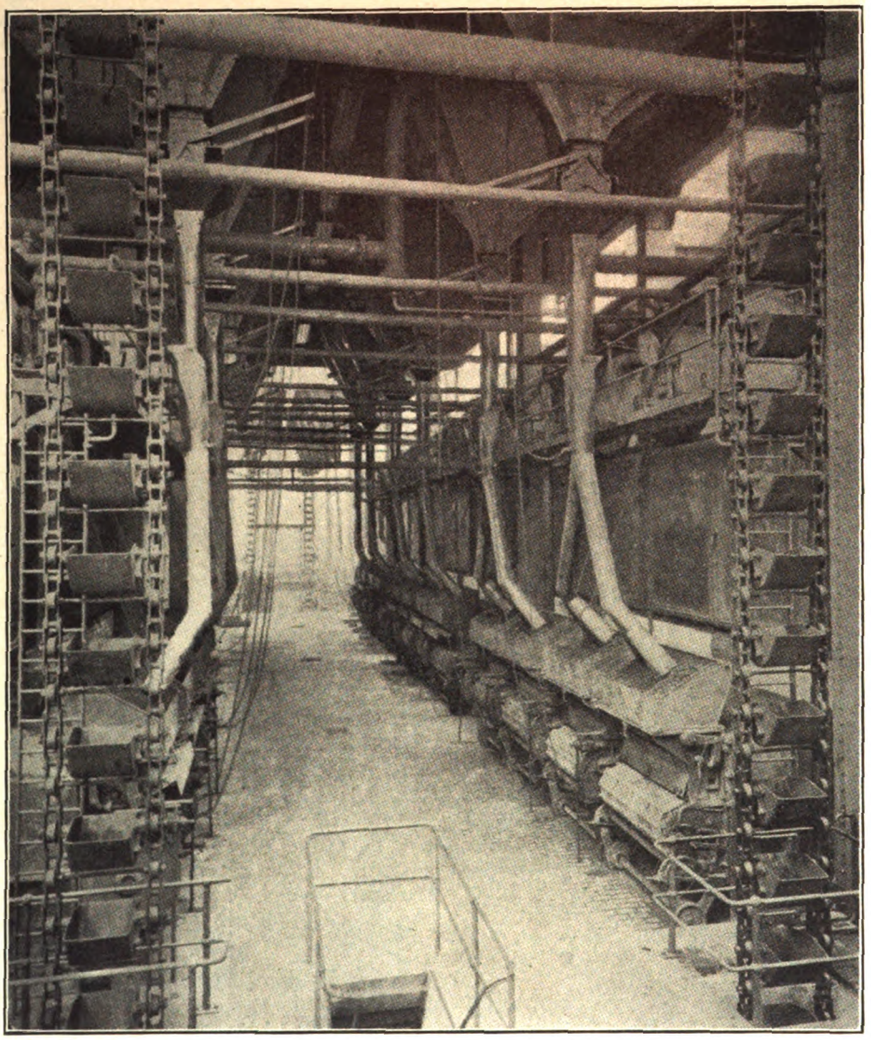
Digitized by Google

one for lighting, one for traction, and one for all spare feeders.

The switchgear was designed and built by the British Thomson-Houston Company, Limited.

The cables connecting the switchboards to the direct-current generators are so arranged that they are kept entirely distinct from each other throughout the whole of their run. They are carried from the basement under the switchboards along subways which run from one end of the engine house to the other, under the floor. These subways are fitted with a series of stone shelves built into the side walls, four shelves being provided for each generator, to accommodate the positive, the negative, the equalizer, and the shunt winding cables. The shelves are arranged one above the other, with the intention of protecting the upper cables from damage should any of those beneath them become ignited.

The three-core extra high-tension cables are run in a similar manner from the generators to the alternating-current switchboards, an entirely distinct subway being provided for these cables. Special chambers under the roadway in front of the station accommodate the large number of direct-current feeder cables which have to be brought into the station. These chambers are arranged so that any feeder can be brought to the exact point of entry opposite its own panel on the switchboard, at the same time being kept entirely distinct from all other cables entering the station.



Boiler House, Summer Lane Generating Station—Birmingham (England)
District Electricity Supply.

The boiler-house equipment at present includes ten Babcock & Wilcox water-tube boilers, evaporating 240,000 pounds per hour. Eventually there will be twenty-four boilers evaporating 576,000 pounds per hour. So far there are four feed pumps each of 8,000 gallons per hour capacity. The boilers have superheaters, and double mechanical chain grate stokers. The feed pumps are Weir's single direct-acting type. The coal supply is brought to the station by barge and there is a Robins' twenty-four-inch band conveyer large enough to discharge three barges simultaneously and capable of dealing with sixty tons of coal per hour (speed 200 feet per minute). It is discharged into a small hopper and fed through an "Ingrey" weighing machine, and then into a hopper at ground level, thence by chutes to the filling apparatus of gravity bucket conveyers. A. H. Bridge.

London, November 1.

"Seeing Electrically."

To the Editor of the Electrical Review:

I read with interest your editorial on "Seeing Electrically," in current Review. I think it proves quite conclusively that one can not believe all the yarns the papers publish about startling inventions in this line. They are especially amusing when one learns that "at the receiver one may view the countenance of his friend in all its natural colors and watch its varying expressions as he talks over the telephone."

"Electrical Vision" is a subject very dear to my heart. It has occupied many spare hours during the last twelve years. Not in experimenting—oh, no! (I realized that it was a tremendous problem)—in preparation. I am familiar with the whole field, from the original discovery by Willoughby Smith, in 1873, that the resistance of selenium was altered by light, to Szepanik's fiasco, that was heralded as the wonder of wonders, destined to dazzle the world, when the Paris Exposition of 1900 (wasn't it?) should have opened. Since then, perhaps half a dozen other men have claimed to have solved the problem, but after the paragraph has gone the rounds, we hear no more.

This problem is one of the most intricate and difficult that the human mind ever attempted to solve. I do not doubt, and yet I do not think it insolvable. We stand to-day in the same relation toward electrical vision that we did fifty years ago toward telephony. Then, the electrical transmission of articulated sounds (speech) was a wild dream. Yet, how ridiculously simple was Bell's solution. So it will prove with electrical vision, probably; a simple apparatus, embodying a new application of old facts, or else a new discovery, and the deed is done. Done, despite the fact that the problem, as you point out, bristles with mechanical, electrical and optical difficulties. Somebody will solve the problem some day—possibly I may myself, for I have some ideas tucked away in my brain—but whoever is the man marked by destiny for the job—it will be done, I am confident.

Alfred W. Storm.

Ramsey, N. J., October 28.

Digitized by Google

SOME POINTS ABOUT SINGLE-PHASE MOTORS.[1]

BY W. LANGDON-DAVIES AND F. B. O. HAWES.

The title of this paper will, it is hoped, be sufficient to prevent you from anticipating more than some brief sketches of a few matters of interest relating to single-phase motors. The types of motors dealt with are those which are used on ordinary single-phase circuits, supplying current for lighting and power, and not with those for traction, etc., working on special low-periodicity circuits. The whole subject is full of interest, but only a small portion can be touched on in the scope of one paper.

One of the earliest, if not the earliest, motors run by a rotating field was that devised by Walter Bailey. In his arrangement the shifting of the magnetic axis of the field, commonly called the rotating field, was produced mechanically by means of a commutator, which, although attached to the rotor, really commutated the field and caused it to more or less rotate. Direct current was used. This machine is worthy of much the same admiration that one bestows on, say, "Puffing Billy," when one considers the difficulties which beset the early pioneers. The shifting of the magnetic axis can be produced by other than mechanical means.

Who was the actual first inventor of the commutatorless single-phase motor starting on split field and subsequently working on a single-phase impressed field is not certain. It was probably invented by more than one person practically at the same time. Professor Ferraris, in a lecture, demonstrated this method in March, 1888. At about that time Nikola Tesla obtained and held patents in America, England and elsewhere for producing the same results. Touching these early patents of alternating-current motors, there is one that will probably interest you—namely, that taken out by Dobrowolsky, dated December 15, 1890, for the introduction of resistance into the induced member, usually the rotor, at starting. This is of particular interest from a commercial point of view, as the patent was kept in force in England during its full time, expiring December, 1904. Although the owners of the patents appeared indifferent to their rights, English makers were restrained from making motors with slip rings. The patent was held by a foreign company.

The first experimental machine made by Mr. Langdon-Davies, which ran at all, was constructed at the end of 1891. This was really a three-phase motor, the three phases being obtained from a single phase by splitting the phases, this being accomplished by inserting resistances in two of the circuits of the motor and no resistance in the third. The two resistances were, of course, of different values. The idea of phase-splitting was suggested by the results of some telegraph experiments. The stator and rotor were each ring-wound, and had polar projections, similar to the field magnet of a direct-current motor. No worse way of building an alternating-current motor can be imagined, but if you remember that there was no common knowledge of the subject fifteen years ago you will realize that a pioneer had to discover these things for himself, and that his most useful discoveries arose from his mistakes.

The next machine—which was a two-phase motor—was wound with two separate windings on alternate poles for each phase. Two phases were obtained from a single-phase supply by the now common means of inserting a choke in one winding and a non-inductive resistance in the other. The rotor was a squirrel cage. The machine required a very large current to get it to start, and was very inefficient, and naturally had a very low power factor.

Realizing that salient poles had serious disadvantages, the next machine was made with slotted tunnel windings with one pair of tunnels for each pole. There were two sets of poles wound with two separate windings, each winding being upon alternate poles. Both sets of poles and windings were used at starting; a variation of phase between the two sets was obtained, as before, by inserting a non-inductive resistance in the one set and a choke in the other. When the speed was nearly synchronous, one set of coils and the resistance and choke were cut out of the circuit and the machine ran as a single-phase motor. This machine, again, took a very large current at starting and was very inefficient.

It became apparent that the idea of having separate poles was a fundamental error. Separate poles may be considered as producing an effect on the rotor somewhat like that of a ratchet and toothed wheel, whereas what is required is a magnetic action upon the rotor which may be likened to the bristles of a brush continuously sweeping it round. The rotation of the rotor is produced by the field of the stator generating current in the rotor, which, again, produces a field reacting on that of the stator. When the rotor is revolving at nearly synchronous speed, the axis of its field should be as nearly as possible ninety degrees behind the axis of the stator field in the case of a two-pole machine. This can not be the case where there are separate poles, because there are points between the poles where the rotor has no effective return path. It was evident, therefore, that the whole of the interior surface of the stator must be magnetized both when running as well as when starting. In this motor such was not the case. In starting it will be seen that, when the alternate sets of poles were at zero they were inert, and when running one set of poles was permanently inert.

This machine was rewound so that the starting and running coils each enclosed the whole magnetic circuit. By this arrangement both the magnetic fields of the rotor and stator when running, or the fields set up by the two windings when starting—to express the action in a very unorthodox manner—were better mixed together, and there was no position at any moment when the magnetic circuit of the rotor had no effective return path. This machine was a great improvement on its predecessors, and was the first machine which did really useful work. An important point to bear in mind as regards this machine was that every turn of the windings surrounded the whole of each of the poles. Consequently, owing to the varying reluctance, the field varied in density from a minimum at the centre of a pole to a maximum at its edge, and a good rotating field could not be obtained. This motor had much to be desired in the way of efficiency. The next machine was built up of stampings having four slots per pole; this was a distinct advance on the previous machines. All these early efforts were made some fourteen years back. At the present date, thanks to the knowledge gained by the pioneers of the industry, the building of good single-phase motors is more a mechanical than an electrical problem.

Four properties are essential to a good single-phase motor—namely: (1) efficiency; (2) a high power-factor; (3) it should not overheat (though heating does not always indicate inefficiency); (4) it should be mechanically sound.

There are two other properties which are commercially useful, but have no other importance—a motor should be cheap and should look attractive. The last factor is a very variable one and we have not as yet found any reliable formula for it.

Dealing first with high power-factor. The power-factor of a motor matters but

[1] Paper read before the Birmingham (England) and District Electric Club, Saturday, October 13.

Digitized by Google

little to the consumer. He need not consider what current ebbs and flows through his meter, he only regards the watts the meter registers against him. Further, the additional amount of copper required adds nothing to his working costs, and but little to his capital outlay. Up to a certain point, however, it does matter to the supply station inasmuch as it entails more loss on the conductors, or, to put it another way, more copper to supply the same power at a lower power-factor.

The efficiency of a motor is not essentially important to the supply companies, the more watts per horse-power it consumes the better in some ways for the supply company. We do not for a moment suggest that a supply company would, or, in our experience, ever has attempted to, get inefficient motors used by its consumers, but we do wish to impress upon you the relative values of power-factor to efficiency in a commercial sense.

The term power-factor is in itself misleading. It suggests to many people that a high power-factor means a high power of some kind, whereas what it really means is that a machine which is described as having a high power-factor is one which really requires a small magnetizing current, and for that reason we prefer to call the wattless current the magnetizing current. All motors require a magnetizing current, even direct-current motors, but the difference between the magnetizing current of a direct-current motor and that of an alternating-current motor is that in the direct-current motor the whole of the current is wattful, if we may use the word, whereas in alternating-current motors the bulk of the current is wattless. In the case of the direct-current motor, the whole of the magnetizing current is recorded in watts on the meter through which the motor takes its supply, whereas in the case of the alternating-current motor none of the really magnetizing current is recorded. The only portion of the alternating current which is recorded is that which either does useful work or is dissipated in hysteresis, mechanical friction, Foucault currents and copper losses. In the case of the direct-current motor, however, the magnetizing current may be very small, whereas in the alternate-current motor the magnetizing current must be comparatively large. The loss on the mains between the supply station and the meter is C^2R, therefore the smaller the current supplied to the motor for a given horse-power the cheaper the supply will be.

It is therefore advisable on general grounds to have as small a magnetizing current as possible. It is not a difficult thing to produce an efficient alternating-current motor, provided the amount of magnetizing current can be ignored. The chief losses are due to Foucault currents, hysteresis and C^2R in the copper. Good lamination of the magnetic circuit reduces the Foucault currents. Good quality of material reduces the hysteresis currents as well as the reluctance. Plenty of copper reduces the copper losses.

The third requirement is the one that gives the most trouble in construction, for the larger the amount of copper wound the more difficult it becomes to keep down the reluctance of the magnetic circuit and therefore keep down the magnetizing current.

There are three ways employed for getting the wire on to the iron: (1) Open slot winding (sometimes with former-wound coils); (2) tunnel winding; (3) combinations of the two.

Open slot winding decreases the area of the air-gap for a given diameter of rotor. Tunnel winding is apt to increase the magnetic leakage. Both of these increase the required magnetizing current in proportion to the power obtained, therefore various compromises are used.

The length of the air-gap is a most important factor in reducing the required magnetizing current. It can, in practice, be reduced to as little as $\frac{1}{32}$ inch, but with so small an air-gap as this the rotor must be very accurately centered. If it were $\frac{1}{128}$ inch out of centre, this would cause the length of the air-gap on one side of a diameter to be in the proportion of three to five of the gap on the other side; a serious concentration of the field to one side of the rotor would result, thereby producing a considerable and useless side pull which would impair the starting qualities of the machine. This side pull is most serious in a two-pole machine.

Ordinary bearings soon wear to the extent of $\frac{1}{128}$ inch, and the absolute necessity for some better bearing was demonstrated. The bearing which, in our opinion, best supplied the necessity was one constructed by our company, which was of highly polished cast iron, a steel spindle being employed. The bearings were ring-lubricated and worked exceedingly well if kept properly lubricated and clean. For example, the company has now a six-brake-horse-power motor running in their works which has been going for ten years, and the bearings have never yet been touched. Unfortunately, these bearings had to be given up because it was found impossible to get the general user to attend sufficiently to the lubrication, especially in seeing that dirt was kept out of the oil. In the case of starting a new machine, it was absolutely necessary to see that the oil was working well through the bearings before running up to speed, as if they were dry it only took a fraction of a second for them to seize.

There have been cases in which the users filled up the oil-box, which was fitted with a ring lubricator, with grease, and then switched on. The shaft seized, naturally, almost at once, and they could not be convinced that this was the result of their own neglect, but regarded the motor as a very bad machine electrically and mechanically. Good phosphor-bronze bearings have, however, been found to satisfy the general conditions.

Passing on to the consideration of rotor winding, it is absolutely necessary, in getting on the requisite amount of copper, to keep the area of the air-gap as small as possible. The earliest form of short-circuited induction rotors were wound (if it may be called winding) by thrusting a number of copper rods through holes in the rotor and soldering them to copper rings at the two extremities of the rotor; this was known as the squirrel-cage rotor. The holes in the rotor were placed as near the periphery as possible to avoid magnetic leakage.

Such a rotor may give trouble in construction, inasmuch as it is difficult to ensure that the copper squirrel cage is exactly concentric with the magnetic circuit of the rotor. Although the rotor might be mechanically balanced, it is possible for there to be a squirrel cage of copper inductors moving eccentrically to the field, which will produce starting difficulties. If the rotor is wound either with copper rods or bars in open slots, troubles arising from eccentricity of the copper produce little or no effect. After some years of experience and experiment my company has adopted for its short-circuited rotors a form of open slot winding. The slots can hardly be called slots, they are more of the nature of saw cuts, which are filled with copper strip. By this form of construction sufficient copper is put upon the rotor and a large area of air-gap maintained.

Passing on to the third property that a motor should possess—namely, that it should not overheat—you will remember that we said this did not always indicate inefficiency. This can be readily understood if you consider that if a well-designed motor which ventilated itself were

Digitized by Google

shut up in a box it would soon overheat. The question of heating is one that requires careful consideration. If the efficiency is not affected it does not really matter how hot a motor gets, unless its temperature is such as to cause damage to itself or its surroundings. For instance, picture a 100-brake-horse-power motor of ninety-five per cent efficiency. The remaining five per cent, or five brake-horse-power, whatever way you like to take it, has to be dispersed in heat, and it is essential that this heat should not produce in any part of the motor such a temperature as to become destructive to the insulation or any other part of the machine; but it should be understood that, provided the temperature of a motor is not sufficiently high to be either destructive to the machine or its surroundings, its actual thermometric measure does not matter.

This brings us to the question of ventilation, which is a most important one, and we venture to say much more difficult in an alternating than in a direct-current motor. The ventilating spaces between the pole pieces do not exist in an alternating-current motor, and as the stator has to completely surround the rotor there are no spaces for the air to circulate in. It will be seen from the rotor on the table that a circulation of air is produced by providing the rotor with blades. These throw the air out from the centre and are shaped so that the same effect is produced whichever is the direction of rotation of the rotor.

So far we have only considered short-circuited rotors. These, of course, have a comparatively small starting torque per ampere. It should be remembered that it is only the starting torque per ampere that is of importance. An ordinary squirrel-cage rotor can be made to give a large starting torque if the stator is so wound as to give it a large current.

The efficiency of a motor when running up to speed is also a point worthy of careful consideration. In such cases as cranes and lifts, where the motor is practically always starting, it is especially important that it should be efficient when running up to speed. This is not so, however, when a motor is used to drive the shafting in a factory, and is only started up, say, twice a day, the time of getting into speed being a minute fraction of the total time the motor is in action.

A larger starting torque is obtained per ampere where the rotor has slip rings and a resistance is introduced into the rotor circuit. This, however, introduces complications. H. M. Hobart, in his book on electric motors, admirably sums up the case. He "would employ the squirrel-cage type of motor much more generally as having such great advantages on the score of simplicity, robustness, better economy in operation, and cheapness in manufacture, as to justify its use, not only in very small sizes, which is the present practice, but also in practically any size, in fact, limiting the use of slip-ring motors to special cases. It is true that squirrel-cage rotors must be started with little or no load, and even then must be started from a compensator, in order to limit the starting current to a permissable amount, but by the use of mechanical devices designed to apply the load after starting, they are made not only equal to, but more satisfactory than, the slip-ring motor, being characterized by higher efficiency, power-factor and overload capacity, and requiring a minimum of attention. The slip-ring motor, on the other hand, is not only less satisfactory with respect to these constants, but it is inherently more expensive, more liable to break down, gives at the slip rings and brushes practically as much trouble as a commutator, and must have troublesome and expensive auxiliary attachments for internally short-circuiting the slip rings and raising the brushes after starting. All these disadvantages are encountered simply in order to obtain improved starting."

So far we have chiefly discussed some mechanical points about a single-phase motor, but the question of starting at once brings us to the unseen, and, we venture to say, the most important, consideration —*viz.*, the rotating field by which the motor is started. Supposing a rotating field to be set up in the motor, in order to obtain the best results its speed of rotation should be perfectly constant, and it should not vary in strength during each revolution. This result is practically unobtainable in a split-phase motor, as certain compromises have to be made. For example, take the case of a two-pole machine, and consider what is really required to produce a rotating field. The field should be perfectly uniform in density all round the air-gap. This in itself is a difficult condition of affairs to produce in practice. Since tunnels of some kind must be used to contain the stator winding, it is obvious that the reluctance across every diameter of the air-gap is not uniform, and therefore the magnetic field in the air-gap can not be uniform. Any want of uniformity in the rotating field produces wasteful currents in the rotor. Modern methods have, however, reduced these irregularities by careful design.

There is, or was, one difficulty in getting single-phase motors to start which we think will interest you, although with modern alternators it is a thing of the past. We refer to the wave shape of the alternating current supplied to the motor. Some of the most astonishing results may arise from irregular wave shapes—*viz.*, those which are not sinusoidal. For instance, with a double-crested wave, a condition which frequently used to occur in practice, the resultant magnetic field would not only cease to revolve, but twice in a revolution it turned back against the direction of rotation of the rotor. It is obvious that under such conditions there will be great difficulty in getting the rotor to run up to speed. The whole of this subject is so extensive that it is impossible to know when to stop, but it is hoped that the above points will be of some interest.

The Rochester, Syracuse & Eastern Railway.

What will be, when completed, one of the largest interurban electric railways in this country. The Rochester, Syracuse & Eastern Railway, connecting the cities of Rochester and Syracuse, N. Y., has now opened up thirty-seven miles of the entire length of eighty-three miles from Rochester to Lyons. The undertaking, which is controlled mainly by Syracuse capitalists, of which Lyman C. Smith is president, has been conducted in the most up-to-date manner. It is expected that it will cost $6,000,000 to complete the road. The roadbed, which in many instances traverses private right of way, is of the most substantial construction, all the material used being the best obtainable. The power-house equipment consists of apparatus representing the highest development of modern electric railway machinery, such as Westinghouse-Parsons steam turbines, Westinghouse turbo-generators, as well as switchboard and auxiliary machinery. The cars are solidly built, weighing approximately fifty tons and measuring fifty-four feet in length by eight and one-half feet in width. Each car is equipped with four 125-horse-power Westinghouse motors, Westinghouse multiple unit control and air brakes. The company will operate express trains and accommodation trains, the former running at a regular schedule speed of from fifty to sixty miles an hour. On a recent trial trip a few days ago, one of the cars attained a speed of seventy miles an hour. It is expected that the entire road from Rochester to Syracuse will be completed and in full operation by January 1, 1908.

Digitized by Google

Electrical Equipment of the Bath Portland Cement Company, Bath, Pa.

OF the many applications of electric motors in manufacturing establishments there is probably no industry where the power demands are more exacting or the operating conditions more severe than in cement works. The heavy starting torque required by cement-making machinery, the nature of the load handled, the constant presence of dust and the inflammability of pulverized coal used in the manufacture of cement, bring up problems in power transmission that require the most careful consideration.

Power transmitted mechanically from a central source is open to many objections not only on account of the loss in long lines of shafting and belting, but the lack of flexibility, and the necessity of laying out buildings to conform to such methods of driving, add to the complexity of such systems.

These considerations led to a demand for a substitute that would in the main eliminate many of the objectionable features referred to and provide a source of power that is immune from fire risk and that can be subdivided and applied at the various points of application. The natural solution of the problem was the adoption of induction motors, which is aptly illustrated by the plant of the Bath Portland Cement Company, at Bath, Pa. This plant was designed for an output of 2,500 barrels of cement per day and is a typical example of modern practice in this industry, the credit for the successful design and operation being due to Frederick B. Franks, superintendent and chief mechanical engineer of the plant, and James A. Gish, assistant.

The buildings are compactly situated on four acres of ground and are constructed of concrete and steel, the extensive use of concrete being regarded as consistent with the cement business.

The company owns 320 acres of ground on which is located, besides the buildings, an almost unlimited supply of cement rock, carrying approximately the correct proportions of material for Portland cement.

A general view of the buildings is shown in Fig. 1. The power-house is built ten feet above the ground level, the lower part being used as a basement, which contains steam and air pipes, cables, overflow conduits from condensers and a receiving tunnel from the reservoir.

An interior view of the boiler room is given in Fig. 2. Here are located eight 300-horse-power Berry boilers, each ten feet six and one-fourth inches outside diameter and twenty feet nine and one-half inches high. Bituminous coal is used for fuel, which is delivered on a trestle twelve feet high, forty-five-degree coal chutes delivering the coal into the boiler room. The boilers at the present time are hand-fired, but the fronts are so arranged that they can be equipped with automatic stokers. A brick stack 175 feet high is located centrally in the building, with four boilers on each side. Each boiler is fitted with two three and one-half-inch pop safety valves, a Reliance water column, self-closing gauge cocks, stop and check valves and three blow-off cocks. The working pressure of the boilers is 150 pounds. Two horizontal fourteen-inch by eight and one-half-inch by ten-inch duplex feed pumps supply water to the boilers through a 2,000-horse-power open-feed water heater.

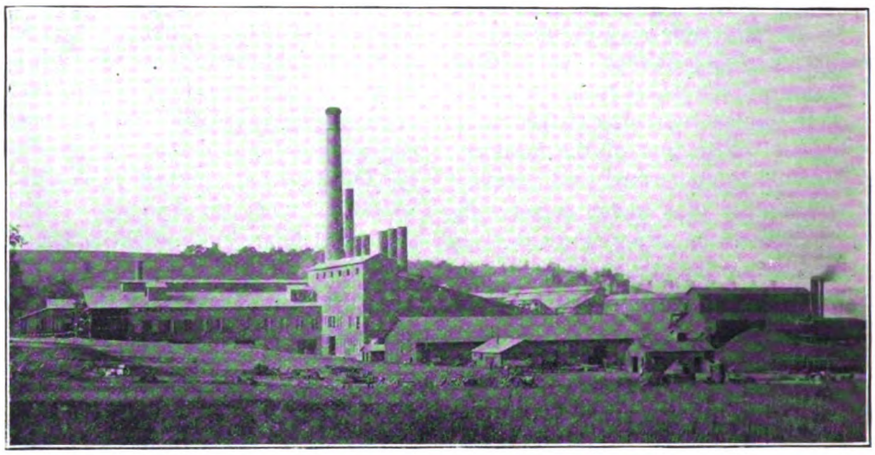


FIG. 1.—VIEW OF BATH (PA.) PORTLAND CEMENT COMPANY'S PLANT.

A large reservoir located within fifty feet of the power-house, and having a capacity of 3,500,000 gallons, is used as a reserve for water supply during the season of the year when a creek, which furnishes the usual supply, is low. Water for condensing purposes is drawn from the reservoir and is returned thereto,

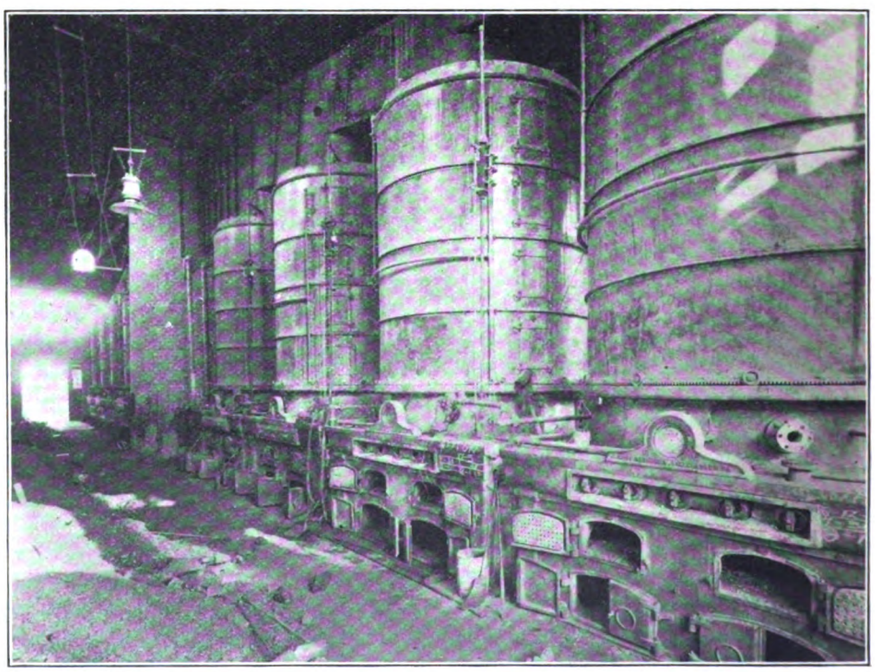


FIG. 2.—BOILER ROOM, BATH (PA.) PORTLAND CEMENT COMPANY'S PLANT.

Digitized by Google

throughout the entire dimensions of which it must circulate before again entering the condenser suction pipes. The water supply for the reservoir, aside from the natural drainage of the surrounding grounds, is drawn from an artesian well

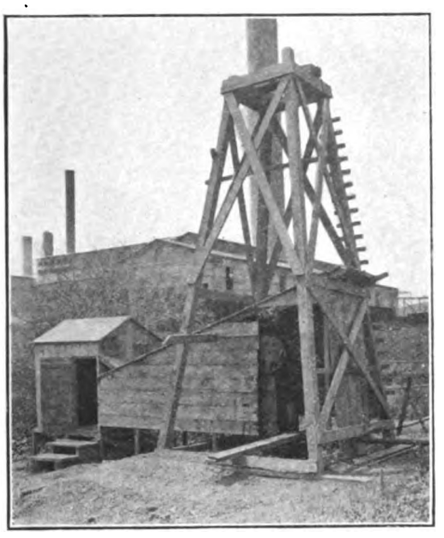


FIG. 3.—ARTESIAN WELL AND ELECTRICALLY OPERATED PUMP, BATH (PA.) PORTLAND CEMENT COMPANY.

300 feet deep by a Deming pump operated by a twenty-five-horse-power Westinghouse induction motor. The pump is illustrated in Fig. 3.

The engine and generator equipment consists of a 350-horse-power Wetherell-Corliss tandem-compound, condensing engine direct-connected to a Westinghouse 200-kilowatt engine-type, three-phase, sixty-cycle, 440-volt generator operating at 120 revolutions per minute, and two 1,100-horse-power, cross-compound engines of the same make, located parallel to each other, employed to drive the raw mill department and the clinker department. These engines are of the heavy-duty Corliss type with cylinders twenty-four inches and forty-eight inches by forty-eight inches. They are fitted with a sheave fly-wheel eighteen feet in diameter and sixty-seven and three-fourths inches face, which drive twenty-two two-inch transmission ropes connected to sheave wheels on the main line shaft. To this line shaft are belted two Westinghouse 180-kilowatt, 440-volt, three-phase, sixty-cycle generators operating at 514 revolutions per minute. Fig. 4 illustrates the engine and generator equipment. All three engines are equipped with the Consolidated Engine Stop Company's apparatus, and any unit may be stopped from several places in the works in case of accident.

A small lighting set consisting of a Westinghouse ten-kilowatt, engine-type, direct-current, 125-volt generator, direct-connected to a Reeves vertical engine operating at 490 revolutions per minute, is illustrated in Fig. 5.

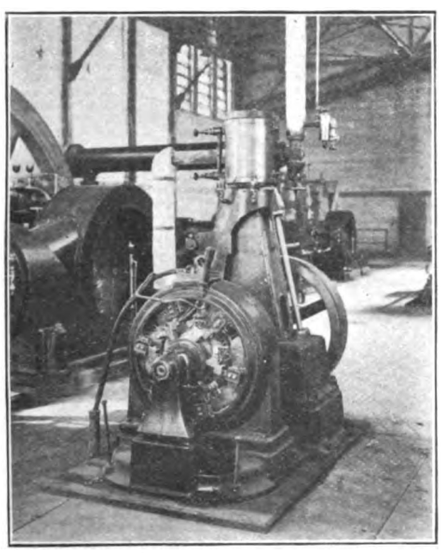


FIG. 5.—LIGHTING SET, BATH (PA.) PORTLAND CEMENT COMPANY.

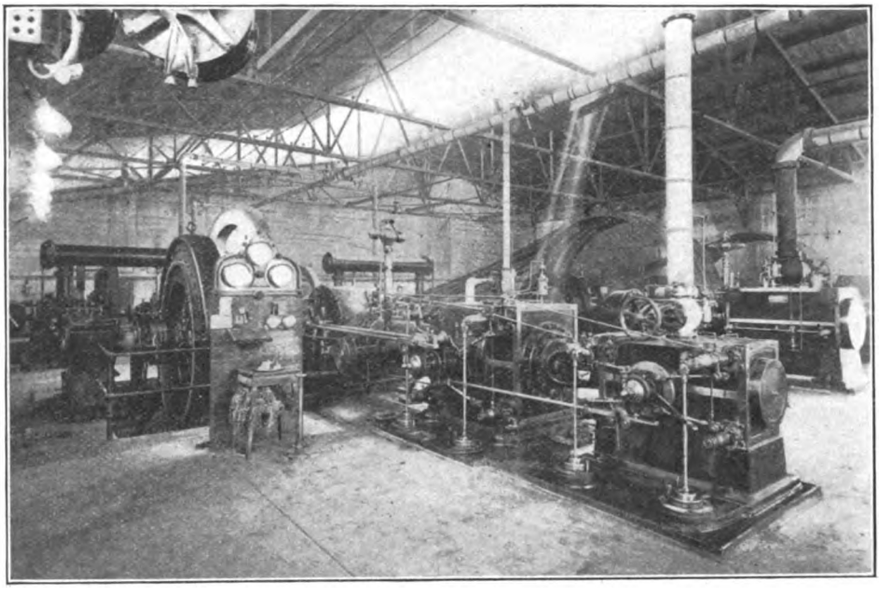


FIG. 4.—DIRECT-CONNECTED ENGINE AND GENERATOR, BATH (PA.) PORTLAND CEMENT COMPANY.

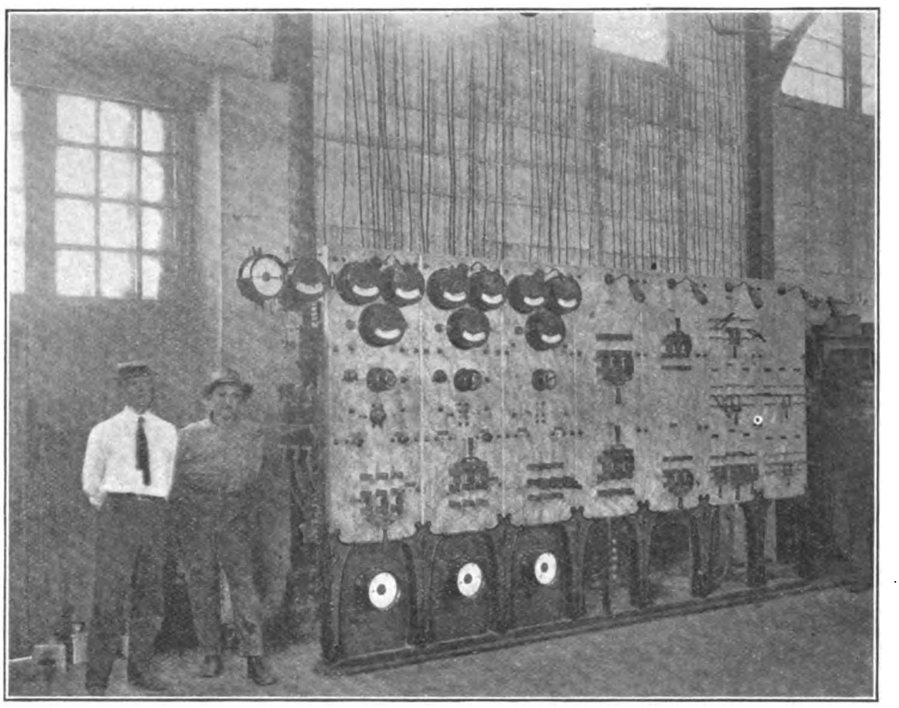


FIG. 6.—SWITCHBOARD, BATH (PA.) PORTLAND CEMENT COMPANY.

A motor-generator set is used for excitation and consists of a fifteen-horse-power Westinghouse induction motor, 400 volts, 1,120 revolutions per minute, direct-connected to a Westinghouse ten-kilowatt, 125-volt, type S generator.

The switchboard illustrated in Fig. 6

Digitized by Google

was manufactured by the Westinghouse Electric and Manufacturing Company and consists of white Italian marble panels mounted upon ornamental iron legs with the standard equipment of instruments for three-phase alternating-current circuits. Located immediately behind the switchboard are two twenty-kilowatt, Westinghouse oil-insulated, self-cooling transformers with a secondary voltage of 120, which furnish current for forty-eight Westinghouse multiple alternating-current arc lamps and 1,500 sixteen-candle-power incandescent lamps.

In order that a clear idea of the manufacture of cement and the various applications of electric motors in such industries may be gained a description is given of the various processes from the time the rock leaves the quarry until the cement is packed in barrels.

In the quarry vertical holes are drilled into the solid rock by pneumatic drills in which the blasting charges are placed and ignited by electricity. The loosened rock is conveyed to the mill in cars by means of gravity and dumped into two No. 6 Austin gyratory crushers, where the material is reduced to two and one-half inches and smaller. The empty cars then run to the foot of the incline (Fig. 7) where an endless chain driven by a ten-horse-power Westinghouse induction motor draws them to the top, and they return to the quarry by gravity. The cars each have a capacity of four tons and an average of seventeen cars per hour are hauled up the incline.

From each crusher the rock is delivered to a continuous bucket elevator which raises it to a small hopper that empties into two large Buchanan crushing rolls, where the rock is further reduced to three-fourths inch and smaller. From the rolls it is elevated on another continuous bucket elevator and emptied into two revolving stone driers seventy-two inches in diameter and fifty-five feet long, having four compartments where the stone is dried. An exhauster is used in connection with the driers, the stack being located on the outside of the building. From the driers the stone discharges into a continuous bucket elevator and is delivered into another set of Buchanan rolls driven by a 100-horse-power Westinghouse motor. From this roll the stone is elevated and delivered into a storage bin in the storehouse or on to a reversible belt conveyer, traveling over the top of the stone storage bin, which conveys the stone into the raw mill and delivers it to a belt conveyer that discharges into seventeen storage bins above the grinding mills. The storage bin in the storehouse is of concrete and steel construction and has a capacity of 1,200 tons of crushed stone. The stone is taken from this bin by a Scandinavian belt conveyer in a tunnel beneath and is emptied into an elevator which, in turn, conveys the crushed stone over the bins in the raw mill. The large storage bin in the storehouse is kept filled to its maximum capacity, as this department operates only ten hours per day, and enough excess material is stored to enable it to close down for three days at least.

The machinery in this department is operated from the main line shaft, which is driven from the engine room as already described.

The next process is taken up in the raw grinding room, where sixteen Fuller-Lehigh mills are located, driven from the same line shaft that operates the machinery in the storehouse, each mill having its independent clutch. Large storage bins are located over the mills, which empty directly into their feed hoppers, ample room being provided for any necessary repairs. Passing through the mill the material is delivered into a screw conveyer located in a tunnel beside the mill foundation, which empties into an elevator in the kiln house. In this house the machinery is driven by a line shaft belted to a 100-horse-power Westinghouse induction motor operating at 580 revolutions per minute. This motor also drives a Westinghouse 22.5-kilowatt, 125-volt, type S exciter which supplements the exciters in the engine room proper. One of the kilns is shown in Fig. 8.

The kiln house connects with part of

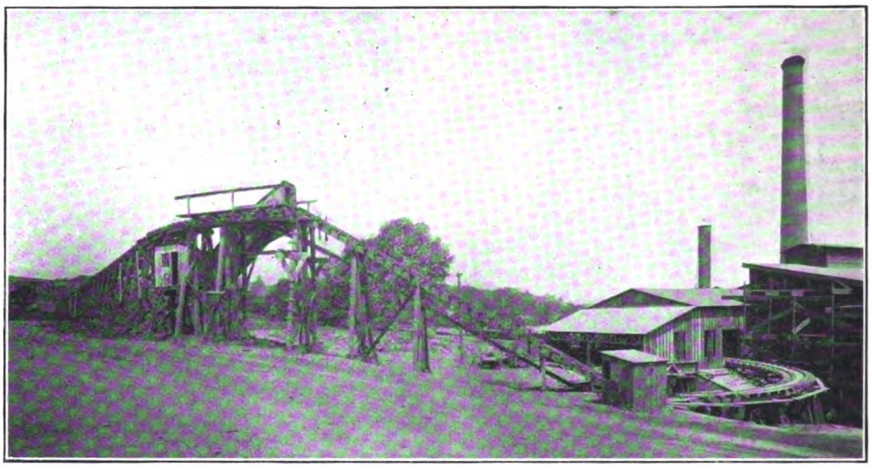


FIG. 7.—TRAMWAY, BATH (PA.) PORTLAND CEMENT COMPANY.

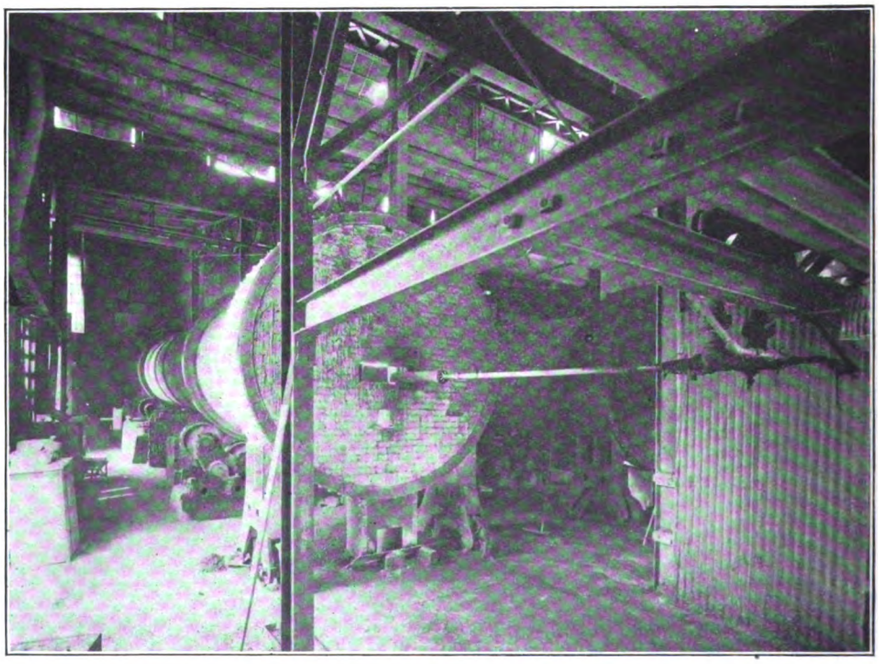


FIG. 8.—ELECTRICALLY OPERATED KILN, BATH (PA.) PORTLAND CEMENT COMPANY.

Digitized by Google

the raw grinding room and the rotary kilns are placed transversely across the building. There are six kilns each 100 feet long, seven feet six inches in diameter at the large end and five feet six inches at the stack end. The stacks are sixty feet high, five feet in diameter. Each kiln is driven from the line shaft by means of a Mosser speed regulator of the interlocking-cone pattern, controlled by a tight-and-loose pulley that also controls the feeding of the raw material from the storage bins, which have a capacity of 200 tons each.

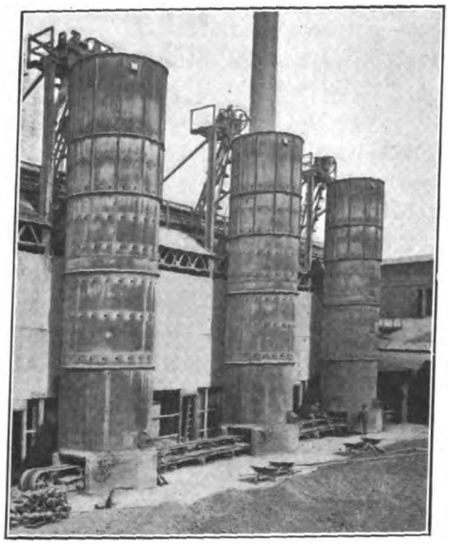


FIG. 9.—COOLERS, SHOWING BUCKET CONVEYERS, BATH (PA.) PORTLAND CEMENT COMPANY.

The raw material is raised by an elevator from the raw mill to a screw traveling transversely across the kiln storage bins. Another screw is also used to remove the spill and dust from the dust chambers at the feed end of the kilns and, in turn, empties into the elevator that receives material from the raw mill. At the delivery end of the kiln the clinker discharges into a pit, forming a chute that empties into three bucket elevators, one elevator being used for two kilns. The clinker is then elevated and discharged into three clinker coolers ten feet in diameter and forty feet high, illustrated in Fig. 9. The elevators are operated by a thirty-horse-power Westinghouse induction motor.

The coolers are arranged with spouts which deliver the clinker into conveying machinery that extends to the clinker storage, where the clinkers are well seasoned before grinding.

Fuel for the kilns consists of pulverized coal, which is forced through pipes from the feeders to burners, as can be clearly seen in Fig. 8. The feeders, six in number, are each operated by a one-horse-power Westinghouse induction motor illustrated in Fig. 10.

The clinker discharges from the coolers upon a belt conveyer traveling through the concrete foundations upon which they rest. The discharge from the cooler is controlled by a hand-operated gate. The first belt conveyer empties into a second conveyer which delivers the clinker to an elevator that, in turn, delivers the clinker to a conveyer distributing from the clinker storage to a belt conveyer. This empties into an automatic measuring device which discharges into a storage bin, thence to three pot crushers. An automatic gypsum-measuring device is used and arranged so that a continuous flow of this ingredient enters and mixes with the clinker before crushing. From the pot crushers the clinker is conveyed on a belt conveyer and emptied into a second conveyer that discharges into an elevator, delivering the material in the clinker-grinding room, which contains twenty-four Griffin mills. The unfinished clinker storage room will have a capacity of 100,000 barrels, with provision for increasing the amount if necessary. Three tunnels will be used, which contain the belt conveyers, the feeding of the clinker being controlled by the Link-Belt Engineering Company's system of under-cut gates. These conveyers will empty into another conveyer, where the material is delivered to an elevator emptying into a measuring device located in a bin connected with the pot crushers.

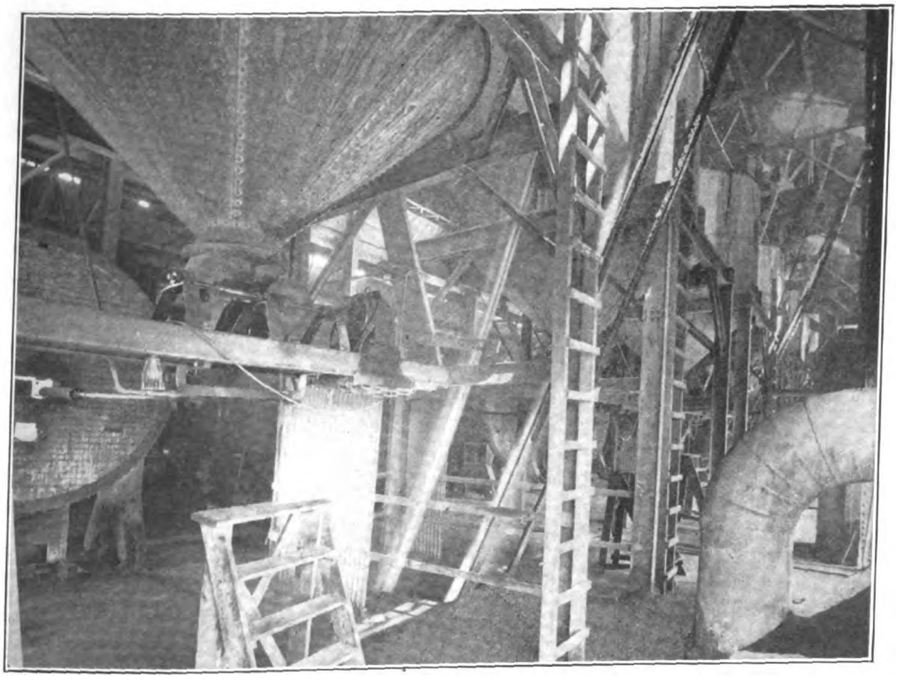


FIG. 10.—ONE OF THE SIX WESTINGHOUSE INDUCTION MOTORS OPERATING COAL FEEDERS, BATH (PA.) PORTLAND CEMENT COMPANY.

The clinker, after passing through the pot crushers in the clinker storage house, enters the clinker-grinding room on a belt conveyer and is emptied into a bucket elevator and conveyed to two sets of clinker-crushing rolls, where the clinker is reduced to about the size of peas, then elevated and conveyed to bins over twenty-four Griffin mills, where it is ground to cement. After the clinker-grinding room comes the cement stock house, where the finished product is stored. From the former department cement screws empty into a bucket elevator that elevates and delivers into an overhead screw operating right and left. This, in turn, discharges into two screws traveling longitudinally with the building, one of which empties into a large bin on one side of the building and into a number of smaller bins on the opposite side, where a screw conveyer in a large tunnel delivers the cement to the packing house. From the large bin there is also a screw conveyer for delivering cement to the packing house, which has a capacity of 4,000 barrels per day. All the machinery in the stock and packing house is operated by a 100-horse-power Westinghouse induction motor.

The coal-pulverizing plant, where the coal for the kilns is prepared, contains one F. D. Cummer & Sons self-contained coal drier, a Mosser crushing roll, and four Lehigh-Fuller mills for pulverizing the coal. After passing through the drier the coal is delivered by a screw conveyer

Digitized by Google

into the Mosser crushing roll, then into a bucket elevator that empties into a screw conveyer above the storage bins for the Lehigh-Fuller mills. After passing through the mills the coal is delivered by means of a screw conveyer and an elevator to the coal bins in front of the kilns. All the machinery in this department is driven by a Westinghouse 200-horse-power induction motor.

A modern machine shop, operated by a ten-horse-power Westinghouse induction motor, where all repairs are made, completes the equipment of one of the most modern and complete cement plants in this country.

A New Method of Testing Magnetic Metals.

At the recent international congress for testing materials, held in Brussels early in September, a new method of testing magnetic materials was described by Capt. L. Fraichet, of the French Artillery. The method consists in observing the variation in the magnetic permeability of a test bar while under tension. The bar is surrounded by a bobbin composed of a primary circuit of stout wire, the current being supplied from storage batteries. A secondary test circuit is placed around the core and connected to the galvanometer. The flux passing through the test bar varies from two causes: the length of the bar increases under tension, and its cross-section diminishes. These two effects should produce a continuous regular variation in the flux. Whenever structural changes in the steel take place irregular changes in the permeability should be observed. Curves obtained in this way are not easy to interpret, because of the disturbing effects of the clamps of the testing machine. This investigation was begun by Fraichet in 1904, but the conclusions then reached have not been confirmed by his more recent researches. The permeability seemed to increase at the commencement of the elastic deformation, and the magnetic circuit to become completely closed much sooner than had been assumed. For this reason weak magnetizations are now used in the tests. The limit of elasticity seems to correspond to a rapid deflection of the galvanometer, not to the maximum deflection.

Motor Mail Wagons.

Consul Albert Halstead, of Birmingham, England, says that it is reported that the British post-office department proposes to use motor mail wagons where at present horse mail wagons are used, and that it is so well satisfied with experiments made with motor mail wagons as to intend to introduce them on all the long-distance horse-coach routes, and later to carry not a little of the mail now dispatched by train.

Illuminating Engineering Society.

A meeting of the New York section of the Illuminating Engineering Society was held at the Edison Auditorium, 44 West Twenty-seventh street, New York city, on the evening of Friday, November 9.

Preston S. Millar, secretary of the section, reported that the membership of the society had reached 850.

President Marks introduced A. E. Forstall, chairman of the New York section, who made a few remarks. Particular attention was called to the tendency to-day to bring together the gas and electric light companies, but no effort seems to have been made to bring together the gas and electrical engineers. It was hoped by the speaker that the society would bring this about. The opportunity for work offered to the society was dwelt upon briefly, attention being called particularly to the need of guiding the public in lighting matters, teaching it how to get the most light for its money.

Three papers dealing with the general subject of fixtures were presented, the first of these being entitled "Location of Lamps and Illuminating Efficiency," by Preston S. Millar, of the Electrical Testing Laboratories. An abstract of this paper will be found on another page of this issue.

The second paper was by Major E. L. Zalinski, U. S. A., retired, entitled "Fixture Design and Location." This dwells upon the application of the law of inverse squares and the location of fixtures, pointing out that, according to this law, a very considerable increase in illumination may be secured by making the fixtures rather longer than is customary, particularly where the ceilings are high, thus bringing down the lamps to a minimum height from the floor. Figures were given showing the relative illumination secured with the fixtures at different distances from the floor. Eight feet is given as the minimum height, thus providing head room, and the lamps being above the direct vision of the eyes. The height at which the lamps are placed depends upon their intrinsic brilliancy and also upon the character of the reflectors used. Clear prismatic glass reflectors, having a higher intrinsic brilliancy than opaque reflectors, must be placed higher than the latter. The law of inverse squares has application not alone to the placement of fixtures, but, as well, to the manner of most advantageous subdivision, lateral distribution and number. It has been found by actual trial that the law of inverse squares, contrary to expectation, may be applied to illuminants equipped with reflectors, with sufficient accuracy for all practical purposes.

Sketches were shown of a number of fixtures of simple design intended to fulfil the requirements called for in the paper. No attempt at elaborate ornamentation was made. The distinguishing feature of these fixtures is the length of the drop. Two of them were designed for use with clusters of lamps, and a third for a central cluster surrounded by a number of single lamps, all of these being fitted with reflectors. In the case of the latter the single lamps are inclined outward from the vertical, so as to give a uniform distribution of light through a fairly large area, the angle of inclination being selected to accomplish this result.

The third paper was by F. N. Olcott, entitled "Fixture Location in Residence Lighting." It is pointed out that in the field of residence lighting there is no set of rules which can be followed closely, owing to the different tastes of owners and the great variety of interior decoration. There is, however, a great similarity in average residences. They usually comprise a vestibule, hall, parlor, dining-room, library, bedrooms and less important rooms. Each of these rooms has accepted types of fixtures, which have been developed for meeting the general requirements and the urgencies of mechanical construction, but in the details of design they are unlimited. With the earlier type of fixtures, designed for the use of candles, oil and gas, it was necessary to eliminate, as far as possible, the chance of burning or damaging the ceilings and walls. For this reason the centre fixture was hung as far as possible from the ceiling, and the brackets extended considerably from the wall. These chandeliers and brackets gradually increased in size until they became the most prominent feature in the room, and dwarfed its size. These conditions were regrettable, but were necessary on account of the means of illumination then available. The early practice left the question of illumination entirely to the owner, who could use as many burners on each fixture as he was willing to pay for; and he usually selected the design. Frequently one design would be selected and used throughout the house, merely varying the number of lights, with the exception of the hall, where a lantern was invariably used. Where it was found that the ordinary burner used with such fixtures did not supply light enough, the burner was changed until the desired illumination was secured. The only end sought was to secure as much light from

Digitized by Google

one source as possible. The introduction of electric lighting altered the conditions prevailing with the older types of illuminant. The elimination of smoke, and the danger of an open flame, afforded the opportunity to create lighter and more graceful fixtures and thus the old, heavy type of chandelier is gradually disappearing. The change gives a more pleasant illumination, as it is possible to place the source of light higher. It also increases the apparent size of rooms, and renders the decorations more effective. This is undoubtedly one of the reasons for the popularity of electric lighting as compared with gas.

One of the primary requisites in designing the lighting system of a house is to provide a sufficient number of outlets and to locate these so as to secure effective illumination of the entire room. In locating the controlling switches the convenience of the resident must be borne in mind. These are features which are very frequently neglected by those who draw up the lighting plans, and it is only when the owner undertakes to select his fixtures that the poor design becomes apparent. Then it is usually too late to make any changes without incurring considerable expense. The result is that the owner is forced to put up with an insufficient amount of light, or he must exceed the capacity of his wire, as specified by the underwriters' rules. These defects in design can be easily remedied with a slight increase in cost, if they are brought to the attention of the owner before the work is done. A residence can never be illuminated merely on the principle of so many candle-power to a square foot, as there will always be a necessary waste of light in connection with decoration, and this depends upon the taste of the owner.

The present tendency is to use more wall brackets. These should be distributed around the room so as to overcome all shadows, permit of shading the light, and yet give enough illumination to supplement the ceiling fixture for complete illumination. The various tastes of the owners prevent any generalization of residence fixtures, but the main object should be to have the fixture part of the general scheme of the decoration of the room, and to this end each room should receive its share of attention. The fixture with the light at an angle has practically been done away with in the better residences, on account of the unpleasant effect on the eye. It has been found that a more satisfactory effect is produced with the lights either vertically up or down on both the brackets and ceiling fixtures, as this permits of screening the lamp from the eye by means of a decorative shade. Installing the lamp upward on a bracket has proved to be the most practical method for general use, for then, with the ordinary open glass shade, the lamp is screened from the eye and its light is reflected to the ceiling, thus adding to the general illumination. Regarding the economical side of the question, there seems to be no better solution than to secure an equal distribution of light from lamps of low candle-power properly controlled by switches, so that the owner can use as many or as few as the occasion calls for.

The discussion was opened by Major Zalinski, who laid a good deal of stress upon the importance of securing accurate data on illumination subjects, such as are given in Mr. Millar's paper.

J. H. Hallberg pointed out the obligation upon consulting engineers of providing the desired illumination at the lowest cost to the householder, without considering the effect upon the central station. Within the past few years he has made recommendations in over 200 instances, and has frequently reduced the cost of lighting fifty per cent.

E. Y. Porter said that the use of shades for throwing all the light downward is not necessarily the best practice. When discussing the use of parabolic reflectors it is important to specify the size of the reflector, as this will affect considerably the character of the distribution.

Dr. C. S. Sharp stated that the inverse square law applies to all reflectors, provided the measurements be made far enough away. The extreme case is that of a searchlight, yet even here photometric methods may be applied if the observations be taken at a considerable distance. Such reflectors produce a virtual image back of the source of light, but, on account of the size of the luminous body, the ray thrown out is diverging and comes apparently from the image. Under this extreme case the measurements give not a true, but an apparent, candle-power, and should be so stated in connection with the distance from the source of light at which the measurement was made. For ordinary reflectors the inverse square law gives results sufficiently accurate for illuminating purposes, provided the surface on which the illumination falls be not too close to the source of light.

G. V. Williams called attention to the effect of the shape of the filament on the performance of reflectors. With the newer types of incandescent lamp in which the filament is long, more light will be thrown out horizontally.

Dr. Sharp replied that, on the other hand, a lamp throwing a large amount of light vertically down must necessarily throw a good deal upward on to the base, where it is difficult to catch.

Dr. W. S. Dennett thought that the laws of geometry and optics should be applied to reflectors of the parabolic type. If one may judge from the effect on the eye of a locomotive headlight, certainly these laws seem to hold in actual practice.

Mr. Millar, replying to a question, said that he had asked a number of men experienced in illuminating problems to estimate the increase of illumination which would be given by reflection from the walls of the room used in the experiments described in his paper. As noted there, the increase varies from forty-five to 166 per cent. The estimate of a number of architects varied as follows: fifteen, twenty, thirty-three, twenty-three and fifteen per cent. Three electrical engineers estimated, respectively, 100 per cent, ten per cent and 100 per cent. Two of the latter later revised their figures, but the revision was, in each case, in the wrong direction. A physicist estimated sixty per cent increase, and a fixture manufacturer, thirty per cent. These figures are strong evidence of the necessity for making actual tests of the results achieved in actual practice, for it is apparent that we can not, as yet, anyhow, make any estimates of the effect of reflection which can be depended upon.

Dr. Sharp, replying to Dr. Dennett, emphasized his previous statement with regard to parabolic reflectors. If the measurements be made far enough away, the ray is really diverging, and the inverse square law applies.

E. L. Elliott stated that some years ago he carried out a series of tests to determine the effect of reflectors and found that, much to his surprise, the inverse square law held sufficiently close for all practical purposes, except when measurements were made very close to the lamp.

In closing the discussion, Mr. Millar stated emphatically that no comparisons of the performance of different reflectors should be made from the figures given in his paper, because, as there stated, the conditions under which they were used varied considerably. Regarding the effect of the new types of filament, the distribution curves which these give do not vary much from those of the ordinary carbon filament. It is not wise to stick too close to the law of inverse squares, for this law, in his opinion, does not apply rigidly to certain reflectors.

The meeting was then adjourned.

Digitized by Google

LOCATION OF LAMPS AND ILLUMINATING EFFICIENCY.[1]

BY PRESTON S. MILLAR.

It is the purpose of this paper to consider the relative efficiencies of four different methods of indoor illumination which are in common use to-day, using as a basis precise measurements of the intensity of illumination produced by incandescent electric lamps used with various fixtures variously placed.

Lack of opportunity to carry out a series of tests for incorporation in this paper has made necessary the adaptation to our purpose of tests made at the Electrical Testing Laboratories with other objects in view. The conditions are not in every case just what one might wish, but it is hoped that the results may be of practical value.

The experiments were made in a rectangular room, approximately sixteen feet long by eleven feet wide and twelve and one-half feet high. The ceiling and walls are finished in a light-buff color, the ceiling construction being steel girder and brick arch. The floor is painted light red. There are three windows, one of transparent glass six feet eleven inches high and three feet wide, one of translucent glass five feet six inches high by two feet six inches wide, and one of translucent glass five feet six inches high by two feet three inches wide. Fig. 1 shows the plan of the room and the location of test stations at which measurements of illumination on a horizontal plane three feet above the floor were made. As no other measurements of illumination were made, this study will be confined to the particular plane referred to without any reference to the effect upon the other portions of the room.

In this room lamps have been installed for test purposes at various times as follows:

Ceiling Installation.—Twelve sixteen-candle-power lamps in the ceiling, tip downward, one lamp located directly over each of the twelve illumination test stations, as shown in Fig. 1.

Drop-Cord Installation.—Six sixteen-candle-power lamps on drop-cords, suspended at a height of nine feet above the floor, directly over the illumination test stations Nos. 1, 3, 5, 7, 9 and 11, as in Fig. 1.

Chandelier Installation.—Four sixteen-candle-power lamps at a height of seven feet one inch above the floor, placed in a chandelier suspended in the centre of the room. The arms of this chandelier were approximately one foot six inches long. The lamp axes formed angles of approximately forty-five degrees with the vertical. The chandelier arms were diagonal with the room.

Wall-Bracket Installation.—Four thirty-two candle-power lamps placed upright in wall brackets seven feet above the floor, located symmetrically one on each of the four walls.

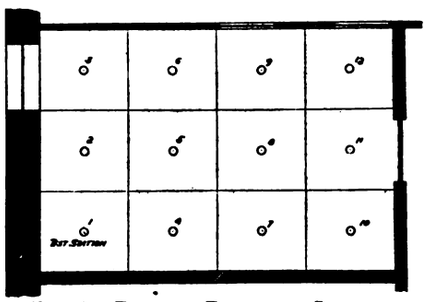


FIG. 1.—PLAN OF ROOM AND LOCATION OF TEST STATIONS.

All of the above lamps were of the oval filament type, and were operated at the voltage at which they gave their rated candle-powers. They were used alone and with reflectors and globes as stated hereafter.

The instrument used to measure the intensity of the illumination was a Weber photometer in which certain important changes were made in order to obviate considerable errors. The illumination was received upon a circular translucent test plate on the upper surface of a box upon the test table. This apparatus bears the following meritorious features which are usually lacking in instruments with which intensity of illumination is measured: Instrument parts, and of necessity, the observer, are below the test plane; there is no objective interference with light coming from any direction; the test plane which does not vary sufficiently from Lambert's law of the cosine to introduce material errors in such tests as those recorded herein; the accuracy of measurement is irrespective of the direction from which light is incident upon the test plate.

In standardizing this instrument, a standard incandescent electric lamp is so placed that its rays will be incident upon the test plate at an angle of thirty degrees. By the application of the formula $E = \frac{I}{D^2} \cos\theta$ the intensity of the illumination so produced upon the test plate is determined. This method of standardizing the instrument does away with any considerable errors due to imperfect diffusing surface of the test plate, when the instrument is used in measuring direct and diffused light of the character used in these tests.

The results of the experiments appear in detail in Table I. In considering these, it should be remembered that no comparisons can be drawn between the reflectors and globes used, since the installations were radically different. Table II shows efficiencies obtained with the various installations and should be considered in connection with Table I. All efficiency values are based upon the numerical averages of the figures representing intensity of illumination at the various test stations as shown in Table I. Such values are assumed to represent properly the mean intensity of illumination throughout the entire plane investigated, because the various test stations are located at the centres of equal areas symmetrically disposed.

TABLE I.

DETAILS OF ILLUMINATION PROVIDED BY VARIOUS INSTALLATIONS OF LAMPS.

Type of lamp	16-cp. Oval Filament	16-cp. Oval Fil'm't		16-cp. Oval Filament			32-cp Ov. Fil'ment	
No. lamps Installed	12 Ceiling	6 Drop Cords 6 ft.		4 Chandelier 4 ft. 1 in.			4 Wall Brackets 4 ft.	
Height above plane	9 ft. 2 in.							
Auxiliaries	None	None	No. 90 I. E. Co. Coated Refl.	None	7½-in. Opal Refl.	No. 2623 Holophane Refl.	None	No. 2905 Holophane Gl. (Sp'l)
Test Station No.	Lux.	Lux.	Lux.	Lux.	Lux.	Lux.	Lux.	Lux.
1	17.3	13.0	21.2	8.0	8.3	8.2	14.8	13.9
2	19.9	14.8	19.5	10.3	10.2	10.2	14.1	19.9
3	19.1	13.4	21.0	8.1	8.3	9.3	14.7	12.8
4	22.6	15.3	21.1	16.4	20.5	26.8	19.2	22.2
5	24.0	16.1	24.1	28.2	37.7	32.1	18.1	19.5
6	22.3	15.8	22.6	15.8	19.1	21.4	19.2	18.2
7	22.6	13.6	21.6	14.6	16.6	25.6	19.9	18.1
8	25.6	17.5	24.5	25.4	31.5	32.6	17.2	18.3
9	23.4	15.3	24.3	15.7	20.1	18.2	19.3	16.5
10	19.9	13.1	17.6	7.9	7.2	7.8	14.6	13.3
11	23.1	15.5	23.0	9.7	9.2	8.8	14.4	18.6
12	21.7	14.6	19.5	8.4	7.8	8.9	14.6	12.3
Average	21.8	14.8	21.7	14.0	16.4	17.5	16.7	17.0

The three large factors to be considered in determining the total efficiency of electric lighting are: The efficiency with which the energy is generated and trans-

[1] Abstract of a paper presented before the Illuminating Engineering Society, November 9.

Digitized by Google

mitted, the efficiency with which the light is produced, and the efficiency with which the light is utilized. With the last two the illuminating engineer is intimately concerned. As respects a particular light-

TABLE II.

SHOWING EFFICIENCY OF ILLUMINATION—CONDITIONS.

No. of lamps	12	6		4			4	
Cp. of lamps	16	16		16			32	
Watts per candle	3.1	3.1		3.1			3.1	
Installed	Ceiling	Drop Cords		Chandelier			Wall Brackets	
Height above plane	9 ft. 2 in.	6 ft.		4 ft. 1 in.			4 ft.	
Auxiliaries	None	None	No. 90 I. E. Co. Coated Refl.	None	7¼-in. Opal Refl.	No. 2623 Holophane Refl.	None	No. 2095 Holophane Gl. (Sp'l)
EFFICIENCY.								
Average lux per cp.	0.114	0.154	0.226	0.219	0.256	0.273	0.130	0.133
Lumen	0.0109	0.0148	0.0217	0.021	0.0246	0.0262	0.0125	0.0127
Watt	0.0364	0 0496	0.0728	0.0707	0.0828	0.0883	0.0421	0.0428
Square ft. floor space	0.124	0.084	0.123	0.079	0.093	0.099	0.095	0.097
Cubic ft	0.0099	0.0067	0.0098	0.0064	0.0074	0.0079	0.0076	0.0077
Cubic ft. above plane	0.0130	0.0089	0.0129	0.0084	0 0098	0.0105	0.0099	0.0102
UNIFORMITY.								
Av. var. from mean	8.3%	7.4%	7.8%	37.8%	48.2%	49.1%	12.5%	15.9%
Range in intensity of illumination	−20.6% to +17.4%	−12.2% to +18.2%	−18.9% to +12.9%	−43.5% to +101.5%	−56.1% to +129.9%	−52.5% to +86.4%	−15.6% to +16.1%	−27.6% to +30.6%

ing installation, the efficiency of the lamps as illuminators may be expressed in "lux per watt." Separate and distinct from this is the term "lux per lumen" which expresses the efficiency of the illumination irrespective of the efficiency of the lamps. Both are of use, but have not necessarily any definite mutual relation. The "lux per lumen," being the ratio of the illumination to the flux of light, depend largely upon the location of the lamps, the nature of their distribution of luminous intensity and the nature of the surroundings. The "lux per watt" being the ratio between the illumination and the power absorbed, depend upon all the conditions which determine the "lux per lumen," but in addition are a function of the efficiency of the lamps. The other expressions such as "lux per candle-power" and "lux per square foot of floor space" are frequently used in practice.

One of the important features of the data presented in Table II is the increased efficiency of illumination due to the use of reflectors in the drop-cord installation, where a gain of forty-six per cent in intensity of illumination is made. The reflectors used in the chandelier installation are not so effective, the opal reflectors increasing the illumination seventeen per cent, and the prismatic reflectors twenty-five per cent. The smaller increase in illumination here observed is not chargeable to the nature of the reflectors, but is due rather to the fact that they are used to make the chandelier look complete rather than to improve the illumination.

The Holophane globes used in the wall-bracket installation were of the combination type with reflecting prisms on the side nearest the wall and diffusing ribbings with directing prisms on the other side. Through a misunderstanding these globes, which are designed to direct the major portion of the light toward a zone slightly below the horizontal, were submitted for test when globes calculated to provide the best illumination at an angle of forty-five degrees were prescribed. Failure to produce any material improvement in illumination with these globes should, therefore, be attributed to the fact that they directed a great portion of the light toward the opposite wall rather than toward the plane to be illuminated.

In considering the effect of the position of the lamps upon the efficiency of the illumination, only the bare lamp installations have been taken into account. The efficiency secured from each installation is as follows:

TABLE III.

Installation.	Position of Lamps.	Height Above Plane Investig.	Eff. of Ill. in Terms of Ceiling Lamps.
Ceiling	Pendant	9 ft. 2 in.	100%
Wall bracket	Upright	4 ft.	115%
Drop cord	Pendant	6 ft.	136%
Chandelier	Axis 45° to vertical	4 ft. 1 in.	194%

Considered from the standpoint of uniformity of lighting, a fair state of affairs will be found except with the lighting by the chandelier installation. Here we find characteristic lack of uniformity which is somewhat increased by the use of both opal and prismatic reflectors.

Considering the part which the walls and ceiling play in the illumination of this horizontal plane, the installations of lamps without reflectors will be considered.

The horizontal illumination produced by each lamp in a given installation at the point where each of the twelve test stations is located has been carefully computed, taking into consideration the candle-power which each lamp delivers in that particular direction, the distance of the test station from the lamp, and the angle at which the rays of light are incident upon the horizontal plane. The sum of these values at a particular test station is taken as the intensity of illumination produced by the lamps directly. The difference between the total illumination measured as shown in Table I, and the illumination produced by the lamps directly, is due to light reflected from the walls and ceilings. Table IV sets forth the data so obtained. This table shows the very great influence which the location of the lamps in this installation has upon the illuminating efficiency. With all other conditions constant, different locations of the lamps vary the reinforcing effect of the ceiling and walls throughout a range of from forty-five to 166 per cent. It will be apparent at once that in a room such as that described the factor K is a variable.

TABLE IV.

AVERAGE INTENSITY OF ILLUMINATION AT TWELVE TEST STATIONS.

Installation.	Direct Illumination from Lamps (Computed).	Total Illumination (Measured).	Per Cent Increase Due to Diffuse Reflection.	K.
Ceiling	8.5 Lux.	22.5 Lux.	166%	0.62
Drop cords	7.0	14.8	113%	0.53
Chandelier	8.9	14.0	69%	0.36
Wall brackets	11.6	16.7	45%	0.31

NOTE—K is factor for wall reflection which appears in the formula $E = e\left(\frac{1}{1-K}\right)$

Conclusions as to the reflecting efficiency of walls and ceiling are based upon data obtained from the ceiling, drop-cord and wall-bracket installations with bare lamps. The total flux of light from bare lamps used in each installation has been analyzed to determine the total lumens which provide the direct lighting on the plane under consideration, and the total lumens which fall upon the ceiling and walls above the plane. This yields the interesting information that only from five to ten per cent of the total light emanating from the lamps goes toward the direct illumination of the plane. In the case of the drop-cord installation,

Digitized by Google

eight per cent of the light is effective in this manner, while ninety-two per cent is directed toward the ceiling and walls above the plane. After more or less multiple diffuse reflection the portion of the latter, which is not absorbed, finally assists in the illumination of the plane. This ninety-two per cent, if directed at the plane, would have increased its illumination by about 1,150 per cent. The portion of it which finally reaches the plane increases the illumination by about 113 per cent. Each lumen which might have produced 0.09 lux now produces 0.008 lux. Ninety per cent of the light which falls upon the ceiling and walls, or eighty-three per cent of the total light generation is absorbed by the ceiling and walls.

TABLE V.

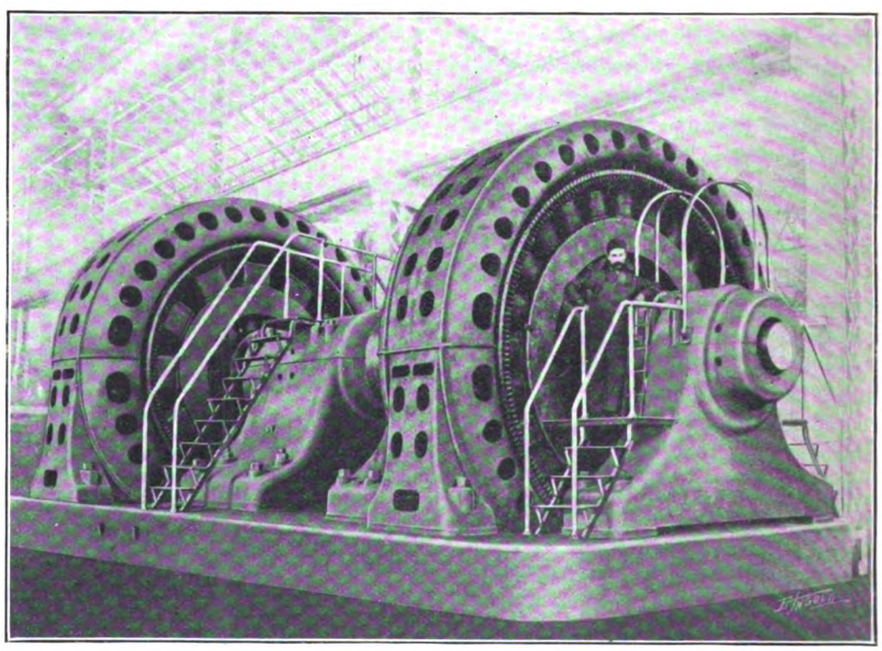
	Installation. Ceiling.	Drop Cords.	Wall Bracket.
Total lumens	2003.	1001.	1335.
Lumens falling directly on plane	94.	80.	119.
Per cent	4.7	8.	8.9
Illumination by direct light			
Lux	8.5	7.0	11.6
Lux per lumen	0.090	0.088	0.097
Illumination by reflected light			
Lux	14.0	7.8	5.1
Lux per lumen	0.0073	0.0084	0.0042
"Efficiency" of walls	8.1%	9.7%	4.3%

For the purpose of this discussion, the efficiency of the direct lighting on the plane investigated will be considered as 100 per cent. The net efficiency of the ceiling and walls being considered the ratio between the lumens which they deliver upon the plane (as judged by the illumination which they produce) and the total lumens directed toward them from the lamps is, in the case of the drop-cord installation, 9.7 per cent. The foregoing information with similar data for the ceiling and wall-bracket installations appear in Table V, which shows that the wall-bracket installation secures a larger proportion of direct lighting than do the other installations, but it shows, on the other hand, that the light which is directed toward the ceiling and walls from the wall-bracket installation is more largely absorbed before reaching the plane to be illuminated than the light falling upon the ceiling and walls from the other installations. This is probably due to the fact that the general trend of the bulk of the reflected light from these lamps is along the walls horizontally, while with the ceiling and drop-cord installations the general trend of such reflected light is downward toward the plane to be illuminated.

At a meeting held by the committee of the Rapid Transit Railroad Commissioners of New York city this week a letter was read from the banking firm of J. S. Bache & Company, New York, expressing its willingness to raise part of the capital necessary to build a monorail traction system between Brooklyn and Coney Island upon the plans outlined by F. B. Behr.

Testing Alternating-Current Apparatus.

The 8,000-horse-power frequency changer recently installed by the Shawinigan Water and Power Company at its Montreal terminal is noteworthy, not only on account of its large size, but because of the exceptionally high efficiency of transformation secured. This unit, which was built by the Allis-Chalmers Company, Milwaukee, Wis., transforms energy from thirty to sixty cycles. A feature of particular interest in connection with this machine is the method adopted for testing it under full-load conditions while in the shop. Very often it is impossible with such large units to make a test under full-load conditions unless some method of circulating the power employed be devised.



8,000-Horse-Power Frequency-Changer Installed at the Shawinigan Water and Power Company's Terminal Station, Montreal, Canada.

The earliest of these methods was that devised by Hopkinson for testing direct-current machines. This method may be applied to alternating machines, and has the advantage that two machines only are required, and full-load conditions may be obtained by circulating large amounts of apparent energy in the form of so-called wattless currents, the true energy supplied to the system being only that necessary to overcome the internal losses. These tests are conducted by connecting two alternating-current machines in parallel and then controlling the excitation of the two so as to obtain the desired current in the armatures. The objection to this motor-generator test is that it requires two machines of practically the same output, and therefore can not be applied to the test of a single machine.

To get around this difficulty a method was devised by W. M. Mordey, which was described by him in a paper presented before the Institution of Electrical Engineers, of Great Britain, in 1893. This method consists in reversing the connections of a certain number of poles of the generator; for example, the field of a machine having twenty poles could be split into two sections of twelve and eight, respectively. That section of the armature under the group of twelve poles would act as a generator, driving the current against the electromotive-force set up under the group of eight poles, so that this section of the armature would act as a motor. This is, of course, simply a modification of Hopkinson's method, but, due to the peculiarities of alternators, it is possible to have one armature act in two senses. The current which circulates under these conditions is almost in quadrature with the resultant electromotive-force, and it is therefore practically wattless. A difficulty met in such tests is that the eight poles of the motor section of the machine are strengthened by the armature current, while the twelve poles of the gen-

Digitized by Google

erator section are weakened. This leads to an unbalanced magnetic condition, as the motor fields carry a greater resultant flux than do the generator fields. With machines having no iron in the armature, as was true of Mordey's generator, this condition may not give trouble; but for modern machines it is not satisfactory. Instead of dividing the armature into two sections and connecting these in opposition, it is possible to split the field into two sections and connect these so that the electromotive-forces induced in the armature are in opposition; but when this method is put into practice it is found that the machine under test vibrates so greatly as to make its operation impossible.

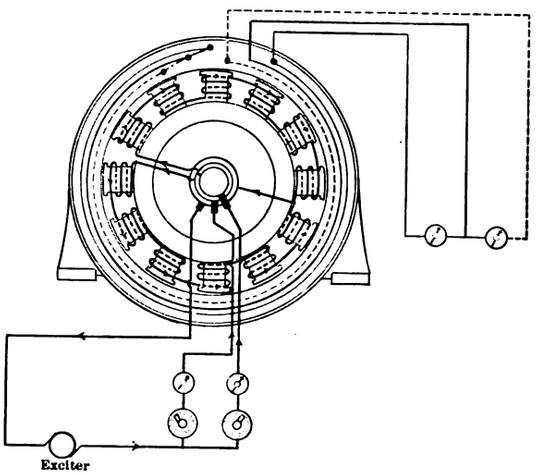


FIG. 1.—BEHREND'S COMBINATION OF FIELD COILS FOR CIRCULATING POWER.

To overcome the objection to Mordey's method—the unbalanced magnetic condition—it is necessary to obtain uniform induction in the air-gap of both motor and generator poles. As the armature reaction strengthens the motor poles and weakens the generator poles when the load is inductive, it follows that the impressed excitation of the motor poles must be less than that of the generator poles, and this can be secured by the method shown diagrammatically in Fig. 1. Here the field coils are split into two equal sets, each set being excited by its own current. This is the method of testing which has been used so successfully by B. A. Behrend, chief electrical engineer of the Allis-Chalmers Company. Fig. 2 shows the effect of the armature reactions upon the poles when this method of testing is employed. The line A represents the field produced by the armature current alone, while the line B represents the resultant magnetic field.

When employing this test it is possible to obtain accurate regulation curves for the generator. Fig. 3 gives regulation curves obtained from a generator by the Behrend method, in comparison with similar curves obtained from the same generator operating on the motor-generator test. The satisfactory agreement between the two methods is apparent. Mr. Behrend has made numerous tests of his method to check it, and has found that the results obtained are always satisfactory. The terminal voltage corresponding to the conditions under which the machine is operating may be determined by measuring the volts across a set of coils per pole, and multiplying this by the number of sets of coils, or by adding to the excitation of the motor fields the excitation required to drive the armature current through the armature winding. Both methods give the same results.

The one drawback to the Behrend method consists in the fact that it is applicable only to machines having a comparatively large number of poles. It has not been applied successfully to machines having fewer than eight poles. The method is confined to machines of the slow-speed type, and this condition calls attention again to the need of devising some method of testing the new type of high-speed generator designed for the steam turbine drive under artificially produced full-load conditions, without the expenditure of full-load energy.

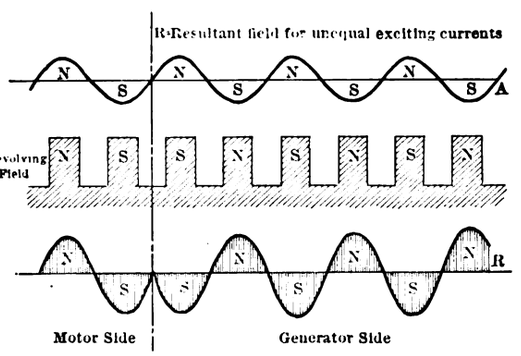


FIG. 2.—DIAGRAM, SHOWING EFFECTS OF ARMATURE CURRENTS IN BEHREND'S SPLIT-FIELD TEST.

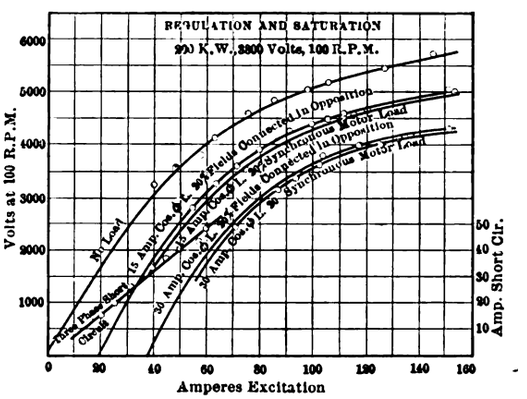


FIG. 3.—COMPARISON BETWEEN REGULATION CURVES OBTAINED BY SYNCHRONOUS MOTOR-GENERATOR TEST AND BY BEHREND METHOD.

Manchester (England) Section of the Institution of Electrical Engineers.

The first meeting of the season of the Manchester (England) section of the Institution of Electrical Engineers will be held in the Banqueting Hall, Midland Hotel, Tuesday evening, November 20. Chairman I. L. Miller will deliver the annual address, at the close of which a smoking concert will be held.

A fine programme of papers has been arranged for subsequent meetings, which will be held in the physical laboratory of the University of Manchester.

The annual dinner will be held on February 22, 1907.

Northwestern Electrical Association.

The next annual meeting of the Northwestern Electrical Association will be held in Chicago, Ill., at the Coliseum Building, January 16, 17 and 18, 1907.

This meeting is being held at the time of the electrical show with the belief that it will be to the advantage of the electrical show people and to the association.

Digitized by Google

The Reflection and Transmission of Electric Waves by Screens of Resonators and by Grids.

Experiments were suggested by E. F. Nichols, with a view of studying more completely than hitherto the passage of electric waves through systems of linear resonators. The work was undertaken by F. C. Blake and C. R. Fountain, who here give the results of the investigation. The vibrator employed was of the Righi type, which is placed in the focal line of a cylindrical parabolic mirror. It consisted of two brass balls, each a little less than one centimetre in diameter, cemented into the ends of glass tubes and submerged in olive oil. Two auxiliary smaller spheres fused to the ends of the lead-in wires were lowered into the tubes so as to approach the main spheres. One of the objections to this apparatus was the necessity of removing the spheres every little while in order to adjust them and remove roughness caused by the discharge. It was, however, found possible to conduct an entire experiment without dismantling the vibrator, and thus obtain concordant results. The receiver was of the Klemencic type, consisting of a number of small thermo-couples made up of iron and constantan wires. In order to check the results of the work a check receiver was placed directly in front of the vibrating system. Studies were made of the energy transmitted and reflected by various systems of resonators in a plane, both in air and on glass. Readings were taken as the length of the radiators was changed, and as their distances apart were varied. In some cases it was found that the system of resonators transmitted more and reflected less energy than did the glass plate when bare, the resonators in this case consisting of strips of tinfoil attached to glass plates. The general conclusions reached are that for a system of linear resonators the length for maximum resonance is, within fairly wide limits, independent of the distance apart of resonators in a direction parallel to the electric force, but varies in an inverse manner with the distance between resonators in a direction perpendicular to the electric force; that the mutual influence between resonators at side-on distances greater than the wavelength of the incident radiation ceases to affect the length of maximum resonance appreciably; that the resonator length for maximum resonance depends upon the dielectric properties of the plate to which the resonators are attached; that secondary resonance maxima occur only at odd multiples of the fundamental resonating length; that neither the Hertz-Poincaré nor the MacDonald ratio for the quotient of wavelength by resonator length holds for a uniform linear resonator; that certain systems of resonators transmit more energy than the glass plate upon which they are mounted does when bare; that it is possible to increase the reflection from a grid of very long strips any distance apart by cutting them up into lengths equal to the resonance length for that distance, and that the distance apart of fine wires in a grid, to be perfectly opaque to electric waves when the wires are parallel to the electric force, should be of the order of one-fortieth of the wavelength. When they are a distance apart equal to four-fifths of the length, the same wires transmit practically all the incident radiation.—*Abstracted from the Physical Review (Lancaster), October.*

An Interesting Use of the Telephone.

Two novel uses of the telephone are given in the *American Telephone Journal* for November 3. During the past summer public entertainments have been given in Riverview Park, Chicago, which is one of the largest of its kind in the United States. One of the novel features of these entertainments was the placing of telephone receivers attached to horns in several of the trees in different parts of the park. During the entertainment, music produced on a piano, a cornet, or songs was reproduced by these telephones, much to the mystification of the audience. This effect was made possible by means of the powerful transmitter devised by the International Telephone Manufacturing Company, of Chicago, known as the "Transmitophone." The soloist who gave the selection was located out of sight and was able to keep in time with the accompaniment of the orchestra by means of a special receiving circuit.

The other interesting use of the telephone was in reporting the Michigan-Ohio State football game. Two bare wires were stretched across the field, and a small trolley arranged to run on them. To this trolley was attached a portable telephone set, which was used by the reporter, who followed the progress of the ball along the field. This circuit was connected with the Ann Arbor (Mich.) exchange, and through it to the University of Michigan. In this way the progress of the game was followed at Ann Arbor almost as closely as it was on the field where it was played.

Music by Electricity.

At a dinner of the directors of the Telharmonium Company, held at the Café Martin, Broadway and Twenty-sixth street, New York city, last week, a notable stage in the development of Dr. Thaddeus Cahill's invention, the Telharmonium, was witnessed. The dining room in which the guests were assembled was over a mile away from the Thirty-ninth street central music station. This is the first transmission of this music since the original plant at Thirty-ninth street was installed. A number of striking pieces of music were rendered, and it was evident that within the last six months remarkable progress has been made in the development of this apparatus.

The decision to give this demonstration was reached only on the afternoon of the day of the dinner. The necessary circuits were completed in two hours. A two-pair cable was run from the Thirty-ninth street plant to the Thirty-eighth street exchange of the New York Telephone Company. From there two pairs of the telephone company's spare cables, leading into a manhole on Fifth avenue at the corner of Twenty-sixth street, were tapped. From this manhole a two-pair cable was run through the telephone conduit into the basement of an apartment next door to the restaurant. From this point the cable was carried up the elevator shaft as far as the sixth floor, then a room was crossed to the fire-escape, and the cable taken over the roof of the café three stories higher and direct down to the dining room on the second floor, where it was connected to two telephone receivers. When the line was tested with a one-to-two transformation it gave about thirty volts, and the music was much too loud for the room. Finally the ratio was changed to one to one and one-half, giving an average voltage of twenty, and a volume of sound exactly suited to the room.

Gold Medal for the Brooklyn Rapid Transit Company.

It is announced that the Brooklyn Rapid Transit Company, Brooklyn, N. Y., has been awarded a gold medal for the company's sociological exhibit at the Milan (Italy) Exposition. The exhibit consisted principally of pictures of the trainmen's clubhouse in East New York, of the Brooklyn Rapid Transit's brass band, and of the different processes of training men to handle surface and elevated cars. There were also a few models of railroad equipment.

Digitized by Google

Street Opening Stopped in New York City.

The Appellate Division of the Supreme Court has affirmed the decision in Special Term, refusing to grant to the New York Electric Lines Company a mandamus directing the commissioner of water supply, gas and electricity to issue a permit to the company authorizing it to open up the streets of New York city and lay new conduits and ducts for electric wires for telephones, telegraph and other purposes. In the court's opinion the history of the company is reviewed. The company got a franchise many years ago, and was also granted special privileges in 1883 by the common council of New York city, authorizing it to lay conduits and wires; but nothing was ever done under that authority, and the city officials considered it to have lapsed from non-usage. In December, 1905, the company made a demand for permits to open the streets, which was refused, and the mandamus proceedings were then begun.

The court holds that the failure of the company to have its plans approved by the board of electrical control or the successors of this board would necessarily deprive it of any rights under the original privileges granted to it, which were contingent upon such approval; but, furthermore, the company's rights have lapsed under an act of the legislature passed in 1885, which made it necessary for any company proposing to lay conduits and electric wires to obtain official approval of its plans within sixty days of the passage of the act.

In connection with the agitation that is now under way to secure franchises for an independent telephone system in New York city, the application of the United States Automatic Telephone Company for a franchise to maintain a system was denied on the advice of the corporation counsel, as the company was not a corporation. Permission was given the company to renew the application when properly incorporated.

Turbine Water-Wheel Tests.

A paper of unusual interest to engineers and users of water power is a compilation of turbine water-wheel tests and power tables that has been issued by the United States Geological Survey as Water-Supply Paper No. 180. The results of tests of McCormick, Hercules, Samson, Swain and other modern wheels by the Holyoke Power Company serve as a basis for the bulk of the data, but other tests and manufacturers' tables have been utilized whenever available.

One object of the paper has been to furnish information required in measuring the flow of streams where the turbine is used as a water meter. The paper contains rating tables and the results of tests of different makes of turbines with register, pivot, or cylindrical gates, so that the power developed at the mills and the quantity of water used can be determined from the size and type of the wheels. As the water rights of mills can often be definitely ascertained only from the quantity of water used, and as some of the wheels are no longer built or catalogued, the records of tests of the older types will be of great value to engineers who may be required to determine questions of water rights. The paper contains also a clear presentation of the evolution of the different types of turbines, all available data relative to the efficiency of the wheels and the power developed, a description of the best methods of turbine setting and arrangement, and a discussion of the conditions that govern the economy in size and number of turbines used.

This paper, which may be obtained on application to the Director of the United States Geological Survey, Washington, D. C., is probably the only published compilation of such data.

Communication from the Secretary of the American Electrochemical Society.

The following communication has been received, with the request that it be published:

To the Members of the American Electrochemical Society:

The secretary desires to lay before the membership of the society a matter that has given him some thought for months past. Although the duties of the office of secretary have been very congenial to him, and the acquaintances and friendships made while occupying the post very greatly appreciated, he feels that he will have to decline to be a candidate for re-election at the next annual meeting. To do the work justice requires constant thought as well as work, and the growing demands of his professional business are now pressing for more of his time than is available under the present arrangement.

He thought it best, therefore, to give this timely notice that the members might find some one for the position who could keep in touch more constantly and thoroughly with the lines of research and industrial development in the field of electrochemistry. In this way the high standard of the transactions and membership may be kept up and the wellbeing of the society in general promoted.

Respectfully,
Samuel S. Sadtler,
Secretary.

The Western Electric Company.

The growth of the business of the Western Electric Company, Chicago, Ill., says the *Wall Street Journal,* affords a most accurate standard by which to measure the telephone development of the United States. The Western Electric Company is the manufacturing concern which outputs the huge bulk of telephone apparatus used by the Bell companies all over the country. The total gross sales for 1906 will amount, in round figures, to $70,000,000, or slightly less than $6,000,000 gross business per month. Last year the gross sales of the Western Electric Company were $44,145,753. Ten years ago the gross business of the company was only $8,775,368.

The increase in ten years is equivalent to a gain of 762 per cent. The company was formed in 1881, and the first year for which sales for a full year were published was in 1884. The gross business booked for that year was $1,534,784.

The remarkable thing about the Western Electric Company is the volume of business which it is doing on its capitalization. With $15,000,000 of stock issued it is obliged to turn its capital over four and two-third times yearly to handle a business of $70,000,000.

Advancing Market in Electrical Apparatus and Supplies.

Prices in the electrical trade continue to show a distinct upward tendency in sympathy with the well-maintained advance which has taken place in the prices of all raw materials. Orders for future delivery can only be placed in many instances at a considerable advance over present market quotations.

The General Electric Company, in common with many other large manufacturing concerns, is announcing a general advance in prices of electrical apparatus and supplies. This will not unlikely be followed by further advances if present market conditions continue.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Single-Phase Railway at the Milan Exposition.

A short description is given here of the single-phase elevated railway which was in operation at the international exposition of transportation materials held in Milan, Italy, during the present year. The exposition was divided into two sections, separated by some distance, and connected by means of an elevated railway about 4,000 feet long. The trains were made up of four cars, the end cars being equipped with two motors each, and the intermediate cars with one motor each. These were connected up with the two motors of one end car and the one motor of its adjacent car in series, thus forming two groups connected in parallel. These connections were not changed, and the system was controlled by varying the applied voltage by means of a multiple-voltage transformer. The voltage applied to the motors varied from 150 to 300 volts. The voltage of the line was 2,000. The motors were of the Finzi type, rated at thirty horse-power for a one-hour continuous run. They were operated at a frequency of twenty-five cycles, 750 revolutions per minute, and gave a velocity of about twenty-five miles an hour. The track contained a number of grades, some being three and one-half per cent. There were also some rather sharp curves. Power was supplied for the system from the Milan Edison Company's plant, and was transformed to twenty-five cycles, 2,000 volts, by means of a 600-horse-power motor-generator taking current at 3,600 volts, forty-two cycles. The substation contained, in addition, a 500-horse-power, gas-engine-driven unit and two other units, one for exciting purposes and the other for charging a storage battery. The current was transformed down from 2,000 volts by means of two transformers on the train, each rated at eighty kilovolt-amperes. This is the first single-phase electric railroad to be put in operation in Italy.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), October* 11.

Radium and Geology.

Some discussion has been going on recently which has been noted in these columns, due to the suggestion of R. J. Strutt that the data showing the radioactivity of the materials of the earth's crust would not only account for the heat radiated by the earth, but, if this radiated heat be actually due to the disintegration of radium, the latter substance must be confined to a comparatively thin layer at the surface. It is suggested here by J. Joly that if a probable reason could be advanced why uranium should disintegrate more rapidly near the surface than at greater depths, there would be no need to limit the radium to a shallow layer, and that the difficulty of restricting the heavy element uranium to the surface would in this way be avoided. Such a reconciliation of observed facts with probabilities may be found in the view that the breaking-up of uranium is not wholly spontaneous, but is partly secondary in character; that disruption of an α particle from an unstable atom may precipitate the failure of neighboring atoms. This method of disintegration has been suggested with regard to radium by J. J. Thomson. Should it be the case it might be assumed that uranium is, in general, distributed in random aggregates throughout the earth. This being the case, the lighter constituents in the outer crust of the earth—aluminum, silicon and oxygen—exert a lesser screening action than the heavy metals deeper down. Thus the conflagration is isolated where the heavier metals interpose to absorb the energy of the α ray which initiates the changes leading to radium. It is probable that if the disruption be adequate to reduce the kinetic energy below a certain critical amount, there will be no propagation of disruption. The mere fact observed by Strutt that radium is more abundant in the heavier silicates than in the lighter, is not opposed to this view, but rather in keeping with it; and the absence of detectable radium in metallic meteorites need not be occasioned by the absence of uranium, but by the slower breakdown of the latter. Cosmical effects of the greatest interest are involved in this controversy, therefore the question of how far radioactive effects are spontaneous deserves full investigation. If these be found dependent on the matrix and on concentration, entirely new considerations arise. It is not impossible, in the present meagre state of our knowledge, that the penetrating radiations observed at the surface of the earth have to do with the genesis of radium from uranium, the failure of such rays to penetrate deep into the crust limiting the production.—*Abstracted from Nature (London), October* 25.

Modern Electrical Illuminants.

After passing in review briefly the newer types of electric lamps, J. S. Dow takes up some of the secondary effects of the introduction of these lamps. One of these is the possibility that with the greatly reduced current required by the new lamps that the size of the supply leads may be limited only by temperature considerations. It is pointed out that in the case of sunlight, presumably as a consequence of the enormous temperature of the sun, the maximum energy curve of the spectrum lies in the neighborhood of yellow-orange light. It has been shown that the luminosity of the spectrum of sunlight is also a maximum about this point, and the maximum efficiency—that is, the maximum illuminating effect with a given amount of energy—will be obtained at the same point. The conclusion is that our eyes have adapted themselves to the most efficient use of natural light—daylight. To this effect it is thought that part, at least, of the luminous efficiency of flame arcs may be attributed, as these arcs are strongly yellow in color. Yellowish light gives the most efficient results, and to produce a corresponding visual effect for rays of a different color more energy is required. Another consideration which affects the choice of color is the fact that the rays of greater wave-length appear to penetrate the atmosphere best. The weakness of the arc-light spectrum in red rays no doubt accounts for the unsuitability of these lights in a fog. For this reason the old white arc lamps used in the lighthouses at the Lizard and elsewhere have been replaced by incandescent gas lights, but it has been suggested that the new yellow flame arcs would be more suitable. There are two theoretical methods of producing light which appeal particularly to the imagination. A very considerable number of substances have phosphorescent properties. After having

Digitized by Google

been exposed to the light they emit light in the dark for a considerable time afterwards. It has been suggested that a frieze encircling the room to be illuminated might be painted with one of these substances, and would then absorb radiate energy during the day, to give it out again in a luminous form by night. This method presents no inherent impossibility, but no suitable substance is yet known. The other method is to produce light waves direct by an electrical method. Hertzian electromagnetic waves are believed to be of the same nature as light waves, except for their greater wavelength and lower frequency. The frequency of the longest visible wave-length of light is of the order of 400 by 10^{12}, and it is not easy to see how waves of this frequency can be produced electrically. Duddell has constructed an alternator which gives a frequency of 120,000, but the difficulties met with in its construction do not encourage the expectation of an alternator with a frequency of 400 by 10^{12}. Electrical waves are produced by the oscillatory discharge of a condenser through a resonant circuit. The frequency is determined by the inductance and the capacity, but to get a frequency of the order named would require the circuit to be reduced nearly to atomic dimensions.—*Abstracted from the Electrical Engineer (London), October 26.*

The Conductivity of Air in an Intense Electric Field, and the Siemens Ozone Generator.

In connection with the study of the electrical production of ozone, A. W. Ewell found it desirable to obtain some additional information regarding the electrical conductivity of air self-ionized in a strong electric field. One of the difficulties met with in such investigations is caused by the breaking down of the dielectric by the formation of a spark discharge. This is easily brought about as the breakdown potential is approached because of the difficulty of preventing discharges from taking place at the edges of the electrodes, or from small irregularities of the surface. This difficulty was got around by placing a sheet of glass, larger than the two electrodes, between them. The glass successfully prevented the formation of an arc. As the electrodes were heated considerably by the discharge, water jackets were placed behind them. To obtain a uniform field in the area studied, one electrode was made smaller than the other and surrounded by a guard ring insulated from it, but maintained at the same potential. The current through the section of area under investigation was read by measuring the fall of potential across a non-inductive resistance placed in series with it. Under the alternating difference of potential between the electrodes, displacement currents traversed air and glass, and when a certain difference of potential was exceeded, depending upon the distance between the electrodes, the air was ionized, and a conduction current was established in it. The displacement currents follow well-known laws, and it is the currents transported by the ions in the air and the electromotive-force applied to the air which are of interest. The displacement current in the air is a quarter of a period in advance of the electromotive-force, and the ionization current is in phase with the electromotive-force. The current in the glass will be a displacement current equal to the vectorial sum of the two currents in the air. The results of a large number of observations are given, curves being plotted from the data thus obtained. These show that as the ionization current in the air increases, the electromotive-force necessary to maintain the current decreases, and that as the current increases, the curves for different distances apart of the electrodes approach each other. The latter result may be explained by the compensation of the reduction of an electric force when the electrodes are separated by the increased volume in which the ionization occurs. The first result shows that when the current is increased beyond the values represented by the familiar lower portions of the curves, the air, under normal conditions, exhibits so-called negative resistance, which has hitherto been demonstrated only under the special conditions of high temperature and low pressure. Curves obtained for the power absorbed show that this does not increase proportionally with increasing distance or current, and is independent of the thickness of the glass. The effect of temperature was studied, and it was found that within the range available—from five to sixty-three degrees—that it had little influence except upon the dielectric constant. Although an alternating electromotive-force was employed for making the tests, the character of the wave could not affect qualitatively the main results, and the general conclusion is drawn that for air at ordinary temperature and pressure, as the current carried through the air by ions increases, the required electromotive-force slowly increases to a maximum, and then decreases and tends to become independent of the thickness of air. For alternating electromotive-forces of approximate sine form, quantitative results have thus been obtained which make possible the calculation of Siemens ozonizers.—*Abstracted from the American Journal of Science (New Haven), November.*

The Preservation of Wooden Ties and Poles.

The firm of Himmelsbach Frères, of Fribourg, Baden, has been conducting a large number of tests on methods of preserving wood, particularly for use as railway ties. This company has furnished 20,000 wooden ties impregnated with coal tar for the railway through the Simplon tunnel, and has obtained fairly good results with this process of preservation. The method employed consists in passing the ties into hermetically sealed ovens, where they are heated and the air exhausted until the pressure falls to twenty-four inches of mercury or less. Ten minutes afterwards the coal tar, previously heated, is introduced, the exhaustion within the oven being maintained during this time. The oven is then maintained at a temperature of about 105 degrees centigrade by means of a steam coil placed in or beneath it. Heating continues for four hours, after which the air pressure is increased until it reaches two atmospheres. Practically the same process is followed in treating pins and other wooden articles. This method, while not difficult, is not as simple as another now being tried, and known as kyanization. It depends upon the antiseptic properties of bichloride of mercury. It has been shown that a solution containing one part of bichloride of mercury to 10,000,000 of water arrests the development of microorganisms, and one part in 3,000,000 suppresses them. The process consists in preparing a two or three per cent solution of the bichloride of mercury in water in large vats of concrete. The wood to be treated is plunged into these vats and allowed to rest there for some time. Chemical tests of wood thus treated show but a slight penetration of the solution. It seems to be limited to the exterior surface, but as the preserving action of this treatment lasts for a considerable time, it is possible that the penetration is really considerably deeper, and although too dilute to be indicated by chemical tests, yet it is sufficient to prevent decay. This process was used some years ago, and a table is given showing the results obtained on various railways. On some of these roads poles treated in this way were erected in 1877, of which from thirty to thirty-eight per cent were in use in 1903. Poles erected in 1883 to 1886 had from eighty-two to ninety-seven per cent still in service. Of poles erected in 1891 and 1892 all are still in good condition. The postal and telegraphic department of Bavaria has had poles treated with bichloride of mercury in service for thirty years, and has found from statistics that the average life of such poles is seventeen and one-half years.—*Translated and abstracted from Electro (Brussels), October.*

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

MAY THE CENTRAL STATION IN THE SMALLER CITY EXPECT ADEQUATE RETURNS FROM ITS NEW-BUSINESS DEPARTMENT?

We have all heard so much during the past year of the wonderful growth of central station business in large cities, that there has naturally come to exist a somewhat distrustful attitude of mind on the part of the managers of smaller central stations (or rather central stations serving smaller cities); that these phenomenal increases of business were possible only in the very large cities, and that it would be out of the question for them to look to any such parallel results in the event of their deciding to adopt similar "get-after-business" courses of proceeding.

It is only natural that, when one sees continually glowing reports of the wonderful things which have been done in New York, Chicago, Brooklyn, and other big cities, and fails to see similar reports published in regard to much smaller cities, that the idea will establish itself in the reader's mind that there is some different set of laws governing the case of the smaller city, that conditions are so different, or that for some reason or another, there is not the same chance of bringing about the large increase of business by the methods which have been successfully adopted and carried out in the large cities.

The ELECTRICAL REVIEW is of the opinion that an aggressive new-business department is an equally profitable investment in cities of from 10,000 to 25,000 inhabitants, as in the very largest cities.

Moreover, it is believed that the little fellow's dollar will bring pro rata results with the big fellow's dollar. In some ways the little fellow has the best of it.

In a smaller city there is seldom the intense rush and bustle which characterizes the larger city. The people have, as a rule, more time to give attention to advertising matter, and have also, as a rule, less advertising matter sent to them, permitting them to devote a greater degree of attention to such advertising as is forcibly brought to their notice by the local central station.

Moreover, in smaller cities, there are, as a rule, a large percentage of people who own their own homes, and they are, as a rule, of a class which takes great pride in the keeping up and beautifying of their homes, making them a very desirable clientele, and one with whom it is more possible to do business than as in the case of the very large cities, where there is always a tremendous floating population living in boarding-houses, tenements and rooms.

The following account of the Wisconsin Light and Power Company, of La Crosse, Wis., will be read with interest by a large number of central station men, who have been under the impression that the smaller city was not so readily amenable to modern commercial methods of securing growth of business as the very large cities.

Here is a condition which will appeal to very many, and the interesting figures and charts shown in this article will doubtless serve as an inspiration to a great many to "climb in the band wagon" and commence using the threefold means to a high per capita sales: Service, Advertising and Solicitation.

WHAT CAN BE DONE NEW-BUSINESS-WISE IN A CITY OF ABOUT 30,000.

The Wisconsin Light and Power Company started operation on November 27, 1905, less than one year ago, and in competition with an existing gas and electric company.

Before construction work was commenced a new-business department was thoroughly organized, and has been maintained in its original form up to the present time. This department has accomplished wonders by systematic campaigning, aggressive solicitation, and effective advertising. The department consists of a manager and four men. The city of thirty thousand inhabitants is divided into four territories, each man being assigned a district consisting of part business and part residence territory.

WINDOW DISPLAY ON THE CLOSING NIGHT OF THE BASEBALL SEASON—LA CROSSE WINNING THE WISCONSIN STATE LEAGUE PENNANT. WISCONSIN LIGHT AND POWER COMPANY.

Notwithstanding the keenest of competition against rates often below operating costs, the Wisconsin Light and Power Company has maintained the prices originally established, and has overcome all obstacles by superior electric service and the most conscientious work on the part of its employés—not an interruption occurring since the day of starting, demonstrating the fact that price is a secondary consideration when compared with many other factors affecting the sale of electric current.

Newspaper advertising in the local papers with daily change of copy is used effectively. Circulars, circular letters, personal letters, and individual calls being

Digitized by Google

successively resorted to as the number of possibilities are separated into different classes of probabilities by a system of careful elimination.

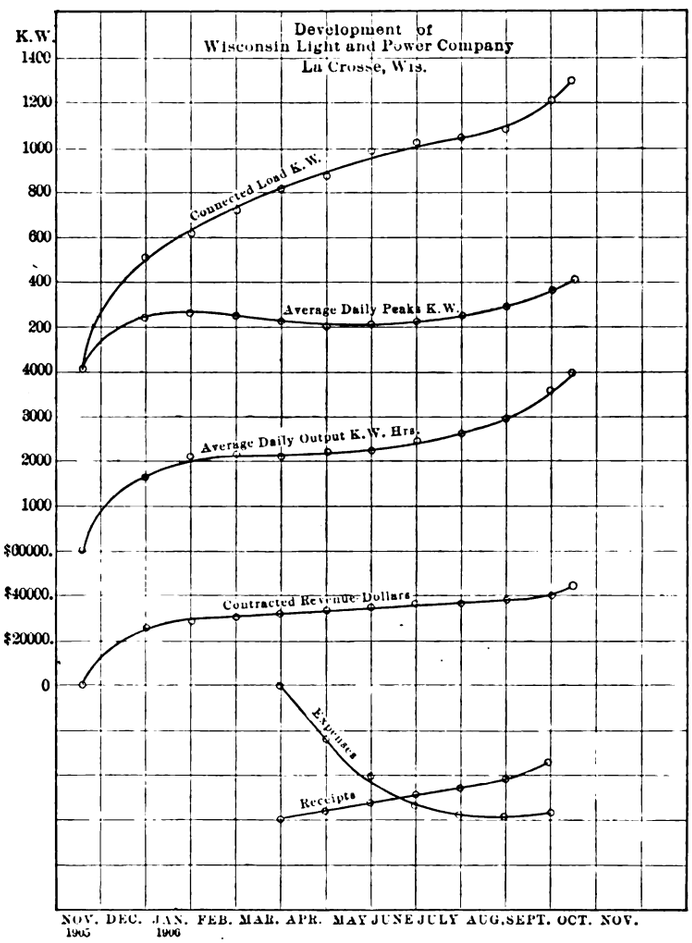
Electric Flat Irons
"The Modern Way"
to Iron
No walking back and forth from a sizzling hot stove
No smoke – no soot – no heat.
No scorched linens – you can iron in the parlor as well as the kitchen or dining room.
Wisconsin Light & Power Company
The Modern Way
Mrs Fortescue
243 Superior

REPRODUCTION OF ADVERTISING CARD USED BY THE WISCONSIN LIGHT AND POWER COMPANY.

A most effective campaign of direct-by-mail advertising is being sent regularly each month to selected lists of residences, stores and business places, and power users.

Personal solicitation follows the advertising campaign, and window decorations are always made especially attractive at the office of the company, located on the main street in the heart of the business district.

We regret that space does not permit of reproductions of all this advertising, but have included among the illustrations an effective mailing card design recently issued to the residence list.



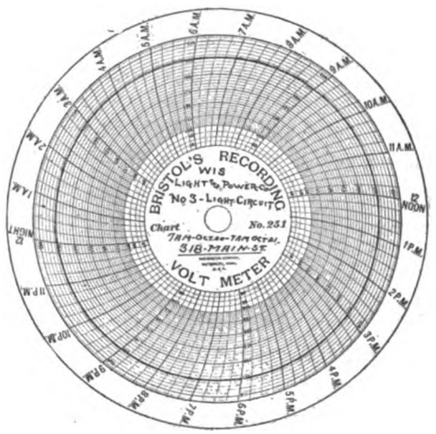
CURVES SHOWING DEVELOPMENT OF THE WISCONSIN LIGHT AND POWER COMPANY, LA CROSSE, WIS.

The generating station is admitted to be the most model and up-to-date plant in the country by all engineers who have examined it, and it contains the best that money can buy. It has an ultimate capacity of 2,000 kilowatts and the accompanying curves show that its consumers are rapidly availing themselves of its reliable product.

Three-phase, sixty-cycle current is generated by Westinghouse steam turbines, backed up with Babcock & Wilcox high-pressure boilers and such auxiliaries, that working under the present load factor, the station is generating its current on an average of three pounds of coal per horsepower on a twenty-four hours' load.

The phenomenal development of the business of this company is shown in the accompanying curves, the first of which shows the connected load as it has increased from month to month from the day of starting in November last to the present time.

The next curve shows the average daily peaks for each month since the time of starting. The third curve shows the average daily output in kilowatt-hours for each month from November last to the middle of the present month. Following this are the revenue curves, showing the contracted revenue in dollars each month since beginning operation.



VOLTMETER RECORD SHOWING LIGHT AND POWER LOAD OF THE WISCONSIN LIGHT AND POWER COMPANY.

An examination of these curves immediately tells the central station man that the load upon this plant is a long-hour load; the peaks low and the output high, presenting ideal conditions for central station operation.

The last curve shows the relation between expenses and receipts, the first period being that from November 26 to March 31; each succeeding period being one month.

This shows the remarkable condition

Digitized by Google

of a new competing plant where operating expenses were paid after the plant had been in service but six months, beyond which time the curve shows a more marked increase than it did before.

Current sold from the plant is contracted for on the "Readiness to Serve" basis, twelve o'clock window and sign work on patrol service being sold only on flat rates and in every instance meters are installed to accurately check all current consumption.

Lighting is furnished through Nernst and incandescent lamps, and regulations are so close that life guarantees are exceeded. (Acompanying is a typical voltage chart.)

In soliciting power business, competent engineers make tests on existing power installations, suggesting changes in methods of driving machinery and in the arrangement of apparatus used, and during the short period of operation fourteen small isolated plants have been taken over and are now operating on induction motors at a saving to themselves, and at a price satisfactory to the producer.

This showing could never have been accomplished without the most untiring efforts in getting the right kind of new business, and stands out as an example of what can and has been done by a well-organized new-business department.

Mr. C. H. Williams is the enterprising manager of the company.

The Long Acre Electric Light and Power Company.

Interest in the development of the Long Acre Electric Light and Power Company, which was organized to supply electric light and electric power in the city of New York and also through the Manhattan Transit Company to furnish passenger service, was renewed last week by an announcement of the election of G. Tracey Rogers, of Binghamton, N. Y., to the board of directors. Mr. Rogers is a successful electrical man of wide experience, and his advent in the board of this New York city company will add to its strength and influence. He was for several years president of the New York State Street Railway Association, and is at the present time president of the Binghamton Railway Company; the Rutland Railway, Light and Power Company; the Waverly, Sayre & Athens Traction Company and the Waverly Electric Light and Power Company.

The Long Acre Electric Light and Power Company recently acquired from Joseph H. Hoadley a controlling interest in the Manhattan Transit Company, formerly The General Carriage Company. The charter of this company becomes of particular interest at the present time in view of the situation in New York city, and is published in full below:

AN ACT TO PROVIDE FOR THE ORGANIZATION OF THE GENERAL CARRIAGE COMPANY.

(NOW MERGED UNDER THE CHARTER OF MANHATTAN TRANSIT COMPANY.)

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. That Henry B. Livingston, Reginald W. Rives, Ed. A. Brennan, J. Frederic Kernochan, Thomas St. John Gaffney and their successors are hereby created a corporation under the name of The General Carriage Company, to have perpetual succession and all the rights appertaining to a corporation as such under the general laws of this state. The General Carriage Company shall have power and authority to purchase, construct and maintain a system of hacks, coaches or vehicles drawn or propelled by horse or other power through any public road, street or highway in any city of the first class in this commonwealth.

SEC. 2. Said corporation shall have the right to establish a time service, and a distance service, and to subdivide the latter into a mileage and circuit service. It shall be allowed to charge a rate of fare not to exceed seventy-five cents per person per hour on the time service, and at a rate of fare not to exceed twenty-five cents per mile or fraction thereof for each person for the mileage service, and a charge not to exceed twenty-five cents per person on the circuit service. The company shall have the right to define the limits and boundaries of said circuits. In the circuit service the company shall also have the right to make such regulations as to operation and variations as to fare as they may desire, provided, however, that the passenger shall at all times have the right to travel a distance of one mile for a sum not to exceed twenty-five cents.

SEC. 3. Said corporation shall pay a license fee to any city in which it operates equal to the usual charge for licensing similar hacks, coaches or vehicles. No permit shall be required, nor greater license charges by any city than is the usual charge for hacks, coaches or vehicles.

SEC. 4. The capital stock of said corporation shall be one thousand shares at the par value of one hundred dollars each, with the right to increase the same from time to time to such amount as the majority of stockholders present at any meeting called for the purpose may desire. Nothing herein contained shall be deemed to release said corporation from the payment of taxes required to be paid under the business corporation law.

SEC. 5. All acts or parts of acts inconsistent with this act are hereby repealed as to this corporation.

SEC. 6. This act shall take effect immediately.

Report of the President of Cornell University.

The fourteenth annual report of President Jacob Gould Schurman, president of Cornell University, Ithaca, N. Y., has been submitted to the board of trustees. This deals in detail with the work accomplished during the university year 1905-1906, and shows that excellent progress took place. The total number of students enrolled for the year was 4,122. An important development in instructional work was the taking of steps to exercise more influence in directing the student's selection of studies.

Two important buildings were added to the campus. Goodwin Smith Hall was dedicated during commencement week to the use of the arts department, and the Rockefeller Hall of Physics was completed and occupied by the physical department.

Attention is called to the need of several new professorships at the University, for which endowments of $100,000 each are the first condition. The most imperatively and immediately demanded by the actual conditions is a professorship of electrical engineering. The president points to the need of increasing the salaries of the faculty, so as to meet, in part at least, the increased expense of living.

The president's report is supplemented by reports from the directors of the various colleges. In that of Director Albert W. Smith, of Sibley College of Mechanical Engineering and Mechanic Arts, is shown the progress made by the electrical department during the year. This department secured the basement and two lower floors of Franklin Hall vacated by the physical department, which gives it quarters which, it is thought, will be satisfactory for several years. The basement will be used for the expansion of the work in experimental electrical engineering and for laboratories for experimental work in connection with the operation of steam and electric railways. The two other floors will be occupied by offices, designing rooms, lecture rooms and special laboratories. The directors' report indicates a serious crowding in the mechanical laboratory, which, it is suggested, might be overcome by the erection of an inexpensive shop building in an inconspicuous location.

Wisconsin Electric and Interurban Railway Association.

The Wisconsin Electric and Interurban Railway Association was organized at a meeting held in the Hotel Pfister Saturday, November 3, at which the managers of companies from all parts of the state were present. The following officers were chosen: president, H. D. Smith, Appleton; first vice-president, Thomas Higgins, Manitowoc; second vice-president, F. W. Montgomery, Madison; third vice-president, Herbert Warren, Superior; secretary and treasurer, C. C. Smith, Milwaukee. Milwaukee is to be the headquarters of the association so long as the secretary is a resident of that city.

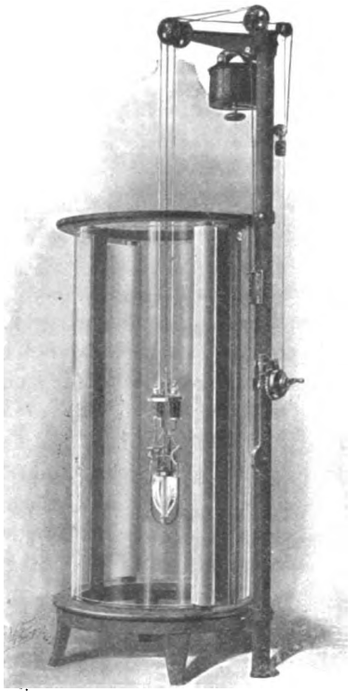
Digitized by Google

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Buckeye Electric Blue-Printing Machine.

For several years the Buckeye Engine Company, of Salem, Ohio, has supplied the market with the Buckeye electric blue-printing machine, an illustration of which is shown herewith. Chief among the characteristics which have made this machine successful are the contact curtains and rollers. To obtain the best results perfect contact must be secured. The tracing and sensitized paper must be held



BUCKEYE ELECTRIC BLUE-PRINTING MACHINE.

firmly and evenly against the surface of the glass to prevent slipping and bulging. Perfect contact is obtained with this machine by means of weights attached to small wire cables, which engage both ends of the rollers, so arranged as to maintain a constant tension, regardless of the position of the rollers. There are two rollers on each machine, one on each side. They operate independently of each other, so that one side only may be used, or one side may be unloaded and reloaded while the other side is printing. This method does away entirely with buttons, clamps or any mechanism for fastening the curtain or holding it in place after it has been unrolled. The rollers will remain stationary at any point on the circle, the curtain back of the roller being in close contact with the glass at all times.

The lamp furnished with these machines is specially constructed for photo-engraving and blue-printing work. It is of the enclosed arc construction, transmitting a light rich in actinic or violet rays. Only one lamp is required to do the work, and it is furnished to operate on direct and alternating currents of 110 to 125, and 220 to 250 volts.

The speed of the lamp while traveling through the cylinder is easily regulated by adjusting the pendulum. This removes the necessity of making more than one drop of the lamp at a printing, regardless of the condition of the tracing.

The glass cylinder is permanently upright or vertical, and is not provided with any arrangement for tilting it to the horizontal position for loading and unloading. The easy action of the ball-bearing rollers so simplifies the operation of loading that the tilting feature is unnecessary.

The machine is entirely self-contained, is not fastened to the wall, ceiling or floor in any way, and may be easily moved from one place to another. The machines are made in three regular sizes—style A, making two prints forty-two by forty-four inches; style B, making two prints forty-two by sixty inches, and style C, making two prints forty-two by seventy-two inches.

The height over all is eight to ten feet, and the machine requires a floor space of about three and one-half by three and one-half feet. The shipping weight is 800 to 1,000 pounds.

A Rubber Show at Peradeniya.

A brief report of a successful rubber exhibition, held at Peradeniya, Ceylon, during this year is given in the *India Rubber World* for November. The exhibition was opened on September 13, and closed September 27. Although at first planned by a planters' association, the idea commended itself to the government, which took it up enthusiastically, broadened the scope of the original plans, and decided upon a two-weeks' exhibition. A number of buildings were constructed at public expense, these being of the native Kandyan type of architecture and decoration. The exhibits consisted of many kinds of rubber products and rubber-working machinery. Many prizes were offered, some of the most important being for instruments for tapping rubber trees and assisting the flow of latix, for storing latix, for methods of coagulation and drying, for obtaining rubber from twigs and leaves, for packing, washing, and for curing-houses.

One of the most noteworthy exhibits was made by the Lanadron estate, Johore, of rubber prepared in a new form. Ordinary crêpe rubber is put through a vacuum drier, pressed in a screw press into blocks a foot square, and weighing twenty-five pounds. This estate is owned by F. Pears, of the Pears' Soap Company.

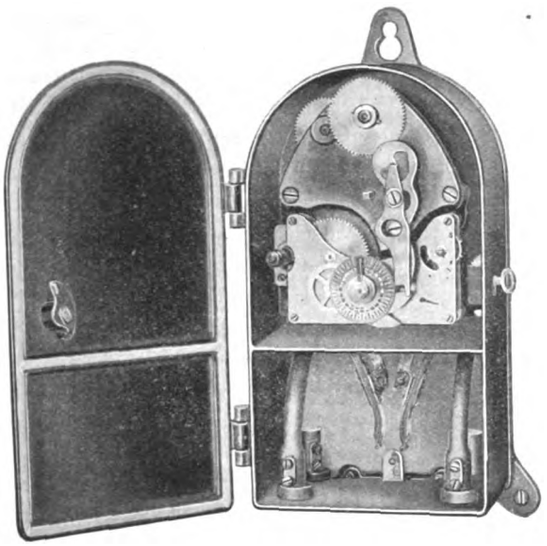
The Cia. Metalurgica de Michoacan, S. A. of Ocampo, Michoacan, is installing a complete electrical plant comprising apparatus from the works of the Westinghouse Electric and Manufacturing Company.

The previous electrical installation is being augmented by a steam engine-driven, forty-five-kilowatt, 250-volt, direct-current generator, which supplies current to the various motors and lights about the smelter. This generator is of a special construction now often used with similar plants where lights and motors are to be operated from the same direct-current generator. What is called a three-wire arrangement is applied, which by an ingenious invention owned by the Westinghouse company, renders it possible to obtain 250 volts and 125 volts from the one generator. The motors, lightning protection and switchboard apparatus make the equipment complete and very economical results will be obtained over what would have been possible from a steam plant driving a single-line shaft as has been the former practice with the older plants throughout the republic.

Digitized by Google

A Commercial Type of Automatic Time Switch.

There is a growing demand, particularly in electric lighting, for an automatic time switch for opening and closing electrical circuits. The time switch shown in the accompanying illustration was designed by the General Electric Company, Schenectady, N. Y., to meet the definite requirements of this class of service, being adapted for both alternating and direct currents.



A Commercial Type of Automatic Time Switch.

This automatic time switch consists of an electrical circuit-breaker operated and controlled by a single clock movement of heavy and rigid design. The parts are mounted compactly in an iron case with two distinct compartments. The upper portion contains the clock, protected against dust and moisture, and the lower part holds the circuit-breaker, mounted on a porcelain terminal board. The clock and circuit-breaker, being operated by the same mainspring, require a minimum number of parts.

The clock movement is of simple and rugged construction. The lever escapement will withstand hard usage and vibration. Extra long bushings and pivots are provided and the gear teeth and pinions are very heavy.

The circuit-breaker has a number of interesting constructive features. The brushes are built up of spring leaf copper and the outside leaf is provided with an arc burning tip, so that the main contact surface does not become roughened, but presents always a smooth rubbing surface.

Clock and circuit-breaker are connected by a simple release mechanism. The clock movement rotates a dial once every twenty-four hours. The dial is graduated in quarter hours, and, for convenience in distinguishing night and day, one-half of the dial is blackened. At the edge of the dial are two cams which revolve with a dial and, acting through levers, control the operation of the circuit-breaker.

In addition to this compact and durable operating mechanism, a small lamp within the clock case increases the reliability of the switch when it is exposed to low temperatures. If the time switch is installed in an obscure position, the light from the lamp is also of service in examining the apparatus.

This time switch is independent of failure of current, being entirely mechanical in action. The principal mechanism is visible when the door is open, and when the door is closed the apparatus is made dust and watertight by a rubber gasket and sealing clamp, which draws the door tightly closed as the handle is turned. The door can then be locked and sealed if necessary. The company rates this time switch at twenty-five amperes and 250 volts.

The Oaxaca Smelting and Refining Company Equipped with Westinghouse Electrical Apparatus.

Through G. & O. Braniff & Company, agents for the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., a large and very modern electrical plant for lighting and power is being installed by the Oaxaca Smelting and Refining Company, of which O. F. Westlund is manager.

There is hardly a smelter in the republic which has not its electrical installation. The advantages resulting from the greater economy and efficiency with an electrically equipped smelter being fully appreciated by this company, they are installing a 110-kilowatt, alternating-current Westinghouse generator, 440 volts, sixty cycles, steam-engine driven, with exciter, switchboards, etc., at the generating station.

Transformers will be used to supply the arc and incandescent lights, the many motors, up to fifty horse-power capacity, being operated direct from the generator. The motor-driven centrifugal pumps are of the Byron Jackson make, and the triplex are made by the Allentown Company. By this method of individual electric motor drive much economy obtains over an engine driving a single long shaft, from which the various smaller machines are driven, and further, with separate motor drive, any one outfit may be shut down without interfering with the others.

National Alternators in the Plant of the Merchants' Heat, Light and Power Company, Canton, Ohio.

The main engine equipment of the Merchants' Heat, Light and Power Company, of Canton, Ohio, consists of two Russell cross-compound non-condensing engines, each of 375 horse-power capacity at 200 revolutions. Each engine is direct connected to a 250-kilowatt, two-phase, 2,300-volt National alternator made by the National Brake & Electric Company, Milwaukee, Wis. These machines carry the entire lighting load, at present about seventy-two amperes. The frames are of cast-iron with sole-plate extensions for supporting them on the engine foundation. Soft sheet-steel laminations are dove-tailed into the frame so as to form slots for receiving the windings. These laminations are carefully japanned to reduce core losses to a low value and also insulate them from each other, and are rigidly supported between end plates at such intervals as are ample to insure good ventilation. The laminae are supported by distance plates, which provide air passages. The armature windings are composed of strap-wound coils insulated with sheet material of highest mechanical strength and dielectric properties. The completed coils are wrapped with linen tape and repeatedly dipped in a vat of special insulating compound. Exceptional care and attention to this part of the machine has resulted in close regulation and large over-load capacity.

The field spiders are of cast iron and are liberally dimensioned to withstand torsional and centrifugal strains. The fields of these generators are wound with copper ribbon in edgewise fashion, thus exposing every turn of the coil to the air. A special fibre paper insulates the turns of the coil from each other in a thoroughly effective manner. A special feature of these machines which contributes very largely to their low operating temperatures is the use of widely separated pole pieces, which construction requires a spider of large diameter and prevents crowding of the coils; thus the coils have a large radiating surface. The method of bolting the pole pieces to the rim of the spider gives unusual accessibility to any portion of the armature or field winding. The bearings

Digitized by Google

of these machines are of generous size, which gives a large wearing and radiating surface,. they are babbitt-lined and are made with a sufficient number of grooves and oil rings to give uniform lubrication throughout the entire length of the bearing. The collector rings are built up on a separate skeleton-type spider which gives them effective ventilation. The rings are cast iron and fitted with carbon brushes so that wear and attention are reduced to a minimum. The generators are excited with a current from 110-volt exciters, which are belted to the shafts of the engines.

The Improved G. D. Telephone Drop.

One of the practical small electrical devices which has recently been placed on the market is the improved G. D. telephone drop, or extension circuit closer, manufactured by the Electric Service Supplies Company, Chicago, Ill. As its name implies, this device is for use on telephones for closing a secondary battery circuit to ring an extension bell.

Arranged to mount on the front of the

IMPROVED G. D. TELEPHONE DROP.

magneto box below the bells, a lever extends upward and rests against the bell tapper so that the first motion will trip the drop shutter and close the secondary or extension bell circuit. A practical and useful feature of this drop is a switch by which the battery circuit may be opened or closed, so that the extension bell may be cut out or put into service at will.

The fact that this closer employs no magnets and is not connected with the telephone circuit insures against the troubles of burned-out magnets and additional line load. It is well worked out mechanically and suffers no wear.

This closer is well and favorably known to the trade in its older form—the improved one will meet with universal favor.

Electric Motor-Driven Pumps for Fire Protection in Large Buildings.

Automatic sprinkler systems furnished with water from gravity tanks on the roof form a most valuable means of fire protection for large buildings. To keep the roof tanks filled under normal conditions and to enable the automatic sprinklers to continue in operation after the roof tanks have become emptied, during the fire, has usually been accomplished by a steam pump. The advantages of electricity in this work, however, are apparent, and an enclosed electric motor, direct-connected to a centrifugal pump, is far superior to steam for the purpose. In case of fire, the current supply from central station mains entering the building through well-insulated underground wires is far less likely to be interrupted by fire or water than is the supply of steam for running a pump. Moreover, the electrical system does away with the need of a steam boiler with its accompanying disadvantages, steam under pressure, presence of fire and necessity of attendance.

A typical electrical equipment for fire protection has recently been installed in one of the largest warehouses in Chicago, built and owned by the Chicago Dock and Canal Company and leased to the Furniture Exhibition Company. The Chicago river side of this structure is shown in Fig. 1. The building is constructed of brick, 450 feet long and 120 feet deep, and rises five stories above the basement, containing about 378,000 square feet of floor space.

The fire-protection system comprises 3,360 sprinkler heads with one fireboat connection and twelve fire-steamer connections. A constant pressure is maintained on the system from four 18,000-gallon tanks, one set on top of each fire wall. The tanks are supplied from an electric pumping set which forms the unique feature of the installation. This set, shown in Fig. 2, consists of a six-pole, 180-horse-power, 800-revolutions-per-minute, 220-volt, direct-current motor, direct-connected to a six-inch, four-stage centrifugal pump. This pumping set has a capacity of 1,000 gallons per minute against a pressure of 150 pounds to the square inch when running at 800 revolutions per minute. The impellers of the pump are so arranged that artificial means of balancing the end thrust are entirely unnecessary.

Special provisions are made to insure the continuous operation of the motor should it become submerged in water and debris in case of fire. The motor is completely enclosed, the joints in the protecting end plates being ground to make them water-tight. At the commutator end of the machine the motor casing is provided with three handholes, each fitted with two

FIG. 1.—WAREHOUSES OF THE CHICAGO DOCK AND CANAL COMPANY.

glass ports for observing the operation of the machine, while the connection between motor and pump, at the opposite end of the motor, is made through a stuffing box.

Since the protective devices render the motor air-tight, special arrangements are made for ventilation. Air is drawn into the motor casing from outside the building by a fan on the armature shaft. The inlet opening is shown in the illustration, at the commutator end of the machine. The outlet pipe, seen at the back of the motor, is made in a special involute form in order to establish a steady flow of air

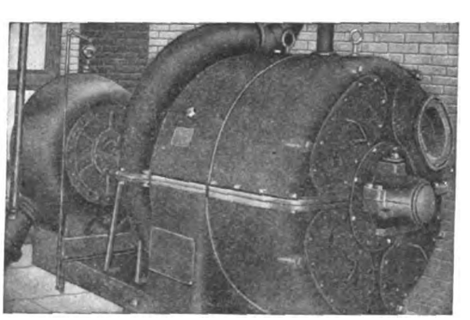


FIG. 2.—180-HORSE-POWER, DIRECT-CURRENT MOTOR, DRIVING FOUR-STAGE CENTRIFUGAL PUMP.

through all parts of the motor by keeping the air in motion in the exhaust pipe. With tight piping connections to the outer air, the motor and pump are perfectly water-tight and will operate when entirely submerged.

Small Light and Power Plant Wanted.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

Can you, through your news items, put me in touch with any parties who will sell an electric light and power plant in a town of ten or twelve thousand or under, somewhere east of the Mississippi and north of Virginia? Naturally the best proposition is a steam plant not paying well. Would be willing to buy or operate under lease an unprofitable municipal plant. H. P. G.

New York City, November 7.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

NEW ELECTRIC RAILROAD—Contracts have been let by the Southern Pacific Company for the construction of a double-track electric railroad to run between Mayfield and Los Gatos, Cal. The line will be twenty miles long and will cost approximately $1,000,000.

NEW ELECTRIC PLANT—Frank M. Waring, cashier of the Tyrone Banking Company, representing capitalists, said to be from New York, Altoona and places in Blair county, Pa., has purchased the Iroquois House and grounds, Harrisburg, Pa., and obtained options on several farms in Perry county. The object is to erect a large electric power plant that will cost $1,000,000. A dam will be built in the Juniata river.

BIG POWER PLANT FOR JAPAN—W. E. Guerin, of New York, is said to be behind an undertaking to develop the water power of a mountain lake near Kyoto, Japan. Seventy thousand horse-power will be generated. Mr. Guerin has been connected with many large financial undertakings on the Pacific coast. One of these was the development of the Deschutes Irrigation and Power Company, of Portland, Ore., which has reclaimed 100,000 acres of arid land in Crook county, Ore., and which has practically 200,000 acres more to improve, under a grant from the state.

INDIANA POWER COMPANY ORGANIZED—The White River Light and Power Company has been organized at Noblesville, Ind. The board of directors is composed of the following: Dr. A. D. Booth and Thomas Griffin, of Noblesville, Ind.; R. H. Sharp, of Columbus, Ohio, and W. E. Kurtz, August M. Kuhn, John T. Dickson, Charles F. Ruschaupt, R. O. Hawkins and Horace Smith, of Indianapolis, Ind. It is the intention of the new company to complete the dam across White river, near Noblesville, that was begun by the Noblesville Hydraulic Company three years ago. The plant will furnish Noblesville with electricity for light and power purposes. The capital stock of the company will be $600,000.

ELECTRIC PLANT ASSURED—Engineers who have been working at Thompson, Mont., for two months past have almost completed plans for the proposed dam at Thompson Falls, which will conserve the waters of the Clark's Fork river for one of the largest power plants and irrigation ditches in the Northwest. It is said that this enterprise is now assured, and that outside capitalists, who are back of the deal, will authorize construction work on the enterprise within the very near future. Present plans contemplate the erection of a dam and power-house which will make possible the generation of 11,000 horse-power. After this dam is completed two others may be built, permitting an increase in the capacity of the plant to 32,000 horse-power.

CONTRACTS LET FOR POWER-HOUSE EQUIPMENT—The Thousand Springs Land and Transportation Company has closed a deal for the purchase of machinery for its power plant at Thousand Springs, Ida. A large force of men is now at work, and the first section of the plant will be ready for operation by January 1. The first transmission line constructed will be to the Bull Run Mountain mines in Nevada, in which A. M. Harris, president of the company, is largely interested. Plans are under consideration, however, for the construction of power lines to Boise and intermediate points. Twelve estimates have been submitted to the company of the capacity of the springs. The most conservative shows a net energy of 12,000 horse-power.

ELECTRIC RAILWAY CHANGES HANDS—The Norfolk & Atlantic Terminal Company, which operates an electric railway from Norfolk, Va., to the Jamestown Exposition grounds and Pine Beach, a distance of six miles, and a ferry line from the latter point to Newport News, has been purchased by the Norfolk & Portsmouth Traction Company, a corporation operating numerous trolley lines, as well as gas and electric plants. The cost of the road and its equipment is said to have been more than $1,000,000. Until its recent sale it was a part of the Newport News & Old Point Railway and Electric Company's system, of which W. J. Payne, of Richmond, is president. The road will be rehabilitated and put in good condition for the Jamestown Exposition.

UTAH LIGHT AND RAILWAY COMPANY SOLD—The Mormon Church, which has for some time been negotiating for the sale of its extensive public utility properties, has disposed of the most valuable of these properties to E. H. Harriman and persons interested with him in railroad affairs. The property which has changed hands is the Utah Light and Railway Company, a $10,000,000 corporation, which controls all of the electric lighting and most of the street railways of Salt Lake City and has net earnings of more than $700,000 a year. Three-fifths of the stock has already been transferred to the Harriman interests. The consideration is not stated. Mr. Harriman was represented at the sale by W. H. Bancroft, one of the vice-presidents and general managers of the Oregon Short Line. The stock will be held by the Oregon Short Line, which is controlled by the Union Pacific, and is the favorite holding company of the Harriman corporations.

WESTERN POWER COMPANY ELECTS OFFICERS—It has now become generally understood that persons prominently identified with the General Electric Company are interested in the Western Power Company, which has elected the following officers: Edwin Hawley, of New York, president; Frank H. Ray, of New York, and Philip Stockton, of Boston, vice-presidents; Frank Tompkins, of New York, treasurer, and H. P. Wilson, of the New York and San Francisco firm of Brown, Wilson & Company, secretary. The board of directors chosen is made up as follows: A. C. Bedford, Edwin Hawley, F. H. Ray, Philip Stockton, F. W. Rollins, F. H. Davis, H. P. Wilson, J. N. Wallace and A. W. Burchard. This company is formed to harness the Feather river, for the purpose of furnishing power to electric railways and other enterprises in California. Construction work has been started at Big Bend tunnel and the Feather river. It is said that the company has negotiated between $8,000,000 and $9,000,000 of its $25,000,000 authorized bond issue.

NEW PUBLICATIONS.

HAWTHORNE WORKS OF THE WESTERN ELECTRIC COMPANY—The Western Electric Company, Chicago, Ill., has prepared a notable catalogue devoted to a description and some illustrations of its works at Hawthorne, Ill., for the manufacture of power apparatus.

THE MOTOR WAY—The Motor Way will hereafter be published by the Motor Way, a reorganization of the Technical Press of America. The officers of the new organization are: F. S. Kenfield, president; A. T. Leach, secretary and treasurer, and W. B. Canis, vice-president and general manager. The offices of *The Motor Way* will be in the Kenfield Publishing Building, Chicago, Ill. Messrs. Kenfield and Leach are the owners of the Kenfield Publishing Company.

ELECTRIC TRACTION WEEKLY.—A new weekly, to be known as the *Electric Traction Weekly*, will be published from Cleveland, Ohio, beginning November 25, by the Kenfield-Fairchild Publishing Company. H. J. Kenfield, formerly New York manager of the *Street Railway Review*, will be general manager; F. L. Heath, treasurer; Charles B. Fairfield, Jr., formerly associate editor of the *Street Railway Journal*, will be editor, and George S. Davis, formerly Ohio correspondent for Ohio of the *Street Railway Journal*, associate editor.

Digitized by Google

PERSONAL MENTION.

MR. G. M. STUART, of Stuart-Howland Company, Boston, was a New York visitor this week.

MR. MAX HARRIS, sales manager of the Nernst Lamp Company, Pittsburg, Pa., was a New York visitor last week.

MR. GERALD W. HART, president of the Hart Manufacturing Company, Hartford, Ct., was in New York last week.

MR. GEORGE TROWBRIDGE HOLLISTER, of Mackay & Company, has been elected a director of J. G. White & Company, New York city.

MR. WALTER DOOLITTLE, president of the Sterling Electric Company, of Lafayette, Ind., was a Chicago visitor the latter part of last week.

MR. E. IRVING, president of the Sunbeam Incandescent Lamp Company, of Catherine, Ontario, stopped in New York last week while en route to Hot Springs, Va.

MR. H. B. KIRKLAND has accepted a position with the National Metal Molding Company, Pittsburg, Pa., as assistant general sales manager. Mr. Kirkland was a New York visitor this week.

MR. E. H. MATHER, who has been treasurer and manager of the Portland (Me.) Lighting and Power Company for the past six years, will resign this position to engage in private work in the city of Boston, Mass.

MR. J. J. NATE, of the Minneapolis office of the Stromberg-Carlson Telephone Manufacturing Company, accompanied by his daughter, was a Chicago visitor last week. Mr. Nate's trip to Chicago was in connection with a line of new apparatus his company is putting on the market. He reports unusual activity in the Minneapolis market.

MR. W. F. LEATHERS has been promoted from the position of chief operator at Worcester, Mass., to that of district service inspector of the New England Telephone and Telegraph Company's Worcester division. Mr. W. D. Sargent, of the company's Boston traffic department, has been appointed chief operator at Worcester, succeeding Mr. Leathers.

MR. GEORGE BULLOCK, formerly president of the South Covington & Cincinnati Street Railway, has been elected president of the United Gas and Electric Company, of New Jersey. Mr. Bullock has also served as president of the Cincinnati Edison Electric Light Company, a director of the Cincinnati Street Railway Company and of the Cincinnati Gas Company, and he was active president of the Bullock Electric Manufacturing Company, which was subsequently acquired by the Allis-Chalmers Company. The United Gas and Electric Company owns or controls the stocks and operates about a score of gas and electric properties in different parts of the country.

OBITUARY NOTES.

MR. WILLIAM H. CAMPBELL died suddenly at his home at Highland Mills, N. Y., on November 5. Mr. Campbell was one of the organizers of the Larchmont (N. Y.) Street Railway, and constructed its lines between Larchmont and Stamford, Ct. He was sixty-two years of age, and is survived by a widow and son.

MRS. NORVIN GREEN, widow of the late Norvin Green, for many years president of the Western Union Telegraph Company, died last Friday morning at her home in Louisville, Ky. Mrs. Green was a daughter of the late Captain English, and was in her eighty-fifth year at the time of her death. She lived for many years in New York city, but about fifteen years ago the family moved to Kentucky. Mrs. Green is survived by two daughters and three sons, Miss Susa T. Green and Miss Grace Green, both of Louisville, and Dr. James O. Green and John E. Green, of New York, and Pinckney F. Green, of Louisville.

EDUCATIONAL NOTE.

THOMAS S. CLARKSON MEMORIAL SCHOOL OF TECHNOLOGY—The Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., will hold the decennial founder's day exercises at Chapel Hall of the institution on Friday, November 30. The address of the day will be delivered by Henry Smith Pritchett, president of the Carnegie Foundation for the Advancement of Teaching. The memorial exercises will be in charge of the Right Reverend William Crosswell Doane, bishop of Albany.

ELECTRICAL SECURITIES.

While many persons interested in the stock market looked for an immediate resumption of the bull campaign, due to a Republican victory in the election of a governor in New York state, there was considerable disappointment in the unfavorable developments that followed. The election result was followed by heavy realizing, with considerable selling, the net result of which was that at the close of the week there had been a number of considerable price reductions. The explanation of this condition of the market is said to be found in the monetary situation, and from now until after the turn of the year it is expected that monetary considerations will be the dominant factors in stock market developments. While the speculative apathy is a fact, it is also noteworthy that the present general prosperity is expected to prevail, and a significant reflection of this sentiment is found in the action of the Pennsylvania Railroad in increasing wages by 10 per cent of some 125,000 employés. The Standard Oil Company has also announced a 5 to 10 per cent wage increase, and it is stated that the United States Steel Corporation is considering similar action.

ELECTRICAL SECURITIES FOR THE WEEK ENDING NOVEMBER 10.

New York:	*Closing.*
Allis-Chalmers common	16⅝
Allis-Chalmers preferred	44
Brooklyn Rapid Transit	77⅝
Consolidated Gas	138
General Electric	174
Interborough-Metropolitan common	36½
Interborough-Metropolitan preferred	76½
Kings County Electric	150
Mackay Companies (Postal Telegraph and Cables) common	72
Mackay Companies (Postal Telegraph and Cables) preferred	69
Manhattan Elevated	142
Metropolitan Street Railway	105
New York & New Jersey Telephone	125
Western Union	85¼
Westinghouse Manufacturing Company	157

The report of the Brooklyn Rapid Transit Company for the September quarter showed gross earnings of $5,156,057, against gross in the same period last year of $4,841,988. There was not much difference in the item from recent estimates that have been made, but net, instead of showing a good increase under the conditions, was $25,737 less than last year, owing to a big gain in operating expenses. This was disappointing, as it had been figured that the latter item would be cut down this year.

The Interborough-Metropolitan Company has issued a statement for the quarter ended September 30, 1906. This shows a deficit of $317,638, as compared with $783,023 for the previous year.

Boston:	*Closing.*
American Telephone and Telegraph	137½
Edison Electric Illuminating	233
Massachusetts Electric	69
New England Telephone	129
Western Telephone and Telegraph preferred	83

Philadelphia:	*Closing.*
Electric Company of America	11¾
Electric Storage Battery common	71
Electric Storage Battery preferred	71
Philadelphia Electric	8¾
Philadelphia Rapid Transit	25¼
United Gas Improvement	96⅝

It is estimated that the lease by the United Gas Improvement Company of the Connecticut Railway and Lighting Company, which is practically completed, will involve about $15,000,000, of which $7,000,000 is actual cash. Among the investments which will be turned into cash through the deal are about $6,000,000 in notes and $1,000,000 in bonds, and the income of the United Gas Improvement Company will be augmented to the extent of $600,000 per year.

Chicago:	*Closing.*
Chicago Telephone	117
Chicago Edison Light	145
Metropolitan Elevated preferred	65½
National Carbon common	86¼
National Carbon preferred	119
Union Traction common	—
Union Traction preferred	—

Digitized by Google

ELECTRIC LIGHTING.

MONTGOMERY, ALA.—The plant of the Pea River Power Company, of Elba, has been placed in operation.

LITTLE ROCK, ARK.—Capitalists of Carthage, Mo., are making arrangements to establish an electric lighting plant at Gravette.

ILION, N. Y.—The Middleville Electric Light Company will increase its capital stock from $4,000 to $12,000 and build a new plant.

MANASSAS, VA.—The contract for installing an electric light plant has been awarded to the J. M. C. Lucas Company, of Baltimore, Md.

SANFORD, N. C.—The electric light plant at Sanford, owned by H. I. Thompson, was destroyed by fire on October 26. It will be rebuilt at once.

KENMARE, N. D.—The plant of the Kenmare Light and Power Company was destroyed by fire in October. The loss is $10,000, covered by insurance.

SALEM, N. Y.—The board of trustees has made a contract with Willett A. Reynolds to furnish light for thirty arc lamps of 2,000 candle-power at $1,800 a year.

HYATTSVILLE, MD.—The Potomac Electric Power Company, of the city of Washington, has been voted a ten-year franchise to furnish commercial and private lighting in Hyattsville.

NEWBURGH, N. Y.—The village board of Marlborough has made a contract with the Newburgh Light, Heat and Power Company to light the village with electricity. The lamps will number forty-five.

KANSAS CITY, KAN.—The city council of Independence has passed an ordinance to extend the service of the municipal electric light plant to Maywood, a village one and a half miles west of the city limits.

McCOMB CITY, LA.—The board of mayor and aldermen has renewed the contract for street lighting with the McComb Electric Light and Power Company for a term of five years at the price of $66 per lamp per year.

READING, PA.—Work has been begun on the construction of the power plant of the Blue Mountain Electric Company in Bethel township, the capacity of which will be sufficient to furnish electricity for Strausstown, Rehrersburg and Millersburg.

WABASH, IND.—Officials of the Fort Wayne & Wabash Valley Traction Company, the first one to enter Wabash, state that when their new $1,000,000 power-house, which is now under construction, is completed they will ask for contracts for city lighting along their line.

BALTIMORE, MD.—Another of the engines in the Westport power-house of the Consolidated Gas, Electric Light and Power Company has been started. Each one of these engines has a maximum capacity of 4,500 horse-power and there are now four of them in operation.

JOPLIN, MO.—The city now enjoys a revenue of $700 a month from commercial electric lighting, improvements costing $30,000 having trebled the capacity of the plant. Each of the 189 city lights now costs $4.50 a month to operate. The price under private contract was $6 per light.

MILWAUKEE, WIS.—The executive board of the Greater Milwaukee Association has appointed a committee to investigate the financial standing and details of the proposition made by the Milwaukee Engineering Company to the city for a franchise to furnish electric light and power.

ANN ARBOR, MICH.—The Washtenaw Light and Power Company, a consolidation of the Pontiac and other companies, has purchased the Ypsilanti paper mill plant at Lowell on the Huron river for $100,000. The projected dams will be built in the spring. The deal is part of an electric power scheme backed by New York parties.

GREEN BAY, WIS.—The Green Bay Gas and Electric Company announces a reduction from seventeen cents per kilowatt-hour for lighting to twelve cents, and from seventeen cents to ten cents per kilowatt-hour for power. New machinery makes the reduction possible. It is expected that the reduced rates will take effect January 1.

GOUVERNEUR, N. Y.—Over 6,000 poles have been purchased and are being drawn along the route between Hermon and Gouverneur, by the Hannawa Power Company, preparatory to stringing its wires to Gouverneur and vicinity. The work of placing them in position will begin as soon as the conditions of a franchise have been arranged.

HAZLETON, PA.—The recently incorporated Consumers' Electric Light and Power Company, of Hazleton, has been reorganized and prominent capitalists are now in control. They are A. W. Drake, of Lattimer, president; O. L. Emmerich, of Hazleton, secretary and treasurer, and David Benjamin and John Crellin, of Hazleton, and Alfred Parde, of Philadelphia, directors.

PASADENA, CAL.—A plan is under consideration to develop power from a hydraulic plant, utilizing the sewage water near the Sewer Farm. The fall of water is between 650 and 850 feet, and with the proper pipes a 400-horse-power plant could be operated. This would generate sufficient electric current to supply 145 arc lights and 3,500 incandescent lights, which will be needed for the new electric lighting system.

KALAMAZOO, MICH.—The Grand Rapids Electric Company has filed in Kalamazoo county a trust deed to the Cleveland (Ohio) Trust Company for $250,000. The company has under way two lines, one extending from Grand Rapids to Alpena, and the other from Grand Rapids to Kalamazoo. This line will be extended to Battle Creek, then across to Coldwater and Ohio. The mortgage is for the purpose of securing more funds with which to do the work.

GLASTONBURY, CT.—The Glastonbury Power Company has awarded a contract to J. G. White & Company, Incorporated, for the construction of a hydroelectric plant on a branch of the Connecticut river near Glastonbury. Current will be transmitted, probably at a pressure of 11 000 volts, to Hartford, and also to Glastonbury and vicinity. A dam, 600 feet long and sixty feet high, will be thrown across the river. Work will be started immediately, and it is expected that the plant will be in operation by the first of April next.

MIDDLETOWN, CT.—The Middletown Electric Light Company has negotiated a contract for a supply of electric power from Leesville on the Salmon river, fifteen miles from Middletown. A Providence syndicate has acquired rights at Leesville and has draughted plans for the development of a large power plant. A tract of land has been obtained in Marlboro which will be flooded and used as a storage reservoir. It is expected that the plant will be completed next summer. The Providence syndicate is negotiating contracts to supply electricity for light and power purposes to a large territory.

SALT LAKE CITY, UTAH—Seldon I. Clawson and Richard R. Romney, of Salt Lake City, are contemplating the establishment of two power plants in Garfield county and with this purpose in view have filed applications for water rights. The first application asks the right to divert fifty second-feet from the Sevier river the water to be conveyed a distance of 6,000 feet, where a power plant is to be erected. The second application asks for fifty second-feet from Coyote creek in Garfield county, the power produced to be used for electric lighting purposes and propelling machinery in Coyote canyon.

GRAND RAPIDS, MICH.—At a meeting of the stockholders of the Northwestern Michigan Light and Power Company, of Manistee, Mich., which has lately purchased the Manistee Gas and Electric Company, the following directors were elected: Edward M. Deane, Dwight Smith, Frank G. Deane, Harry B. Wales and Charles E. Moore. Immediately after the stockholders' meeting a meeting of the directors was held and the following officers elected: Edward M. Deane, president; Dwight Smith, vice-president; Frank G. Deane, secretary and treasurer, and Harry B. Wales, general manager. This corporation is one of the new companies lately taken over by Edward M. Deane & Company, of Grand Rapids. New apparatus is being installed and new mains laid, greatly extending the system. The bonds of the company have been sold.

Digitized by Google

ELECTRIC RAILWAYS.

NORTH YAKIMA, WASH.—The stockholders of the Yakima Intervalley Traction Company have subscribed $100,000 for the construction of the electric railway for this city and valley.

SHELBYVILLE, KY.—The electric line from Shelbyville to Louisville is now an assured fact. The entire right of way has been secured on the state pike except in a few cases, and condemnation proceedings have been instituted.

WATERBURY, CT.—The Connecticut Railway and Lighting Company is making preparations to double track the Waterville line from Highland Park to Faber's Switch, so-called. Most of the new track will be laid on private property.

PORTLAND, ORE.—South Portland property amounting to $325,000 has been purchased by the Oregon Electric Railway Company. The tracts purchased lie along the surveys in South Portland and consist of thirteen city blocks. They will be used for terminals and warehouses.

MASSILLON, OHIO—The electric lines formerly known as the Canton-Akron, Canton-New Philadelphia and Tuscarawas traction lines will, in the near future, be operated as divisions of the Northern Ohio Traction and Light Company's extensive system of interurban and city electric railroads.

CLEVELAND, OHIO—The three-cent street-car fare in this city became a reality on November 1, when the first cars were run on the lines of the Municipal Traction Company, recently established, which now has thirteen and one-half miles of its road in operation. The three-cent fare applies only to this line.

KETTLE FALLS, WASH.—Engineers have arrived here to resume work on the Colville & Columbus Electric railroad that passes through this place. This is the road that was commenced last July and discontinued. It is understood that the old set of men is now entirely out and that men of capital are back of the enterprise.

PORTLAND, ORE.—Supplementary articles of incorporation for the Portland Railway, Light and Power Company have been filed. By the filing of additional articles the corporation was given legal power to acquire the Portland General Electric Company, the Portland Railway Company and the Oregon Water Power and Railway Company.

SCHENECTADY, N. Y.—An order for electrical equipment amounting to about $50,000 has been placed with the General Electric Company by the Schenectady Railway company. The order calls for motors, air-brake equipments, controllers, etc. It is the intention of the railway company to standardize its equipment on the various cars.

SCRANTON, PA.—A third-rail road is to be built by the Midway Connecting Railway Company between Wilkesbarre and Sunbury and through Nanticoke. The new line will also enter Plymouth and connect with all the large towns in the southern end of the Wyoming valley. An ordinance granting franchises has been introduced in the councils of Wilkesbarre.

JACKSONVILLE, FLA.—The contract for the erection of the power-house for the Tampa & Sulphur Springs Traction Company has been awarded to J. E. Bates & Company. The structure will be 104 by 104 feet and will be of sand-lime brick. It is estimated to cost $15,000. It is thought that the power-house will be completed and the cars running to Sulphur Springs by January 1, 1907.

MARENGO, IOWA—The citizens of Marengo have taken the first steps in the preliminary work of securing an electric freight and passenger railway southwest to Oskaloosa *via* Millersburg and What Cheer. At a recent meeting of the citizens of Marengo $5,000 was raised for purposes of preliminary work. It is expected to interest the people of Oskaloosa, What Cheer and Millersburg in the enterprise.

PITTSBURG, PA.—Manning Stires, president of the new Pittsburg-Westmoreland Street Railway Company, while in McKeesport, stated that all the difficulties had been settled and cars over the new road between McKeesport and Irwin would be running over the lines of the West Penn railways within six weeks. This new road has been building for several years but was delayed by many lawsuits and obstacles, which have finally been overcome.

MILWAUKEE, WIS.—A petition has been circulated among property owners and residents of the towns of Grenfield and Franklin in this county and of the town of Raymond in Racine county, asking for an extension of the interurban service of the Milwaukee Electric Railway and Light Company. The line asked for would extend from the Hales Corners line to Howard's Prairie, Raymond Center and Eagle Lake.

BUFFALO, N. Y.—A certificate filed in the office of the county clerk tells of the merger of the Buffalo, Dunkirk & Western Railroad Company and the Lake Erie Traction Company under the name of the Buffalo & Lake Erie Traction Company. The new company will be capitalized at $3,900,000, being 39,000 shares of the par value of $100 each. The annual election of officers of the new concern is fixed for the third Monday in each September. The certificate of merger is signed by the directors of both companies.

PITTSBURG, PA.—A new electric railway, to carry passengers between Pittsburg, New Castle, Beaver Falls and Midland, is being projected. The promoters and their engineers have gone over the ground recently, and it is said that the speed maintained on the new road will at least equal that of the average railroad passenger train. Twelve companies have been chartered by the Commonwealth of Pennsylvania, but these concerns may work in unison, it is said, to give western Pennsylvania a fast and efficient electric railway service.

OSSINING, N. Y.—The village authorities of Ossining have granted a franchise to the Hudson River & Eastern Traction Company, of which F. A. Stratton is president, to operate an electric street railway system in the village. The franchise is over the main thoroughfare of the town, which runs from the New York Central railway station to the centre of the village. Mr. Stratton's company, it is said, will use 1,000 feet of the present street railway of Ossining, which is owned by the Westchester Traction Company. It is expected that the line in Ossining will be in operation within sixty days. The new company has a capital of $2,000,000.

GETTYSBURG, S. D.—The farmers of Sully county, by popular subscription, have raised over $100,000 for the purpose of constructing and equipping an electric line from this city to Okobojo, a distance of twenty-one miles. The money has all been paid in and is on deposit in the bank of Pierre and Oneida, the county seat of Sully county, in which Okobojo is situated. Construction will be begun in the spring. Sully and Buffalo are the only counties east of the river that are not traversed by one or more railroads. It is proposed to build the new line first from Pierre to Okobojo, then west to Oneida and then north to Gettysburg, the terminal of the Watertown-Redfield line of the Northwestern.

JOLIET, ILL.—It is stated that the Chicago, Joliet & Kansas City railway will run in an almost direct line from Joliet to Princeton, thence it will bend southerly and run into Toulon and then make its course almost straight westward to Keithsburg, where connection will be made with the Iowa Central. Branches may be run to Morris, Marseilles, La Salle and Kewanee. Possibly Monmouth and Galesburg will receive consideration. It is positively stated that the $10,000,000 bond issue on the Illinois division of the road has been taken by New York men. The contracts for the construction work have also been awarded. There is to be a mileage of 246 miles in Illinois, and the construction is to commence January 1. The officers of the company are: president, J. C. Eden; chief engineer, B. F. Hardesty; constructing engineer, C. A. Denham.

BOSTON, MASS.—Over 200 prominent business men representing the boards of trade of Lynn, Salem, Peabody, Lowell and Beverly gathered at Burdett Hall, Lynn, recently to hear of the plans for a new electric air line which, it is claimed, a company is planning to build from Beverly to Sullivan square, Charlestown. The speaker was John H. Bickford, a Salem engineer, who said that a company, capitalized at $250,000, was shortly to go before the railroad commission for permission to put the scheme in execution. The new road, he said, will run trains from Beverly to Sullivan square in less than twenty minutes. The road is to start at Beverly, go through Salem, Peabody, enter Lynn at Glenmere, go along the base of High Rock to a central station in City Hall square, thence to West Lynn, Revere and Sullivan square. From Lynn to Boston the line is to be elevated.

Digitized by Google

NEW INCORPORATIONS.

COLUMBUS, OHIO—The Sunbury & Galena Telephone Company, Sunbury. Capital increased from $25,000 to $50,000.

ALBANY, N. Y.—Queens Lighting Company, Queens county. $10,000. Directors: F. E. Wiske, J. F. Seering, J. W. Demarest, Queens.

SALEM, ORE.—Gordon Falls City Manufacturing Power and Light Company. $175,000. Incorporators: Sigmund Sichel, Henry Hewett and R. W. Wilbur.

NASHVILLE, TENN.—National Power Company. $25,000. Incorporators: James E. Caldwell, Daniel C. Buntin, V. E. Schwab, F. O. Watts and S. H. Ellison.

SALT LAKE CITY, UTAH—Richfield Electric Light and Power Company, of Richfield. $50,000. Thomas Brown, president and manager; W. H. Seegmiller, vice-president; John Hood, secretary; J. M. Peterson, treasurer.

AUSTIN, TEX.—The American De Forest Wireless Telegraph Company, of Texas. Principal office at Austin. $25,000. Incorporators: W. D. Hart, G. W. Allen, M. A. Kopperi, of Austin; Abraham White, of New York; C. C. Wilson, of Denver, and Kal Schwartz, of Corsicana.

ST. JOSEPH, MO.—St. Joseph Belt and Interurban Railway. To build a belt line through St. Joseph and around it to the north, and to construct an interurban line to Savannah. $1,500,000. President, John S. Logan; vice-president, Louis Huggins; secretary and treasurer, John E. Dolman.

OLYMPIA, WASH.—The Pacific & Eastern Railway Company, of Raymond. For the purpose of building a steam or electric railway from South Bend to Chehalis. $150,000, fully subscribed. Incorporators: W. S. Cram, Jacob Siler, T. H. Donovan, of Raymond; S. L. Hyman, F. G. and H. G. Schoemaker, of South Bend, and Walter G. Hyman, of Burlingame, Cal.

DATES AHEAD.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.

Northwestern Electrical Association. Milwaukee, Wis., January 16, 1907.

American Society of Mechanical Engineers. New York city, December 4-7.

INDUSTRIAL ITEMS.

THE CASE MANUFACTURING COMPANY, Columbus, Ohio, in bulletin No. 22 describes and illustrates its line of electric cranes.

THE NERNST LAMP COMPANY, Pittsburg, Pa., has published an interesting booklet called "Lux." This deals with the effectiveness of Nernst lamps in illumination.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., in bulletin No. 101 describes and illustrates the installations of chloride accumulators for the Columbus Railway and Light Company, Columbus, Ohio.

THE WELLMAN-SEAVER-MORGAN COMPANY, Cleveland, Ohio, has ready for distribution a handsome catalogue devoted to engineering work. This covers mechanical, civil, electrical, mining and hydraulic engineering.

DOSSERT & COMPANY, New York city, announce that they have received from their representatives in Milan, Italy, word that the Dossert solderless connectors exhibited at the Universal Exhibition, Milan, 1906, were awarded a gold medal.

THE STANDARD VARNISH WORKS, New York city, announces that its W. P. insulating black, gotten up especially for use in connection with interior wiring, signal telephone and telegraph work, has been approved by the Underwriters' laboratories, Chicago, Ill.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 17 Park place, New York city, is calling attention to its ironclad weatherproof bells, improved water-tight push-buttons and red-seal dry batteries, in a neat folder, copies of which may be had upon application.

THE CENTURY ELECTRIC COMPANY, St. Louis, Mo., announces that the demand for its single-phase, self-starting vertical motors for direct-connection to centrifugal pumps, etc., has far surpassed its most sanguine expectations. This vertical type is becoming more popular all the time.

THE INDEPENDENT ELECTRIC COMPANY, El Paso, Tex., has been organized by B. P. Dubinski and S. Frankenstein. This company will deal in electrical supplies, machinery and implements, and is requesting discount sheets, catalogues and bulletins from supply men and manufacturers.

THE BANNER ELECTRIC COMPANY, of Youngstown, Ohio, manufacturer of the "Banner" incandescent lamp, is reported to be having a record season and that the month of October was by far the largest since the company has been in business. The company reports that it is actually making on an average of 8,000 lamps per day at the present time.

THE PACIFIC ELECTRIC MANUFACTURING COMPANY, 1161 Howard street, San Francisco, Cal., is prepared to furnish apparatus and appliances for handling electrical energy at high potentials on long-distance transmission systems. This company has published a new catalogue which it will be pleased to send to any one interested upon request.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is sending to the trade circulars and bulletins descriptive of the Columbia incandescent lamp, for which it is sales agent. The Columbia lamp is well and favorably known and as this is the time of the year when the majority of lamp contracts are made, the company suggests that consumers write them for its yearly-contract plan.

THE ELECTRIC SERVICE SUPPLIES COMPANY, Chicago, Ill., is distributing an attractive catalogue devoted to the "Automotoneer." This is a mechanical device for attachment to the controller spindle of electric cars, which forms an effective check upon a careless motorman and preserves the car equipment from unnecessary shocks, due to too rapid application of the controller handle.

THE SPRAGUE ELECTRIC COMPANY, New York city, has published a handsome bulletin devoted to round-type direct-current motors. In addition to the text describing these machines there are dimension diagrams given, and also a number of views showing typical applications of this apparatus. Another pamphlet which the company has recently published is devoted to electric motors for driving ventilating fans and blowers.

THE NEW YORK ELECTRIC CONTROLLER COMPANY, 21-27 New Chambers street, New York city, has ready for distribution some attractive literature devoted to its automatic motor-controlling devices. This apparatus was illustrated and described recently in the ELECTRICAL REVIEW. Some of the features of this apparatus are the elimination of rubbing contacts, suction air pots, cams, gears, belts, compression cylinders or retarding springs.

THE ILLINOIS TELEPHONE CONSTRUCTION COMPANY, Chicago, Ill., has published a handsome catalogue describing the Chicago tunnel system built for the Illinois Tunnel Company. The grand total of tunnel feet constructed August 1, 1906, was 239,205. George W. Jackson, general manager and chief engineer, states that the construction of the entire system has been accomplished without the company being called upon to defend or pay any claims for damages of any kind. Albert G. Wheeler is president of the company.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has published a new series of descriptive literature for insertion in its perpetual catalogue. A partial description of these are as follows: Bulletin 34—self-starters for use with squirrel-cage motors; 35—self-starters for slip-ring type motors; 51—electric-elevator controllers; 53—elevator controllers for direct-current motors; 54—elevator controllers, mechanically operated; 56—elevator controllers for use with slip-ring motors; 57—elevator controllers for use with squirrel-cage motors; 61½—reversible speed regulators; 67—non-reversible drum controllers, for printing presses, machine tools, etc.; 67½—"compound" non-reversible drum controllers; 68—drum controllers with two reverse speeds; 68½—"compound" full reverse drum controllers; 77—"compound" non-reversible machine tool controllers, drum type; 78—"compound" full reverse machine tool controllers, drum type; 79—"compound" resistances; 79½—machine tool controllers, reversing and non-reversing, with no-voltage release, or overload and no-voltage release.

Digitized by Google

Record of Electrical Patents.

Week of November 6.

834,899. DENTAL HANDPIECE. Wallace W. Freeman, Norfolk, Va. Filed August 22, 1905. A small electric drill for dental purposes.

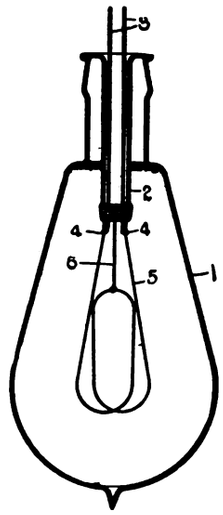
834,912. ELECTRIC IGNITER. Joseph N. Kelly, Dayton, Ohio, assignor of one-half to G. H. Geiger, Dayton, Ohio. Filed October 29, 1903. An igniter for gas or oil engines.

834,948. ELECTRICAL FURNACE. Frank J. Tone, Niagara Falls, N. Y. Filed September 14, 1905. Renewed April 6, 1906. The base of the furnace is provided with a space for a cooling medium, so as to prevent diversion of the current through it.

834,952. THERMOSTATIC CIRCUIT-CLOSER. Charles L. Walker, Harrow, England. Filed March 25, 1904. Two vessels containing the measuring fluid and having a connecting passage are constructed so that one follows more quickly temperature variations.

834,953. RHEOSTAT. Orville T. Weiser, Philadelphia, Pa., assignor to Siegmund Lubin, Philadelphia, Pa. Filed February 7, 1906. A supporting frame carries conducting members for making connections between the resistance units.

834,989. ELECTRIC FUSE. John J. Miley, Boston, Mass. Filed March 5, 1906. One terminal of the fuse is elongated so as to adapt it to various fuse boxes.



834,990. INCANDESCENT ELECTRIC LAMP.

834,990. INCANDESCENT ELECTRIC LAMP. George P. McDonnell, St. Louis, Mo., assignor to American Electric Company, East Orange, N. J. Filed September 1, 1905. The ends of the carbon filament are imbedded in the stem of the lamp.

834,995. ELECTRIC CLOCK. Arthur F. Poole, Wheeling, W. Va. Filed December 6, 1900. A system of electrical synchronized clocks.

834,998. ELECTRIC-WAVE-FORM TRACER. Harris J. Ryan, Ithaca, N. Y. Filed July 3, 1905. A pencil of rays produced in a vacuum is deflected by means of two sets of coils so as to produce a luminous trace on a phosphorescent screen.

835,003. ELECTRIC TERMINAL FIXTURE. Arvid H. Svensson, Buffalo, N. Y. Filed January 8, 1906. The conductors are imbedded in a flexible insulating cord which is screwed directly into the ceiling fixture.

835,006. MEANS FOR OPERATING THE SWITCHES, FROGS AND SIGNALS OF ELECTRIC TRAMWAYS. Leonard Atkinson, Christchurch, New Zealand. Filed April 18, 1906. A signal operated mechanically by the passage of the car.

835,013. TELEGRAPHIC TAPE PERFORATOR. Patrick B. Delany, South Orange, N. J., assignor, by mesne assignments, to the Telepost Company. Filed November 1, 1904. An electromagnetic perforator for machine telegraphy.

835,023. TRANSFORMER. Hermann Heinicke, Steglitz, near Berlin, Germany. Filed January 17, 1905. A transformer for high-tension electric waves.

835,025. CIRCUIT PROTECTIVE DEVICE. Dugald C. Jackson, Madison, Wis. Filed September 24, 1904. A resistance introduced in the circuit is normally short-circuited, but brought into action due to excessive loads.

835,037. TELEPHONE REPEATER CIRCUIT AND APPARATUS. Herbert E. Shreeve, Newton, Mass., assignor to American Telephone and Telegraph Company. Filed January 24, 1906. Means are provided for adjusting the relative resistance and capacity of a relay and an induction coil.

835,046. TELEPHONE SYSTEM. Alfred Stromberg, Chicago, Ill., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Filed November 24, 1902. A common battery system employing an adjustable cut-off relay in the line circuit.

835,047. TELEPHONE EXCHANGE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Filed May 7, 1903. A switching apparatus is provided at a substation which is controlled by a source of current at the exchange.

835,074. CONTROLLING MEANS FOR ELECTRIC CIRCUITS. Julius K. Lux, St. Louis, Mo. Filed October 11, 1904. A rotary snap-switch.

835,097. TORPEDO-SETTING MECHANISM. Chester L. Chamberlain, Los Angeles, Cal. Filed April 19, 1906. An electrical device for setting signal torpedoes on railways.

835,103. DEVICE FOR REVERSING AND AUTOMATICALLY BLOCKING TRAINS ON ELECTRODYNAMIC TRACTION RAILWAYS. Julien Dulait and Leon Rosenfeld, Charleroi, Belgium. Filed February 8, 1905. Contacts closed by a car on a track section cut off power from the preceding section by means of an oscillating motor.

835,113. INSULATING COMPOUND. Samuel G. Penney, Allegheny, Pa. Filed June 19, 1906. The compound consists of maltha, byerite, benzine and carbon tetrachloride.

835,119. TELEPHONE ATTACHMENT. Bradley L. Stone and George M. Dressel, Belpre, Ohio. Filed March 12, 1906. A drop attachment for extension bells.

835,142. INSULATING COMPOSITION. Wilson H. Strickler, Columbus, Ohio. Filed February 16, 1906. The material is formed of communited asbestos and mica, double silicate of soda and a solution of soap.

835,158. TERMINAL TIP FOR ELECTRIC CONDUCTING WIRES. Gustave L. Herz, New York, N. Y. Filed August 15, 1904. A sheet metal terminal.

835,181. TELEPHONE. Robert A. Davidson, Santa Cruz, Cal. Filed May 14, 1906. A talking circuit is normally open, but may be closed from the exchange or by lifting the receiver.

835,183. ELECTRIC BELL. Harold W. Eden, Detroit, Mich., assignor, by mesne assignments to P. R. Manufacturing Company, Detroit, Mich. Filed December 26, 1905. The hammer is carried on a compound lever.

835,199. ELECTRIC BELL. Charles M. Proctor, Detroit, Mich., assignor, by mesne assignments, to P. R. Manufacturing Company, Detroit, Mich. Filed December 26, 1905. The supports for the apparatus are punched up out of the sheet metal base.

835,211. COUPLING DEVICE. Charles E. Atkinson, Richmond, Ind., assignor of one-third to John M. Lontz, and one-third to Alexander Gordon, Richmond, Ind. Filed October 20, 1905. The two members of the couple dovetail together.

835,227. DYNAMOELECTRIC MACHINE. Robert Pohl, Bradford, England, and Felix Pohl, Cologne, Germany, assignors of one-half to the Phœnix Dynamo Manufacturing Company, Limited, Thornbury Works, Bradford, England. Filed January 28, 1905. Employs auxiliary poles.

835,235. PRESS FOR MAKING GLASS INSULATORS OR SIMILAR ARTICLES. Henry M. Brookfield, New York, N. Y., and William D. Stivers, Jersey City, N. J.; said Stivers assignor to said Brookfield. Filed January 30, 1902. A press for molding glass insulators split vertically.

835,236. PRESS FOR MAKING INSULATORS OR SIMILAR ARTICLES. Henry M. Brookfield, New York, N. Y. Filed August 10, 1905. A press for molding glass insulators having a single solid portion forming the head.

835,269. SELECTIVE SYSTEM. William R. Whitehorne, Bethlehem, Pa., assignor of one-half to Barry MacNutt, Bethlehem, Pa. Filed March 15, 1906. A signaling device is provided with a plurality of paths for the magnetic flux. The operating device is placed in but one of these paths.

835,279. TELEGRAPH POLE. Broderick Haskell, Franklin, Pa. Filed May 7, 1906. The pole is built up of U-shaped members held together by clips.

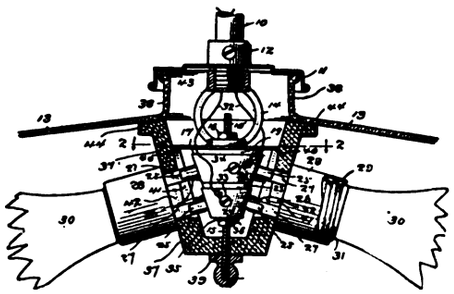
835,280. POLE FOR TELEGRAPHS, ETC. Broderick Haskell, Franklin, Pa. Filed May 7, 1906. The U-shaped members of the pole are held in place by filler blocks and bolts.

Digitized by Google

835,281. TELEGRAPH POLE. Broderick Haskell, Franklin, Pa. Filed May 31, 1906. The upright members of the pole are held in place by outside clips bolted to a spreader.

835,282. INCANDESCENT LAMP CLUSTER. Harvey Hubbell, Bridgeport, Ct. Filed October 15, 1904. A method of construction.

835,321. ELECTRIC METER. William H. Pratt, Lynn, Mass., assignor to General Electric Company. Filed April 20, 1904. A meter of the induction type.



835,282. INCANDESCENT LAMP CLUSTER.

835,322. ELECTRIC MEASURING INSTRUMENT. William H. Pratt, Lynn, Mass., assignor to General Electric Company. Filed May 24, 1904. An indicating meter.

835,327. PROCESS OF INSULATING ELECTRICAL CONDUCTORS. George H. Rupley, Schenectady, N. Y., assignor to General Electric Company. Filed January 13, 1906. Oil, freed from glycerine, mixed with powdered material, applied to the conductor and dried.

835,329. MEANS FOR PRECIPITATING GOLD AND SILVER. James Snodgrass, Johannesburg, Transvaal. Filed January 3, 1906. The cathodes are formed of wire mesh.

835,344. CURRENT RECTIFIER. William S. Andrews, Schenectady, N. Y., assignor to General Electric Company. Filed August 13, 1904. An electrolytic rectifier adapted for polyphase current.

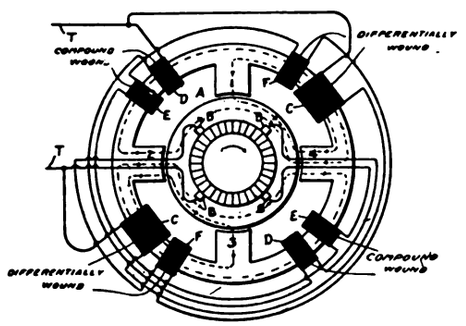
835,353. CUT-OUT. Richard Fleming, Lynn, Mass., assignor to General Electric Company. Filed April 30, 1903. A switch is contained within a supporting insulator.

835,354. SYSTEM OF ELECTRICAL DISTRIBUTION. Richard Fleming, Lynn, Mass., assignor to General Electric Company. Filed October 13, 1905. Vapor rectifiers transform the alternating current to direct current for operating arc lamps.

835,361. TELEPHONE RECEIVER. Charles T. Mason, Sumter, S. C., assignor to the Sumter Telephone Manufacturing Company, Sumter, S. C. Filed March 7, 1906. The cup supporting the diaphragm is carried on the magnet.

835,362. OPERATING BULKHEAD DOORS. Wilbur L. Merrill, Schenectady, N. Y., assignor to General Electric Company. Filed January 19, 1906. The door is operated by a motor.

835,363. CONSTANT-CURRENT GENERATOR. Maurice Milch, Schenectady, N. Y., assignor to General Electric Company. Filed April 3, 1905. Two series of field coils are used connected differentially and controlled by two sets of brushes.



835,363. CONSTANT-CURRENT GENERATOR.

835,367. INSULATION FOR ELECTRIC CIRCUITS AND METHOD OF PRODUCING THE SAME. Harris J. Ryan, Ithaca, N. Y., assignor to Westinghouse Electric and Manufacturing Company. Filed September 24, 1903. The transformer coils are submerged in a liquid dielectric under pressure.

835,377. MACHINE FOR BASING INCANDESCENT LAMPS. Alfred Swan, New York, N. Y., assignor to General Electric Company. Filed March 17, 1905. A machine for placing bases on incandescent lamps.

835,382. SYSTEM OF VALVE CONTROL. Frederick A. Willard, Rochester, N. Y., assignor to General Electric Company. Filed February 23, 1906. The valves are operated by electric motors.

835,384. ELECTRIC SIGNALING SYSTEM. James S. Anderson, Ames, Neb. Filed June 16, 1906. The signal is operated by contacts closed by the train.

835,388. THERMAL CUT-OUT. Ernst J. Berg, Schenectady, N. Y., assignor to General Electric Company. Filed June 1, 1903. A multiple fuse, one fuse being surrounded by a reactive coil.

835,401. PROTECTIVE DEVICE FOR AUTOMOBILE MOTORS. Alexander Churchward, Schenectady, N. Y., assignor to General Electric Company. Filed June 12, 1905. Means are provided for opening the armature circuit should the field circuit be broken.

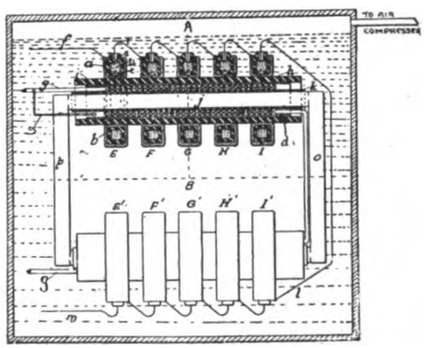
835,407. ALTERNATING-CURRENT MACHINE. Max Déri, Vienna, Austria-Hungary, assignor to Stanley Electric Manufacturing Company. Filed April 12, 1905. Transformer windings are provided on the field in addition to the ordinary windings.

835,410. SIGNAL. Charles R. Dowler, Lamar, Col., assignor to the Colorado Railway Signal Company. Filed January 12, 1906. A railway signal of the closed-circuit type.

835,411. CIRCUIT-BREAKING DEVICE. Charles R. Dowler, Lamar, Col., assignor to the Colorado Railway Signal Company, Lamar, Col. Filed February 9, 1906. A signal arranged to be actuated by the washing away of the track embankment.

835,415. SWITCH. Edgar W. Gough, Great Barrington, Mass. Filed May 3, 1905. A time-control switch.

835,416. REGULATOR FOR ELECTRIC CIRCUITS. Edgar W. Gough, Great Barrington, Mass. Filed July 6, 1905. The regulator is operated by two independent electromagnets.



835,367. INSULATION FOR ELECTRIC CIRCUITS AND METHOD OF PRODUCING THE SAME.

835,419. ALTERNATING-CURRENT BLOCK-SIGNAL SYSTEM. Max R. Hanna, Schenectady, N. Y., assignor to General Electric Company. Filed April 26, 1906. A block-signal system operated by alternating currents.

835,422. LAMP-SHADE HOLDER. Henry A. C. Hellyer, Tenafly, N. J. Filed April 26, 1906. The holder supports the shade by means of interior projections.

835,427. RECEPTACLE. Charles H. Hill, Schenectady, N. Y., assignor to General Electric Company. Filed February 11, 1905. A receptacle suitable for switchboard signal lamps.

835,441. SIGNALING SYSTEM. Wesley E. Laird, Pittsfield, Mass., assignor to Stanley Electric Manufacturing Company, Pittsfield, Mass. Filed July 22, 1904. A signal is actuated by means of electromagnets and a ratchet.

835,444. INDUCTION-MOTOR CONTROL. Marius C. A. Latour, Paris, France, assignor to General Electric Company. Filed March 27, 1905. The motor is provided with a number of pole-windings, and the speed is varied by changing the position of the poles without changing their number.

835,461. ELECTRICAL MEASURING INSTRUMENT. Edwin F. Northrup, Philadelphia, Pa., assignor to the Leeds & Northrup Company, Philadelphia, Pa. Filed May 26, 1906. The movement of the indicating needle is controlled by a number of coils moving into and out of a magnetic field.

835,484. DEMAND INDICATOR. Leonard Wilson, Pittsfield, Mass., assignor to Stanley-G. I. Electric Manufacturing Company. Filed September 18, 1905. The displacement of an indicating liquid is controlled by a heating strip.

835,487. SYSTEM OF ELECTRICAL REGULATION. John L. Creveling, Cronly, N. C. Original application filed February 12, 1902. Serial No. 93,775. Divided and this application filed December 19, 1903. A regulator for maintaining given current outputs of a generator according to the voltage of the storage battery being charged.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 21. NEW YORK, SATURDAY, NOVEMBER 24, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK

PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO

WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON

NEW ENGLAND OFFICE, ... 95 MILK STREET

LONDON

EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
The Telephone as a Measuring Instrument 835
Underground Cables for High-Voltage Transmission 836
Increasing the Institute Membership 836
Substation Practice 837
Plans for Electrical Supply in London 837
Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw. 838
New Developments of the Southern Power Company 841
Electricity in the Treatment of Disease, by John V. Shoemaker 841
Liverpool's Street Lighting 842
Practice *versus* Theory in Electric Railway Substation Operation, by Sydney W. Ashe 843
London Power Bills 845
Electricity as a Power in Mining in Mexico 847
Dinner of the Electrical Trades Association of Philadelphia 847
The William J. Hammer Collection of Incandescent Electric Lamps .. 847
Electrical Notes from Europe 848
Absorption of Radioactive Emanations by Charcoal 849
National Convention for the Extension of the Foreign Commerce of the United States 849
Adjuncts to the Power Load, by C. J. Russell 850
A Good Year for the Boston Elevated Railway Company 853
The Indiana, Columbus & Eastern Traction Company 854
Economy in Central Station Operation, by George Wilkinson 855
Recent Storage Battery Improvements, by Sherard Cowper-Coles 858
New York Electrical Society 861
Standardization of Tramway Motors 862
The Behavior of Iron Under Weak Periodic Magnetizing Forces 863
Magnetic Survey of South Africa 863
Single-Phase Railways in England 863
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 864
METHODS OF GETTING NEW BUSINESS 866
INDUSTRIAL SECTION:
Mercury Arc Rectifier Panel for Charging Ignition Batteries 867
Westinghouse Gets Orders for Large Electrical Pumping Stations to Supply Mexico City with Water—Five Stations to Be Installed 867
A New Line of Adjustable Lamp Brackets 868
Interborough-Metropolitan Makes Good Showing 868
A New Flush Receptacle 868
A Large Order for Wright Demand Indicators 869
A Unique Lighting Proposition for Milwaukee, Wis 869
Merger of Wireless Telegraph Companies 869
Evening Technical Courses at Columbia University 869
Milan Honors for the "Long Arm" System 869
Rejuvenated Sons of Jove 869
Illuminating Engineering Society 869
CURRENT ELECTRICAL NEWS 870
RECORD OF ELECTRICAL PATENTS 875

Copyright, 1906, by Electrical Review Publishing Co.

THE TELEPHONE AS A MEASURING INSTRUMENT.

A good deal has been heard of late about the use of the telephone for measuring small electric currents. In this connection it is always the telephone receiver that is implied, and its value depends upon its sensitiveness; a very small amount of energy is sufficient to produce an audible click in a sensitive instrument. For certain purposes the telephone receiver is a reliable and sensitive device. It may be used with good results for comparing electrical quantities, if the proper conditions be secured. When it is possible to arrange the measurement so as to use a null or zero method the telephone works very well. It serves here merely as a means of balancing two quantities. It will indicate by its silence a slight unbalancing one way or the other, serving to produce a sound in the receiver. For such uses it is necessary that the energy which actuates the receiver be pulsating; otherwise no sound will be produced. The earliest use of the instrument was to compare inductances and capacities, an alternating current being employed; and later it was used in an adaptation of the potentiometer, measuring electromotive-forces. The circuit containing the receiver in this case was periodically opened.

But the telephone receiver is now being used to some extent in another way, the accuracy of which may be questioned. It is sought to measure by means of it small amounts of electrical energy by comparing the intensity of the sound produced in the telephone receiver with that produced by energy supplied from a second source. The latter supply is varied and the connections alternately thrown from one circuit to the other until the experimenter decides that the sounds are equal. In this use very much depends upon the judgment of the experimenter. He must determine the relative intensities of two sounds. Any one who has done any photometric work knows how difficult it is to decide when two surfaces are equally illuminated if the color of the lights be not identically the same. Although it is possible that the eye may be somewhat more erratic than the ear, it is not probable, and unless the two sounds produced in the telephone are exactly alike in all respects, both in intensity and quality, it will be just as difficult to decide when a balance is secured as it is in the photometer. And when using the telephone there is this additional difficulty as compared with the photometer: In the latter case two things are compared which are seen simultaneously, but in the former two sounds are compared which are heard alternately.

There is also another chance of error. The sound produced in the telephone undoubtedly depends not only upon the quantity of energy passed through, but the manner of its passage;

Digitized by Google

upon the form of the electric impulse; and until this phase has been tested it is a little risky to accept quantitative results when obtained by means of the telephone receiver. Under proper conditions it might give satisfaction for qualitative results, but even here there is ample opportunity for error.

UNDERGROUND CABLES FOR HIGH-VOLTAGE TRANSMISSION.

In the discussion of underground cables contained in the paper presented by Mr. H. G. Stott at the recent street railway convention, the reference to cables for higher voltages is significant. Heretofore the use of underground cables for transmission purposes has been confined almost entirely to city use, and the voltages employed have been from 6,000 to 11,000. In some cases higher values have been used—as high as 25,000; but this has generally been to meet some peculiar condition. For city purposes, where the distances are not great, there would seem to be no need at present for a great increase in pressure. For long-distance transmission, on the other hand, the expense of laying the conductors underground makes such a system prohibitive at the present time, even were it possible to construct a cable for the voltages now employed. On first thought, therefore, there seems to be no demand for a cable which could be used safely on a 44,000-volt system underground.

Nevertheless, that the idea of using such cables should occur to any one indicates the general trend of engineering progress. At the present time the high-tension apparatus of a city system is capable of operating at a considerably higher voltage than that employed, with the exception of the cables, and our present experience leads us to believe that when cables for these higher pressures are demanded that they will be forthcoming. As pointed out by Mr. Stott, a 44,000-volt, three-phase, star-connected system with grounded neutral should be as safe to operate as a 25,000-volt system with the neutral ungrounded. But the question may be asked, in what way would a city system gain sufficiently by a four-fold increase in voltage to compensate for the increased cost of the cables? The distances are short as compared with cross-country transmission systems; and the opportunity of transmitting this power throughout the large area which a high voltage would bring within economical distance is one which few companies are in a position to avail themselves of. Evidently the gains must be sought in some other way. They consist, of course, of an increase in efficiency of transmission which, in some cases, would be but a small gain; and in a decrease in the cross-section of copper conductors, somewhat, if not entirely, offset by the increase in the cost of insulation. But the most important gain would undoubtedly be the reduction in the currents transmitted, The experience of some of our largest city systems has shown that more trouble is to be expected from cables carrying large currents at moderately high voltages than from those carrying small currents at the highest voltages we employ; and a reduction in these currents, even at the cost of increasing the voltage, would, it is believed, add much to the reliability of the system and reduce the damage to cables when accidents do happen.

If 44,000 volts be adopted for underground transmission lines, and it be found successful, it would not be surprising to have even higher voltages tried. Such a system is coming very close to the voltages now employed on the longest overhead transmission systems. These generally lie between 50,000 and 60,000, the latter figure as the upper limit, set, not by the weakness of the electrical apparatus, but because above this point the losses from the overhead wire increase rapidly. It is possible that some such limitation will be found for underground cables, yet if transformer windings operate satisfactorily at 80,000 volts or more the limiting consideration may be merely one of cost. The insulation thought to promise best for such cables is one consisting of cloth tape properly impregnated with some good compound. Rubber will hardly be used until some way of preventing the deleterious effect of high-tension discharges has been devised. This is fortunate, in a way, since our rubber resources are already taxed to the utmost to supply the necessary quantity of material for insulating low-potential wires.

INCREASING THE INSTITUTE MEMBERSHIP.

The American Institute of Electrical Engineers is the representative organization of the electrical engineering profession, and, as has been pointed out several times in the presidential addresses of recent incumbents of office of the Institute presidency, it should be the duty of all those who are directly connected with the electrical industry, and particularly those whose earning powers are augmented by the advancing prestige given to electrical engineering by reason of the Institute and its work, to support the organization, and, entering into its spirit, to live up to the high standard it seeks to provide.

The nearness to completion of the new Engineers' Building, with adequate office facilities, expanded library accommodations, and members' privileges to which the Institute is entitled as one of the founder bodies, brings out very strongly at this time the advantage of Institute membership.

While the growth of the Institute membership has been steady and considerable gains have been made within the past three or four years, the numerical gain has not been in proportion to the gain in the industry, to the efforts of those who have been largely responsible for this wide-spread activity, nor to the prosperity which has come to those who have been engaged in the industry.

In his discussion of "Engineering Honors," which was taken as the theme of the presidential address, delivered at the Milwaukee convention, President Wheeler quoted Francis Bacon where he says, in the preface to his "Maxims of the Law":

"I hold every man a debtor to his profession; from the which as men of course do seek to receive contenance and profit, so ought they of duty to endeavor themselves by way of amends to be a help and ornament thereunto."

The speaker showed that one way in which every one ought to be a help to his profession is by giving it the support which comes from his membership. This seems to be little enough to ask of any one who has profited in any way by his profession,

Digitized by Google

yet an examination of the Institute membership list will show important sections of the country without Institute representation. In his inaugural address on September 28, President Sheldon stated that "one of our foremost and largest universities, with an electrical engineering course in its curriculum, has not a single person connected with it whose name appears upon our rolls."

This is not as it should be. Many of the brightest minds in electrical engineering of history have done noble work in the name of the Institute, and to-day, men of the same type are giving conscientious service to the Institute, largely that the profession as a whole may be advanced. Every man who possesses the proper qualifications for membership either associate or full, should hold it an honor and distinction to be enrolled.

SUBSTATION PRACTICE.

It is unfortunately true that the practising engineer finds little time for writing. This lack of opportunity is felt not only by the students of text-books, who are forced to depend largely upon those who have made a business of teaching, rather than upon the men who actually do the work, but by the technical journals as well. Probably in no other field of journalism is it so difficult to get the proper men to discuss vital problems, and nearly all such contributions are obtained by solicitation—they are not offered voluntarily.

This condition must not be taken as a discredit to those who do write for the text-books or for the journals; in fact, many of these books or writings could not be improved upon, so far as they go. The theory is accurately and clearly presented, and often the modifications which practice makes desirable are dwelt upon, sometimes at length; yet there does remain a lack of discussion of the problems met every day by the man who spends his life in the central station or on the railway or in telephone work, or any of the other many branches of engineering.

Many of these men do not seem to have time for writing; to others, no doubt, these matters are so commonplace that they can not believe that they are interesting to those who are not so familiar with them; and others, again, have not developed the faculty of observation. For this reason the paper presented on another page of this issue by Sydney W. Ashe is of unusual interest. Mr. Ashe, having felt during his work of teaching the need for more definite information dealing with operating practice, obtained employment at a railway substation, actually doing the work there, and at the same time studying it in all its phases. The result is not only a clearer insight into the ways of doing things, but, by comparing the conditions of the men who work upon the different shifts of the day, some deductions are drawn which seem to be of considerable value. Such studies are not only interesting to others who are doing just such work, but they are doubly interesting to the man who has not had the opportunity of actually seeing for himself.

PLANS FOR ELECTRICAL SUPPLY IN LONDON.

An interesting report has been presented to the London (England) County Council by its highway committee, drawing up a scheme for supplying London with cheap power. An abstract of this report will be found on another page of this issue. It shows that the committee has taken a broad view of the situation and plans on a large scale.

At the present time there are in London fifteen municipal systems and a number of private plants. The report advises that all of these be acquired by the County Council and that power be obtained from Parliament to supply electric power to an area of 451 square miles. Of this large district 117 square miles are in London, the rest lying in the surrounding districts. The scheme suggested is, in brief, the building of one or two large generating stations where modern machinery may be installed for generating power and distributing it by means of high-tension, three-phase lines to substations suitably located. The generating stations now in operation there may be used as substations, though it is contemplated to abandon their generating machinery gradually as the new system goes into operation. Several of these power stations are very modern in design, some of them having been put into service recently. The investment which has already been made in these plants amounts to over $63,000,000, a great deal of which was alvanced by the London County Council to assist the local authorities in financing their individual plants. The new system, it is estimated, will cost $7,000,000 for the land, station and equipment, and $13,250,000 for the transmission and distributing systems. This brings the entire cost for the undertaking to about $85,000,000, allowing for the private plants which must be acquired. It will not be necessary to raise all of this large sum, as, of course, in acquiring the old plants that money which has already been advanced will be deducted from the cost.

The outcome of this undertaking, as well as that which is now under consideration for Paris, will be watched in this country with much interest. No city on this side of the Atlantic has gone so deeply into the municipal operation of light and power systems, and recent reports from engineers who have been to Europe were, on the whole, rather unfavorable. London, it seems, is in a peculiar condition. It is losing a number of its important manufacturing works because they can not secure cheap power, or rather because they can do better elsewhere; and it is to supply this want that the present scheme is proposed. Although $63,000,000 seems a lot to pay to acquire one or two large plants in place of some fifteen small ones, it should be borne in mind that it will be some years before the new system can be delivering power—the earliest date set is 1910—and that a good deal of the machinery now in use will be by that time superannuated and should be retired. It is probable that the more recent plants will continue to work as auxiliaries for some years longer. The engineering problems in the plan are of considerable magnitude and must be viewed broadly. If the report of the committee be adopted and authority be obtained from Parliament to go ahead with the work, the engineering plans will certainly prove of very great interest.

Digitized by Google

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW.

XI—The Use of Continuous and Recording Gas-Testing Apparatus.

A large number of automatic and recording gas-testing instruments of various types have been devised and are now being sold to steam users for checking the work of the firemen engaged upon the boiler plant. These instruments are costly to install, and require skilled attention to maintain them in satisfactory working order. When placed in the charge of men who will give the necessary time and trouble to the work, they yield in most cases, however, satisfactory results.

The tests obtained with these automatic and recording gas-testing instruments can only be regarded as supplementary to the gas-testing methods described in the previous article—for neither hydrogen nor carbonic oxide gas is recorded by the apparatus. The heat losses, due to the presence of these two constituents in the waste gases from the boilers, are, however, so great that no method of control which ignores their possible presence can be considered satisfactory. This matter will be further dealt with in Article xii. Even the carbon dioxide test is liable to be incorrect, and independent check tests once a week or oftener with an Orsat apparatus are necessary, to ascertain the margin of error with the automatic apparatus.

The automatic gas-testing instruments may be divided into two classes: those depending for their action upon carbon dioxide absorption in caustic potash, and those based upon the observation of some physical characteristic of the waste gases, which varies in definite ratio and within fixed limits with different percentages of the same gas. To the first of these classes belong the "Ados" and "Uehling," to the second the "Krell," "Arndt" and "Haber" instruments. Of these various types the "Ados" and the "Krell" are the most widely used in the United Kingdom.

1. The Connections between the Testing Instrument and the Flues—As generally arranged, one automatic instrument with a recording attachment is installed in a closed cabin or case in the boiler house and connection from this instrument to the side flues of each boiler of the installation is made by one long main of three-quarter-inch wrought-iron pipe, with branch connections of the same diameter. Each branch pipe to the boiler flue is provided with a cock. A filter filled with glass or wood wool is employed in the main suction pipe to retain dirt and soot.

By means of a fan or pump gas is drawn continuously from the flues through these connecting pipes to the testing apparatus; and by opening only the cock leading to the flue of the boiler or boilers under test, the gas sample can be varied as required.

Many objections, all bearing upon the accuracy of the results obtained, may be urged against this method of obtaining the sample. The distance of the testing apparatus from the boiler flue and the presence of a very large number of cocks and soot filters on the one line of pipes, may cause air leakage, and consequently incorrect

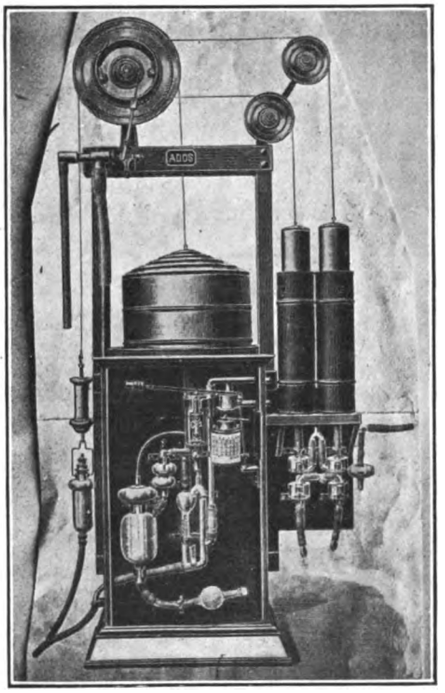


Fig. 41.—The "Ados" CO_2 Recorder, Old Form.

CO_2 tests. The use of iron pipe leads to corrosion by the chimney gases, and to absorption of some portion of the constituents. In some cases so serious is this corrosion and formation of salt deposits within the pipes, that great difficulty is experienced in keeping these open for the passage of the gas sample. The large volume of stale gas contained within the long length of sampling pipe, and in the soot-filters, is another cause of incorrect results, since the speed of the fan or pump is not sufficiently high to clear this gas out in reasonable time. Six times the volume of gas must be drawn through these pipes and filters before all the stale gas can be considered to have been removed.

The following recommendations are therefore made for connecting the automatic recording apparatus of any type to the boiler flues, and only when these have been strictly followed can confidence be placed in the test results.

A water-jet pump of the type shown in Fig. 34 (Article ix), should be employed for drawing the gases from the boiler flues. This pump should be fed from a water tank placed twenty or more feet above the ground, fed from the general water supply by a ball tap, and provided with a filtering arrangement at the run-off pipe, which carries the water to the water-jet pump. This plan ensures a constant head of clean water and constant work of the pump at a uniform rate, with all freedom from stoppage due to the collection of grit or dust in the water jet.

The connecting pipe to the flues should either be of iron enamelled inside, or of six-foot lengths of glass tube. If glass be used the pipes must be placed overhead, and not laid along the boilers, and a T-piece provided with a glass stop-cock must be used for each branch to the boiler flues. The vertical branch into the flue must be of hard potash glass, three-eighths-inch external diameter. All connections of glass tube must be made with the best red rubber tubing and fastened with wire, and once a week the tightness of the system must be tested by closing all the cocks and working the water-jet pump until a twenty-inch vacuum is registered by the pressure gauge attached to the system near the pump.[1]

The dependent glass tubes into the flues must be fixed in flanged guard pipes by cork bungs, as described in Article ix, and once a week they must be withdrawn and cleaned both internally and externally from the adherent soot.

The main lengths of enamelled iron or glass tubing must be set with a fall away from the testing instrument, and these should also be cleaned monthly or oftener if required by blowing steam through them.

The vessel or vessels which act as soot-filters must be placed close to the water-jet pump, must be designed without any water seal, and of small dimensions. They should be cleaned weekly or oftener if required.

Finally, it is advisable to have one automatic instrument installed for each six boilers, and to place the cabin or cupboard in a position central to this bat-

[1]All rights of translation and reproduction reserved. Copyright, 1906, by John B. C. Kershaw.

[1] A twenty-nine inch vacuum can be obtained with these water-jet air pumps when a sufficient pressure of water is obtained in the supply.

Digitized by Google

tery of boilers in order that the connecting pipes to the furthest boiler of the system may not exceed thirty feet in length. A connection should also be made to the nearest point in the main flue leading to the chimney. A separate apparatus should be installed for testing the exit gases at the chimney, and from the flue midway between the economizers and the chimney. By this plan of arranging the testing system, a battery of twenty-four boilers would be provided with five testing instruments, and continuous tests of the gases from any boiler of the twenty-four from five points on the main flue, and from the chimney, could be obtained.

As already stated the present methods of connecting up the automatic testing

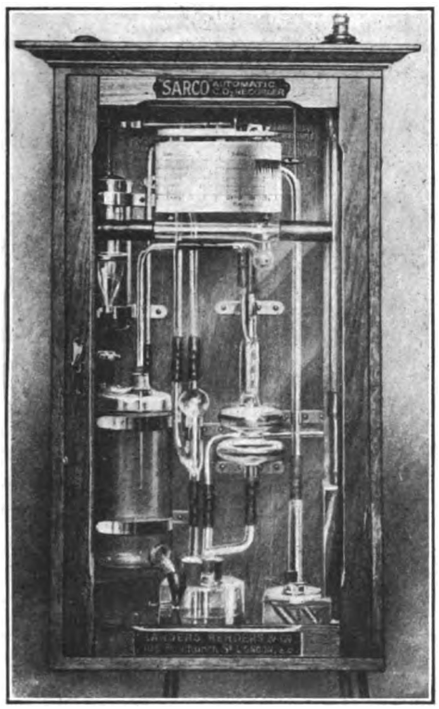


FIG. 42.—THE "ADOS" CO_2 RECORDER, NEW FORM.

instruments are in most cases defective, and only by following some such plan as that described above, can these defects be removed.

2. Automatic Testing and Recording Instruments. (*a*)—*The "Ados" or "Sarco" Recorder*—The Ados recording apparatus is widely used in this country and in Germany for testing the waste gases of boiler plants. Fig. 41 shows the old form of this instrument and Fig. 42 the new form. The two cylindrical vessels shown on the right hand of Fig. 41 contain samples of the flue-gases drawn by suction from the flues. While one of these is filling, the other is delivering a sample of the gas into the measuring and absorption pipettes of the apparatus. One hundred cubic centimetres of the gas are used for each test, and the percentage of CO_2 is determined by absorption with caustic potash solution, exactly as in the two forms of testing apparatus already described and illus-

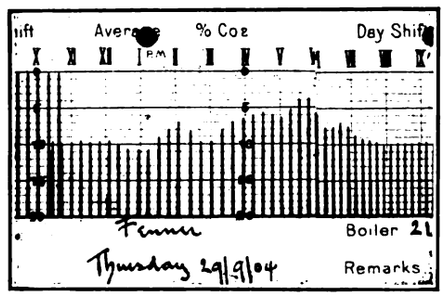


FIG. 43.—RECORDS MADE WITH AN "ADOS" INSTRUMENT.

trated. The absorption takes place in the disc-like glass vessel shown on the left in Fig. 41 in order to obtain a large surface of KOH solution in contact with the exit gases. The volume of the gas remaining after the absorption of the CO_2 is recorded by means of a float and lever upon paper carried on a revolving drum, a vertical line being marked by the pen attached to the lever for each separate test. When the volume of the remaining gas is 100 cubic centimetres (*i. e.*, when no CO_2 is present), this line extends the full width of the lined paper; when ten per cent of CO_2 is present, the vertical line extends only up to the line 10. The clear space above the line thus measures the percentage of CO_2 present in the flue gases at any particular time during the day, and as the frequency of testing can be varied at will, the average of the day's work can be ascertained by means of this apparatus. It is customary to arrange the controlling mechanism so that samples of gas are drawn from the flues and tested every ten minutes. The Ados apparatus requires careful adjustment and control, and the KOH solution must be renewed at intervals depending upon the frequency of the tests. Fig. 43 shows a record made with this instrument over a period of twelve hours.

(*b*)—*The Uehling Gas Composimeter*—This instrument is an American invention and is not much known in this country, although a pyrometer based on the same principle is widely used in ironworks in America and in the United Kingdom. The gas composimeter is shown in Fig. 44. Its working is based upon the law which governs the flow of gases through small apertures. A constant suction is applied by means of a steam jet at one end of a gas-tube provided with an inlet smaller than its outlet, and connected to the exit flue. In this tube the chimney gases are submitted to the action of a caustic potash solution. The variations in pressure of the gases within this tube give the measure of the absorption which is occurring, and therefore of the amount of CO_2 present. The exact measurement of pressure variation by means of a mercury column is, consequently, all that is required to yield the percentage of CO_2. This instrument can be provided with a recording pen and drum in order to obtain continuous records of the CO_2 present in the waste gases. Since the Uehling composimeter requires a caustic potash solution and takes no account of the carbonic oxide present, it is open to the objections already mentioned.

(*c*)—*Arndt's Econometer or Gas Balance*—The two instruments described above depend for their action upon the absorption of carbon dioxide gas by solu-

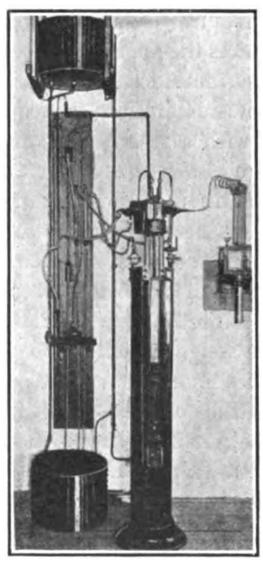


FIG. 44.—THE "UEHLING" CO_2 TESTING INSTRUMENT.

tions of caustic potash. The three remaining recording instruments depend for their action upon the variation in some physical property of the mixed gases. The Arndt gas balance is shown in Fig. 45.

Carbonic acid gas is considerably heavier than air, the respective weights of one litre being 1.97 grammes and 1.29 grammes. Thus an increasing percentage of carbonic acid gas will be indicated by an increase in the relative weights of a measured volume of the waste gases, and of air. This fact is made use of in Arndt's econometer, which is in reality a gas balance. The waste gases are weighed after being continually drawn from the flue at E, through the weighing bulb C, by means

Digitized by Google

of a steam jet fixed at D. A and B are filters and drying tubes to remove soot and moisture, before the gases are passed

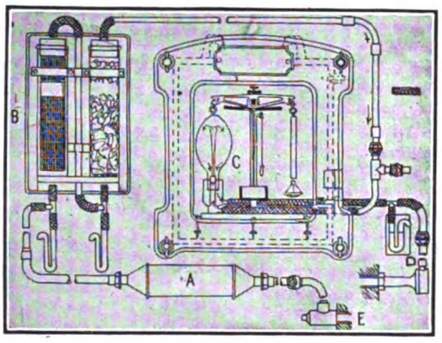


FIG. 45.—ARNDT'S GAS BALANCE.

into the bulb C. The scale of the balance is graduated so that the percentage of CO_2 at any given moment can be read off directly. If desired, the apparatus can be provided with a recording attachment in order that a continuous record of the CO_2 may be obtained.

The filters and drying tubes of this apparatus require constant attention; in other respects the apparatus is less troublesome than the Ados apparatus, since no caustic-potash solution is required. If provided with a recording drum, the test records are also continuous and not intermittent, as in the Ados apparatus. The possible presence of carbonic oxide in the exit gases is, however, ignored, as in all other forms of automatic recording apparatus. Since this gas is lighter than air (one litre weighing only 1.25 grammes), its presence in any quantity will render determinations of the CO_2 from the readings of the Arndt apparatus incorrect.

(*d*)—*The Krell Recorder*—This apparatus is shown in Figs. 46 and 47. In principle it is allied to the Arndt gas balance, since its action depends upon the relative weights of the flue gases and of air. In this case, however, the difference is measured by a delicate differential gauge, attached to two tubes of equal height, one containing air and the other the sample of gas from the flues. The pressure-gauge readings are taken by means of a slightly inclined glass tube filled with colored alcohol, which projects from the pressure gauge-box. The position of the end of this thread of colored alcohol varies with the pressure in the gauge-box, and by means of a scale marked in percentages of CO_2 corresponding to certain pressures, the percentage of this gas present in the flue gases at any given moment can be read off directly on the scale. This instrument is usually provided with accessories by which the position of the thread of colored alcohol is continuously photographed on a recording cylinder and paper. A continuous record of the percentage of CO_2 present in the waste gases is thus obtained.

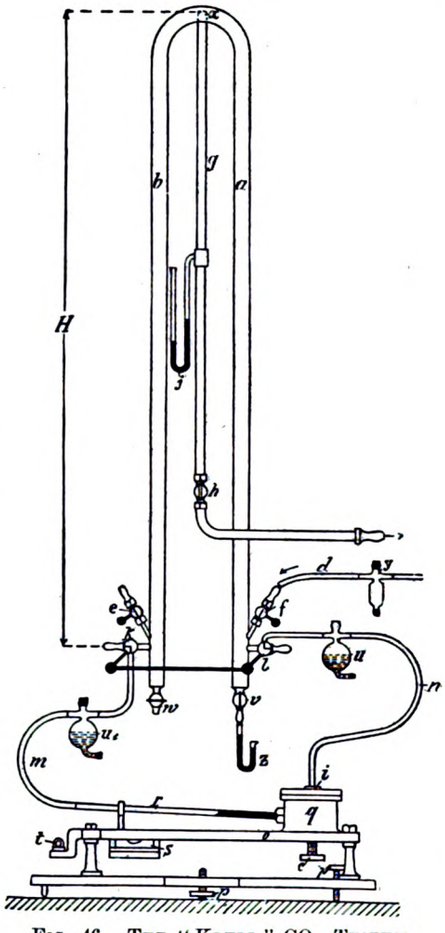


FIG. 46.—THE "KRELL" CO_2 TESTING INSTRUMENT.

The defects of this apparatus are: first, that no account is kept of the carbonic oxide which may be present in the exit gases—this gas, if present, will render all the readings for CO_2 incorrect, for the reasons already given when discussing the Arndt instrument. The second defect is

FIG. 47.—THE "KRELL" CO_2 TESTING INSTRUMENT, WITH RECORDING DRUM.

that the necessity for developing the records photographically adds considerably to the trouble and expense of keeping the apparatus in working order.

The Krell apparatus is now installed at several electric light stations in this country.

(*e*)—*The Haber-Loewe CO_2 Testing Instrument*—This instrument differs from all others in that the variations in the refractive index of the waste gases are made use of to determine the percentage of CO_2 by direct observation. The method is therefore an optical one and resembles in some respects the optical methods for determining temperature. The instrument consists of the following essential parts—a prism, a telescope and a microscope.

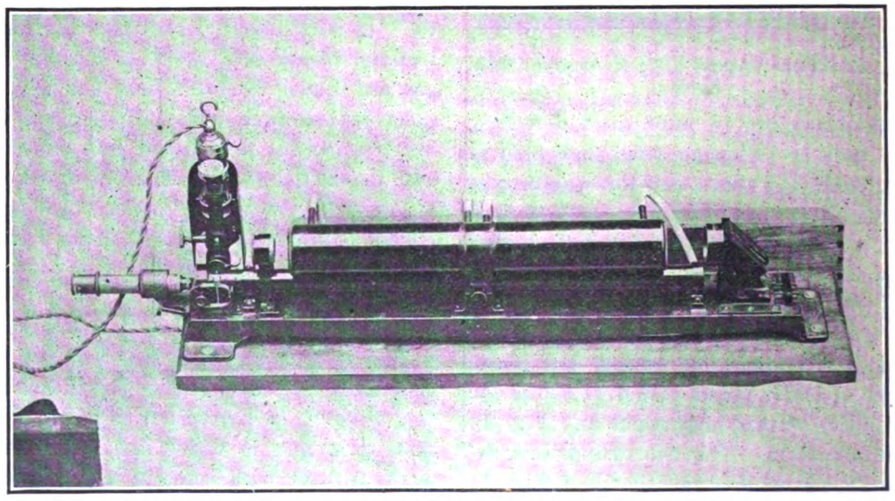


FIG. 48.—THE "HABER-LOEWE" CO_2 TESTING INSTRUMENT.

Digitized by Google

The gas to be tested flows through the prism, which is hollow, is made of varnished metal, and is provided with windows for the incident and refracted rays of light. The gas used for comparison flows through a casing. When observations are made with the telescope and microscope in position, the observer sees in the field of vision a scale which is partly light and partly dark. In pure air the boundary of the dark zone would coincide with 0 degree on the scale; in air containing 0.9 per cent CO_2 this boundary would coincide with 1.0 degree on the scale; and in air containing 9.0 per cent of CO_2 the boundary of the dark zone would be at 10.0 on the scale.

The instrument can be graduated so as to yield the percentage of CO_2 in the waste gases by direct observation, air being generally used as basis of the comparison. If desired, the instrument can be made to record the readings by a photographic attachment, as in the Krell recorder.

The refractive indices upon which the instrument is based are as follows:

Hydrogen	1.000139
Aqueous vapor	1.000261
Oxygen	1.000270
Dry air	1.000291
Nitrogen	1.000297
Carbon monoxide	1.000340
Methane	1.000444
Carbon dioxide	1.000452
Acetylene	1.000610
Sulphur dioxide	1.000665
Ethylene	1.000678

The method is only applicable with success to gas mixtures containing two gases whose indices of refraction differ by considerable amounts—and the figures given above show that the presence of hydrogen, aqueous vapor and sulphur dioxide will all influence the results unfavorably. Carbon monoxide gas will also be returned as carbon dioxide by this method of observation. Fig. 48 illustrates the form of this new instrument, which is being manufactured by Carl Zeiss, of Jena.

New Developments of the Southern Power Company.

The Southern Power Company, Charlotte, N. C., will shortly commence work on two new power sites, one at the Ninety-nine Islands, on the Broad river, six miles south of Blacksburg, S. C., and the other at Rocky Creek, two miles below the Great Falls station, on the Catawba river. The Ninety-nine Islands developments will produce 16,000 horse-power, while the capacity of the Rocky Creek station will be 30,000 horse-power. The total cost of these two developments will approximate $3,000,000, and both will be completed by January 1, 1908.

The company recently made an addition of $2,500,000 to its capital.

ELECTRICITY IN THE TREATMENT OF DISEASE.[1]

BY JOHN V. SHOEMAKER.

Perhaps the best use I can make of the time at my command this afternoon will be to devote it to the consideration of a few applications that I have found especially serviceable in my own experience. In concluding, I will make a comment based upon personal observation with regard to the proper field of usefulness of this potent force. In order to obtain the best results in practice it is important that we shall bear in mind the limitations of electricity in clinical medicine, because if these are disregarded we may expect to meet with certain disappointment. Extravagant claims made by too enthusiastic advocates are not only unjust to this valuable therapeutic resource, but they are also unjust to the patients who are led to expect impossibilities.

I think it will lead to a clearer view of electricity from the medical standpoint if we lay aside for the moment any preconception we have in our minds with regard to its being a mysterious, life-giving force, capable of working miracles upon the human body, and as being at all times constructive, energizing, and beneficent in its effects in pathological conditions. This, I know, is the popular idea, which has been largely founded upon the seductive and boastful advertisements of charlatans, who have found this a fruitful field in which to work on the credulity of the ignorant public. "There is no sacred disease," said Hippocrates, "or all diseases are equally sacred." So we may say with regard to remedies, there is no mysterious remedy, or all remedies are equally mysterious.

Mercury, arsenic and other potent drugs may, according to circumstances, act as caustic agents and destroy tissues, or they may act as tonics and favor physiological changes. In the same way electricity may be used in medicine to destroy tissue, or, on the other hand, to favorably influence metabolism, depending upon the form in which it is used and the skill with which it is applied.

Let us now briefly consider the forms in which electricity is utilized in medical practice. We observe, in the first place, that it is used both indirectly and directly. Among the indirect applications of electricity are those in which it is employed as a source of heat, light, magnetism and X-rays. As illustrations of the former I may mention the galvanocautery, the electric light and the Rœntgen apparatus; also the electromagnet. Illustrations of the direct application are the galvanic, the static, and the induced currents, obtained from the ordinary medical coil or from the large commercial dynamo. The latter, however, is much more powerful than is required for medical purposes, but it may be reduced by transformers and controllers, or "stepped down," so that it can be used therapeutically, as well as for heating and lighting the doctor's office.

The first point that I wish to make is that electricity is always the same in itself, but, like the other agents I have named, it may be given in different dosage and in different ways, so that entirely different therapeutic results may be obtained. Success in therapeutics, whether in the use of electricity or any other remedial agent, depends, as we know, very largely upon the personal skill and good judgment of the physician who makes use of it. This method of regarding the subject will help to explain why certain conditions, such as neuralgia, may be treated successfully either by galvanism, static electricity or by the Rœntgen ray; these apparently different forms of electricity being skilfully employed to produce apparently the same local effects.

Taking a broad view of the subject, we observe that electricity is employed in therapeutics to accomplish certain definite ends. The clinical fact that these objects may in some cases be attained by several different methods or forms of application I have already alluded to. It is also true that others apparently, so far as we know, can only be accomplished by special apparatus and by a single method or technique. In fact, particular means are often employed to obtain definite results, because at present they appear to be the best which have yet been devised to fulfil the special conditions.

With regard to the modus medendi, or the physiological action of the agent, we may observe that electricity may be used to produce the following effects:

1. To produce local necrosis, or an eschar. Limited applications may not go so far as to cause tissue or cell destruction, and may only produce local vascular changes, or, in other words, they may act as rubefacients or counter-irritants. Powerful currents, if passed through the body, will, on the contrary, abruptly terminate and abolish all physiological processes.

2. To disturb the electrical relations of the elements of nerves and muscles. This

[1] Abstract of a paper read before the Pennsylvania State Medical Society at Bedford Springs, Pa., September 11, 1906.

Digitized by Google

is shown by muscular contractions, produced when a nerve trunk and a voluntary muscle are brought within the influence of a current of appropriate strength. It is to be observed here that the electricity primarily gives no additional strength to the nerve or muscle, but simply calls into action energy which is already there. However, by its power to call into play the latent energy of the muscle, it causes movements of the muscle, which in turn leads secondarily to increased blood supply and improvement in nutrition. Illustrations of this are very common, as in treating muscular paralysis.

3. To modify metabolism. Its effects in this direction are well illustrated by the Rœntgen apparatus. Exposure to the X-rays causes local nutritive changes in the skin, the linugo hairs fall out from the operator's hands, the skin becomes glossy and thin from the atrophy of the glands, chronic ulceration may occur, which in turn may be followed by malignant disease. It has been repeatedly observed that unguarded exposure of the body to the X-rays causes degenerative and atrophic changes in the deeper parts, especially in the fundus of the eye. In therapeutics this inhibitory and atrophic action may be skilfully directed against cancerous or other new growths. The latter, having less power of resistance than normal tissue, are made to undergo retrograde change and to wither away. This is especially noticeable in epithelioma of the skin, and also in accessible organs.

4. To act as a temporary stimulant to nutritive processes, and especially to the nervous system and the circulatory apparatus. This is illustrated by the good effects upon nutrition produced by the static current and electric bath, in anæmia, neurasthenia, atonic dyspepsia, chronic rheumatism, and incipient tuberculosis.

5. To accomplish certain local effects by stimulating physiological functions. This is shown in the use of electricity to increase the flow of milk from the mammary gland. The systematic application to the scalp causes improved nourishment of hair follicles, and not only prevents baldness, but also actually increases the growth and thickness of the hair.

6. To destroy parasites upon the surface of the body. Many infectious diseases of the skin caused by vegetable micro-organisms are promptly cured by the X-rays.

7. To produce electrolysis. By means of needles introduced into the skin and the passage of a suitable galvanic current, decomposition of fluids and solids occurs, and as a result there may be absorption of new growth. This is utilized in treating keloid or hypertrophied tissue of the nose or throat, and in the destruction of pigmented moles, and the removal of superfluous hair.

8. To produce intense light. The method, introduced by Finsen, which has been modified by the use of the electric source of illumination, has yielded really remarkable results from its action upon lupus, and on some superficial malignant growths. The electric light bath has been vaunted as a great restorative agent, but its utility is doubtful. In its operation the entire body is exposed to several hundred incandescent lights. In studying its effects it is difficult to separate the effects of the heat of the bulbs (which acts like a Turkish bath) from the effects of the light itself. We know that light is very irritating to the nervous system, and that the intense sunlight of tropical regions makes these unfit for a permanent residence for white races of men. At all events, the electric light bath does not act like the electric bath, but simply as a light and heat bath.

9. To produce high degree of heat. I need not stop to speak of the uses of the galvanocautery in surgery. It is a complete substitute for the actual cautery, and is superior to it when used as the caustic loop in removing vascular growths on the tonsils, especially in cases of hemophilia.

10. To produce magnetic effects. The electric magnetic coil is used to extract iron fragments from the eye in surgery. It is also utilized in the electric balance for detecting the location of a foreign body, such as a bullet embedded in the tissues.

The use of the X-ray in photography and in diagnosis, as in the skiascope, does not properly come within the province of the therapeutic applications of electricity.

I have now mentioned quite a number of useful applications of electricity in medicine, and I have by no means exhausted the list.

The second practical point I wish to make with regard to electricity, and with which I will close these rather desultory remarks, is this, and I regard it as a most important one:

Electricity, in most cases, is to be regarded as only an adjunct to other treatment. While giving the special electric application we should also give appropriate remedies to act upon the glands of excretion and secretion. We should consider the state of the blood and give hematinics to increase the blood corpuscles and hemoglobin, or give antidotes to certain toxins, or eliminants to carry off gouty, rheumatic, or other pathogenic agents, in addition to our prescription of electricity. Massage, exercise in the fresh air, a proper diet, regulation of habits of the individual, all these are accessory agents and should be conjoined with the electrical treatment if we wish to obtain the best results. Such, indeed, is the intelligent medical use of this agent in the hands of the qualified physician. Without such therapeutic accessories, electricity, like massage, is very restricted in its usefulness and tends toward charlatanism.

Liverpool's Street Lighting.

Consul John L. Griffiths, responding to an American letter requesting him to furnish information on the street lighting of Liverpool, writes as follows:

"Electric street lighting in Liverpool is represented by 188 electric arc lamps of the Johnson & Phillips ten-ampere double-carbon type, running four in series. Each arc burns until midnight, when it is extinguished, and two sixteen-candle-power incandescent electric lamps lighted in lieu, which burn until daybreak. However, during the months of November to February, inclusive, the arc lamps are relighted at five each morning, and burn until daybreak (Sundays and Christmas day excluded). Apart from the foregoing, the Liverpool streets are almost exclusively lighted by the 'Bellamy' type of incandescent gas lamp.

"The annual average cost of the electric lamps for lighting and maintenance is $80.78. The annual cost of two-light incandescent gas lamp for gas, lighting and maintenance amounts to $15.96. The annual cost of the one-light incandescent gas lamp is $11.71. Therefore, assuming lamps are placed fifty yards apart and gas at fifty-four cents per 1,000 cubic feet and electricity at four cents per unit (which are the present prices), the cost per mile works out as follows: electric lamps, $2,827.43; two-light incandescent gas, $554.78, and one-light incandescent gas, $408.78.

"As to what is considered the best illuminating lamp, the lighting committee of the Liverpool Corporation some years ago went very closely into this matter, I am informed, and came to the conclusion that on economic grounds the incandescent gas lamps yielded the best results and the type of lamp now in use was, as a result, adopted, and out of a total of 445 miles of streets in Liverpool 430 are lighted by this type."

Digitized by Google

Practice versus Theory in Electric Railway Substation Operation.

By Sydney W. Ashe.

THERE is a great tendency at the present time in the discussion of electric railway substation problems to view them entirely from a theoretical standpoint. Unfortunately, operating men who have had the greatest experience in the school of practice are men who seldom write for publication, who rarely present papers at the meetings of engineering societies, and who are loth to discuss papers at these meetings when they are present. As a result of this condition there seems to be a preponderance of theory in engineering literature. This does not apply alone to the discussion of problems relating to substation practice, but to every other phase of engineering. It is the purpose of the writer to discuss this feature in its relation to substation practice only.

With this idea in mind he entered the employ of one of the large operating companies in New York, and for a period of two months, under varying conditions of time and load, made a close investigation of substation operation. During this period a study was made of the individuality of various operators, the effect of various combinations of apparatus upon the operation of the system as a whole, of the utility of automatic apparatus, of the effect of depreciation, maintenance, distribution of operators' time, and of the desire to work at the different periods of a twenty-four-hour day. In fact almost every feature which entered into the operation of the system was closely studied. Subsequently with this knowledge other plants were visited and other conditions studied, the result of which was to create a broadened vision of the subject. Some of these impressions will be discussed in detail.

The Appreciation of Small Periods of Time—Imagine that an overload on the line has occurred when the second hand of a watch is at sixty. Then count one, two, three, four, five seconds. If the overload relays in the substation are set for five seconds then this is the interval which is allowed for the operator to reach the middle of a switchboard, watch the banked ammeter needle for an instant to see whether it is ever coming back, and finally to pull his section switches or to adjust the fields on the rotaries so as to shift some of the load to adjoining substations to keep his station from going out of commission. During this time the brushes of the converters are sparking viciously and the converters emitting a low painful grinding sound characteristic of an overloaded machine. This illustrates the great value to an operator of a few seconds of time. It is clear, therefore, that any arrangement of switch gear which will facilitate the manipulation of switches by the operator is to be recommended.

Another illustration of the value of time: Most of us have undoubtedly started in operation by means of a direct-current starting box, machines of about ten horse-power. Let us assume that a man experienced with small units is about to start for the first time a 1,500 kilowatt rotary converter, using a five-point starting switch, the machine starting from the direct-current side. What would be the result if he performed the operation upon the large machine in the same time required with the small machine, probably eight seconds. The rush of current into the 1,500-kilowatt converter would be so great as to trip out the circuit-breaker on the starting bus. The inertia of the large converter is so great and the resistance of its armature circuit so small that fully twenty-five seconds should be allowed for such an operation. Here is only a difference between twenty-five seconds and eight seconds, small enough, but still of vital importance to the operator.

One great advantage with rotary converters started from the alternating-current side is the small amount of time necessary to start such machines from rest and have full load upon them. The writer remembers one instance in which a 1,000-kilowatt converter was started from rest, synchronized, and placed under full load in twenty-eight seconds. This is the minimum value that the writer has ever obtained upon test. Fig. 1 is a starting curve for this same machine on a later test.

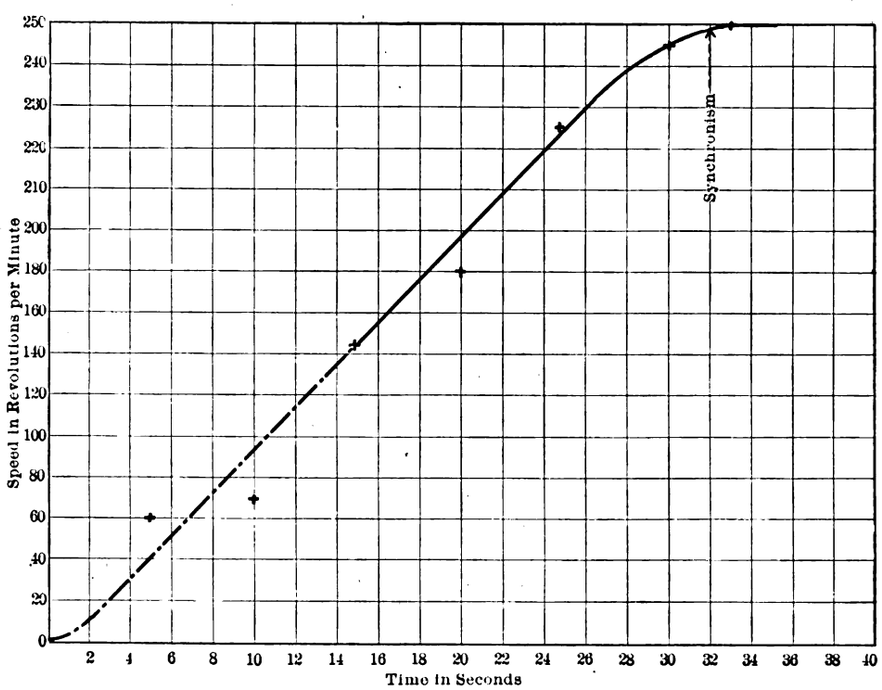


FIG. 1.—SPEED-TIME CURVE OF 1,000-KILOWATT ROTARY CONVERTER, STARTING FROM ALTERNATING-CURRENT SIDE.

One can readily imagine in cases of sudden overload the great value of such quick operation. With this method of starting time is saved by the absence of synchronizing, as the machine builds up directly into synchronism.

Consider another case, namely, the closing of an oil switch. This operation requires about four-tenths of a second. Assume that the switch is operated from local storage batteries, and that the battery voltage has been allowed to fall too low. Assume also that a rotary is being synchronized and that the local battery switch is closed at the right time. The result might be that the oil switch would close a fraction of a second late. This

Digitized by Google

would cause the converter to be connected to the circuit out of step, which would result in severe sparking.

The Effect of Inertia of Armatures—It is a common mistake with new operators to imagine that, with converters out of step, if the oil switch (connecting the converter to the alternating-circuit side) is closed at the instant of synchronism, that no sparking will occur. Such operators close the local battery switch when the pointer of the synchronoscope is moving rapidly over the dial; and although the pointer may be over zero at the instant the oil switch closes, the converter will spark viciously. Considerable energy is required to overcome the great inertia of the converter armature, and the sparking is a direct result of this. The only proper way to synchronize a machine so started is to adjust its voltage and speed so that the pointer of the synchronoscope is moving slowly over the dial, and to close the local battery switch as the pointer is approaching zero and is a few degrees off the zero mark. As it requires four-tenths of a second for the oil switch to close it will close the circuit by the time the pointer of the synchronoscope reaches zero, showing synchronism.

Connecting a Converter to the Direct-Current Bus—It is natural for a beginner to connect a converter which has just been synchronized to the direct-current bus when the voltage of the converter is the same as the bus, and when the total fluctuating station load has a low peak. In doing this the operator makes two mistakes. In the first place, regarding the voltage, if the converter voltage is the same as the bus voltage before tying the machine in, it is likely that the bus voltage will be slightly higher than the converter voltage when all of the switches are closed. This is due to the IR drop. The result is that the current tending to leave the converter will reverse and the reverse current relays mounted on the positive switch will trip the machine out of circuit. Consequently the converter voltage should be about forty volts higher than the bus voltage in order to insure perfect operation. Regarding the second feature, namely, the load. When a converter having small self-induction in its armature circuit is connected in parallel with other converters, the load, if low, is quite likely to readjust itself so that the new machine will become overloaded. This is due to the converter "going in" having a higher power-factor than the other machines. If the field rheostats of all the converters operating are set for unity power-factor at normal load (almost full load) the power-factor will become poor when the fluctuating load is small. If the positive switch of the machine "going in" is closed when the load upon the individual converters is about two-thirds full load it will catch all of the converters at about the same power-factor, namely, unity, at which point it will be itself. The new machine will then draw a load slightly lower than the other converters. Its field rheostat can then be readjusted till it draws the same load as the other machines. This condition applies to substations of large capacity in which converters are usually operated without their compound coils.

Effect of Self Induction of Converter Armature Circuit—Most operators know that there is a fixed relation between the voltage of the direct-current side of a converter and the voltage of the alternating-current side. These operators do not understand how, if this fixed relation exists, it is possible to adjust the load upon the converters by regulating the field rheostat. It is true, as we know, that this fixed relation of voltages is a fact; but, nevertheless, by altering the inductive electromotive force of the converter by varying its field strength, it is possible to alter the direct-current voltage slightly, but enough to produce load regulation.

It is desirable for good running characteristics that a converter should have the smallest possible self-induction in its armature circuit. There are several ways of neutralizing the self-induction of converter armatures, one of the most successful of which is that used by the Westinghouse Electric and Manufacturing Company. The pole faces of the converters are slotted, and copper grids—Figs. 2 and 3—are inserted in the pole faces, in which position they are faced up—Fig. 4. This form of pole damper is effective because it is very close to the armature surface, and furthermore, being of grid form, it impedes the passage of flux which tends to shoot across the pole face of the converter when hunting is about to occur.

Maintenance—In considering the maintenance of a substation it is convenient to assume that all of the care bestowed upon the apparatus, excluding supervision, operating, and repairs, is restricted to the efforts of three rotary tenders each working eight hours per day including Sundays. This makes a grand total of 168 hours. Their time as devoted to the various types of apparatus will be divided about as follows:

	Hours.	Per Cent.
Rotary converters	93	55.36
Transformers	42	25
Starting sets	3.5	2.08
Transformer blowers	3.5	2.08
Oil switches	3	1.79
Auxiliary apparatus	21	12.50
Local storage batteries	2	1.19
Total	168	100

These figures are approximate but they represent about average conditions.

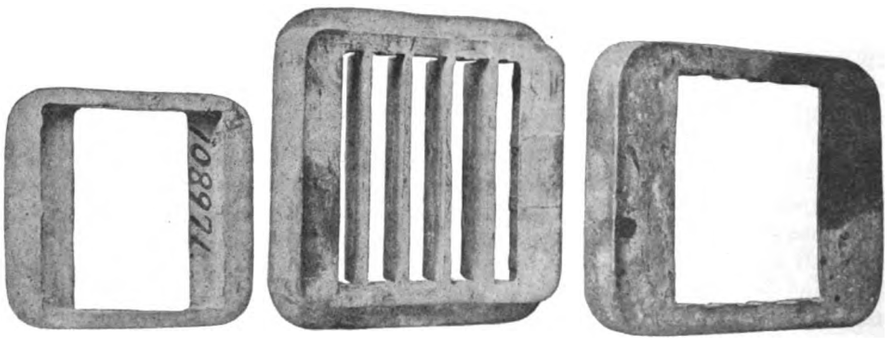


Fig. 2.—Copper Grids Inserted in Pole Faces of Converters.

It may be observed from this table that 55.36 per cent of the total time is devoted to the maintenance of the converters, whereas but 1.78 per cent of the time is spent in testing and cleaning the oil switches. Also the starting sets where employed have but 2.08 per cent of the total time and the auxiliary storage batteries operating the control have but 1.19 per cent of the total time. It is true that the transformers and the converters perform perhaps heavier service than the oil switches, blower motors, batteries, etc., but the factor of safety of the system as a whole could be increased considerably by devoting more time to this lighter apparatus.

In the larger stations where a station foreman and a janitor are employed in addition to the operators and the rotary tenders it would seem that considerably more time would be spent upon this detail work as the duty of this apparatus is heavier, but about the same proportion

Digitized by Google

of time applies, the additional time being taken up with repairs.

In order to increase the efficiency of railway systems as a whole it has become

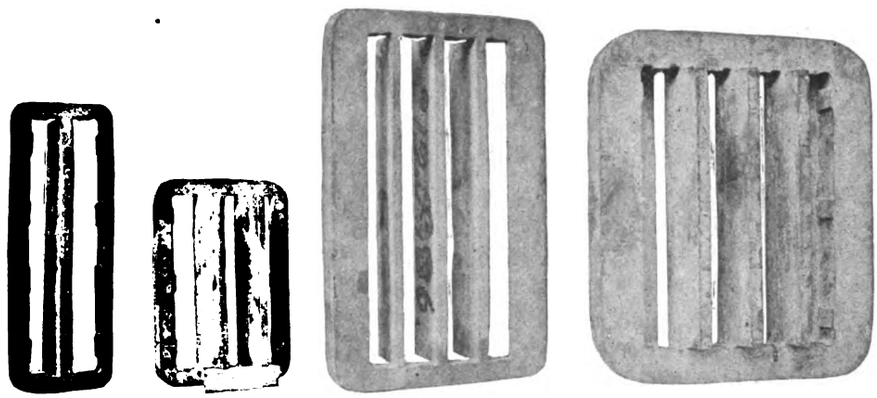


FIG. 3.—COPPER GRIDS INSERTED IN POLE FACES OF CONVERTERS.

the practice of some of the large companies like the Interborough Rapid Transit Company, of New York, to select a corps of experienced men whose time is devoted exclusively to inspection of instruments, oil switches, and feeders. At regular intervals these men go the rounds of all of the substations, inspecting their particular apparatus. One body of men devotes its time exclusively to instruments, another

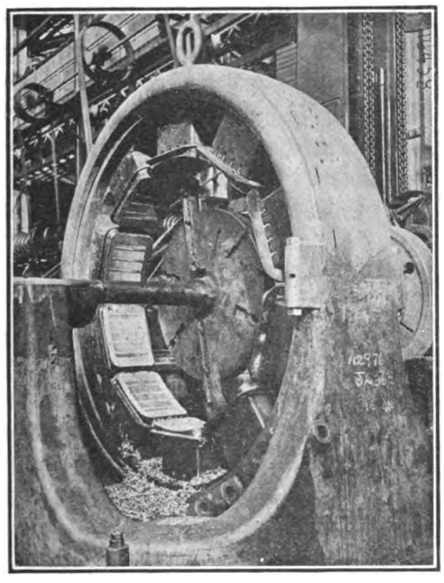


FIG. 4.—POLE FACES SET UP IN CONVRRTER.

to oil switches, and still another body to the inspection of feeders. By this system the factor of safety of operation is considerably increased. In addition to this special inspection a considerable part of the time of the station foreman is devoted to this purpose.

Working at the Different Periods of a Day—Planning the duties to be performed by the station help at the different periods of the twenty-four-hour day, it would be natural for the theorist to apportion the work equally. Such a division, however, would not meet entirely with success. Assume for instance that the time is divided as follows: 9 A. M. to 5 P. M., 5 P. M. to 1 A. M., 1 A. M. to 9 A. M. Some companies make the division 8 A. M. to 4 P. M., 4 P. M. to 12 M., 12 M. to 8 A. M. Taking the first case, consider the man whose watch is from 9 A. M. to 5 P. M.: This watch is equivalent to a regular eight-hour day, and there is every inclination when on this watch to perform one's duties willingly. Consider the second watch from 5 P. M. to 1 P. M.: The operator retires about 2 P. M. and sleeps till about 10 A. M. He arises and uses his day with the feeling that he has been staying out rather late; and then, at 5 in the afternoon, when other men are leaving work, his working day begins. He works till midnight. A man on this watch has small desire for work and possesses a feeling of lassitude most of the time. Furthermore his time for recreation is practically worthless. Few operators like this watch. Consider the third watch from 1 A. M. to 9 A. M. This watch is termed the "graveyard watch." It is very hard to arise at 12 o'clock at night and get ready for work so as to be there at 1 A. M. But operators do not seem to mind this watch as the load on the station is usually light until about half-past five, at which time travel increases. Moreover operators feel that they have the whole day at their disposal for pleasure should they so desire it. Some operators prefer this watch to others.

Summing up, the heaviest work should be done on the day watch and the lightest work on the five to one watch. On the latter watch the machines might be blown out with compressed air, but such work as sandstoning commutators, sandpapering brushes, and repairing should be done on the day watch. On the morning watch dusting, polishing and cleaning up the station generally should occur.

London Power Bills.

The following is an abstract of the report of the Highways Committee of the London (England) County Council. The report is dated October 18:

"Attention is called to the report of the select committee of the House of Commons on the London County Council electric supply bill, which expresses the opinion that the best means of providing for the supply of electrical energy in bulk, and for power and motive purposes, is by one large and inclusive scheme, extending over not only the entire county of London, but also to adjoining boroughs and districts. For the purpose of carrying out such a scheme some central authority is required with ample statutory powers and corresponding duties, and the London County Council should be the authority."

The highways committee has drawn up a scheme intended to fulfil these conditions and has been advised in this work by the chief officer of tramways and the tramways electrical engineer, together with H. F. Parshall, Robert Hammond and J. F. C. Snell, the experts specially engaged for the purpose. The committee recommends that the council should introduce a bill into Parliament next session to authorize, on the lines indicated in this report, a comprehensive scheme for the supply of electrical energy for London and the adjacent districts. The subject is dealt with under the following heads: (1) area of supply; (2) acquisition of existing undertakings; (3) districts without supply; (4) scheme of supply.

1. Area of Supply—The report recommends that authority should be sought in respect of the county of London and portions of Essex, Kent, Surrey and Middlesex. The total area involved is 451 square miles, comprising 117 square miles in London and 334 square miles in the surrounding districts.

2. Acquisition of Existing Undertakings—The committee believes that to secure cheap power, which is the object of the scheme, it will be necessary to construct a large generating station and shut down the various independent plants now running. The report, therefore, provides for the eventual purchase of the existing systems. These come under three main subdivisions, namely, (1) undertakings of local authorities inside the county; (2) undertakings of local authorities outside the county, but in the area proposed to be dealt with; (3) companies' undertakings throughout the whole area. There are also some districts without supply.

1. Local Authorities' Undertakings in

Digitized by Google

the County—Electric lighting orders have been granted to sixteen local authorities in London. All of these authorities, with one exception, are now supplying electricity. The council should be empowered to acquire compulsorily at the expiration of five years from the passing of the bill, or at any time thereafter by giving one year's notice, these undertakings. The council should be enabled to purchase at any time by agreement the whole or any part of the undertaking of any of the local authorities within the county, and that powers should also be taken for the council to enter into agreements with local authorities with regard to the council's undertaking, so that, if it may hereafter so decide, the council may be able to arrange for the whole or any portion of the work of distribution of electricity being carried out by the local authorities. The total capital expenditure incurred in connection with the local authorities' undertakings up to March 31, 1906, is about $27,250,000. The capital expended on the undertakings of these authorities has to a very large extent been advanced by the council on loan, and when any undertaking is acquired the council would take over the outstanding liability; there would, therefore, be no necessity to raise further capital for the purposes of the acquisition.

2. Local Authorities' Undertakings Outside the County—As regards the undertakings of local authorities outside the county of London, a different state of affairs obtains, and the committee does not think it necessary to purchase their undertakings compulsorily. It would, however, be useful for the council to obtain powers to purchase the whole or part of any such undertaking by agreement.

3. Companies' Undertakings Throughout the Area of Supply—A large number of orders have been granted to companies to supply electrical energy in the area dealt with by the scheme. As regards the undertakings in the county of London, the several local authorities concerned have powers of compulsory purchase, the latest date at which any of such powers become first exercisable being 1931. It is recommended that the council be empowered to purchase compulsorily the undertakings of companies within the proposed area of supply at the time when, and on the terms on which, such undertakings would have become purchasable by local authorities, or at any time to purchase by agreement the whole or any part of such an undertaking. The bill should provide for the council to be enabled to enter into any agreement with companies which it may consider advisable in the interests of its undertaking. The expenditure charged to capital account in the companies' books on December 31, 1905, was, for companies supplying in the county, $63,592,670.

3. Districts Without Supply—It is recommended that the council be made the authorized distributor in those districts where there is now no supply.

4. Scheme of Supply—It is proposed that the generating station to be used for the scheme should be erected on one of two alternative sites; one of these is situated at Barking, and the other at Erith. The proposed generating station would be erected in sections which could be proceeded with as the demand requires. The site acquired will be large enough to enable the station to be subsequently increased to a very large capacity to meet the anticipated increase in the demand for power resulting from a cheap supply.

Subject to the proper safeguards, an obligation to supply should be placed upon the council. This will necessitate provision being made for a supply adequate to the probable demand from existing undertakers as well as to meet the requirements of large individual consumers, such as railways, tramways, docks, waterworks, etc., to which the council should have power to supply direct. In addition to giving a supply untransformed at high pressure, the council should also give the supply at the pressure and of the kind which may reasonably be required by the various classes of consumers, and provide the necessary transforming apparatus.

Under the clause, which was settled by Sir James Kitson's Committee in 1900 for South Wales and other areas, a power consumer can obtain a supply direct from the central undertaking if he is unable to obtain it at a reasonable rate or within a reasonable time from the local undertakers. This clause should be included in the present bill, and it is necessary to anticipate a demand for a supply under this head. It is, therefore, evident that a large station will be required, and this has been borne in mind in preparing the scheme.

The total cost of the proposed new station, including land, is estimated at $7,000,000, while the estimated cost of the transmission and distribution system, etc., is $13,250,000. The latter figure covers the cost of (1) the switch centres, (2) the trunk cables from the generating station to the switch centres, and (3) the cables from the latter to the point at which energy will be delivered to customers. As regards the switch centres, it is proposed in a number of cases to utilize the existing tramway substations, and this will enable considerable economy to be effected. In other cases either fresh sites will have to be obtained or the stations of existing undertakers will be used.

It is proposed to make provision for the purchase of motors and other apparatus for hire to power consumers, a matter of considerable importance in securing the extended use of electricity for manufacturing purposes. The capital expenditure thus involved, which is included in the sum of $13,250,000 above mentioned, will be covered by the rent which it is intended should be charged for the use of the plant.

The bill shall provide for the maximum charges for energy being governed by the amount and regularity of the demand of the consumer, different charges being made according to whether the current required is high or low tension, alternating or direct, the times at which it is used, etc., and that the charges shall be as low as is compatible with the financial success of the undertaking. In this connection regard will be had to the necessity for building up an adequate reserve fund to meet all possible contingencies, and generally to the importance of ensuring that the undertaking shall be placed upon a sound financial footing. The scheme to supply provides for the first two sections of the generating station to be completed and working by 1910, and by that time it is anticipated that the demand for power will be such as to employ fully this part of the station, and to enable energy to be supplied at a low rate.

As regards the financial results of the undertaking, the committee is confident that the prospective demand for electricity is so great that the revenue derived from the undertaking will be more than sufficient to cover the expenditure, including the charges for sinking fund and interest on capital, and it is strongly supported in this view by the experts employed by the council. The capital expenditure will be gradual, as the scheme contemplates that the new bulk supply station shall be built in sections to meet the increasing demand as it arises, and the scheme accordingly provides for the expenditure to be spread over a period of seven years.

Digitized by Google

Electricity as a Power in Mining in Mexico.

When we come to consider the present mining industry with that of two or three years ago, or even taking it but one year ago, a wonderful change has taken place which is only apparent to those who are located in the immediate camp or camps using the new electric power. While it is true that the majority of the mines are still steam or hand power, in some of our well-known camps the excessive cost of power, on account of the difficulty of obtaining fuel at a reasonable price, has caused the owners to look for a cheap power. This was absolutely necessary where the ore mined was not of extremely high grade.

In El Oro and Guanajuato alone the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., through its agents, Messrs. G. and O. Braniff & Company, who are making this a specialty, have installed over 10,000 horse-power of electrical machinery, all of which is driven from a water-power source. The cost of this power is from two to three times cheaper than the corresponding power by use of wood or coal without taking into account the greater conveniences, saving of time and increase in output. Practically all of the mining machinery builders have for some time acknowledged electricity as the coming power, and have so modified their machines that they can be applied to electric motor drive or have gotten out a new line entirely for this purpose. In mines where steam has formerly been employed electric motors can be applied to them if they are not too antiquated. Many have held back from the idea of putting in electricity, believing that nearly an entire new outfit of machinery would have to be purchased. This is a mistake, as steam hoists, compressors and the majority of the machinery about the usual mill and mine can, with very little expense, be adapted to motor drive.

While in El Oro considerable activity has existed for many years, so that the change to electric power has not been as noticeable, in Guanajuato the conditions have been quite different. In the latter camp a time was reached when the advancing cost of the necessary fuel made it impossible to profitably mine and mill the grades of ore obtainable. For this same reason development work had to be abandoned to a certain extent. When we compare the present Guanajuato with the above conditions which existed but about two or three years ago, all of which has been brought about by the introduction of electric power, the possibilities obtainable where this force can be applied seem unlimited.

In Sinaloa, at the Black Mountain Mining Company, where electricity is employed entirely, we find it is generated by means of Westinghouse steam turbines at an expense greatly below that obtainable from the usual steam engine. With installations for generating electricity, the generating stations can be located at a considerable distance from where it is to be consumed, in some wooded sections if available, from which place the energy is cheaply transmitted, gas or steam being generated from the wood. This is what we find in Parral, where just such a plant is now going in to transmit to the mines about that place.

Another one of our most prominent camps which should be mentioned as being one of the first to adopt electric power and make use of it most universally is Pachuca. A large amount of electrically driven mining and milling machinery has been, and is still being added to the various mines in this locality. The power in this camp is supplied by the Irrigadora Company. Until recently its large power plant at Juando was ample to supply the demand, but they are now building a second plant equally as large which will very shortly be in full operation. This company owns sufficient water power to build even a third plant of about the same capacity and due to the business in sight this also may soon be developed to meet the popular demand for electrical energy.

In Oaxaca, within the last six months or a year, a few of the companies in that district have ordered and will shortly have in operation isolated individual electrical plants for lighting and power in connection with their mining work.

Dinner of the Electrical Trades' Association of Philadelphia.

The eleventh annual meeting and dinner of the Electrical Trades' Association of Philadelphia was held Thursday evening, November 1, 1906, at the Manufacturers' Club, Philadelphia, Pa.

The reports of officers showed the association to be in a flourishing condition and its value to its members, availing themselves of the use of the several forms provided, of the most substantial character.

The combined membership of the several local associations comprising the National Association now numbers over 350 of the leading manufacturers and dealers in electrical material.

After the termination of the business meeting an enjoyable social session was held, enlivened with wit and practical addresses by several of the members and guests.

After adjournment at a late hour, and the departure of many members, a few remained to witness an exciting game of pool, participated in by two Philadelphia members and Messrs. Haight and Issertel, of the New York Electrical Trades' Society. The brilliant and masterly handling of the cue by the latter gentlemen excited unbounded admiration and applause.

The officers and directors for the coming year are:

C. E. Trump, president, representing the Novelty Electric Company, Philadelphia.

C. M. Wilkins, vice-president, representing Partrick, Carter & Wilkins Company, Philadelphia.

H. G. Kepler, representing Walker & Kepler, Philadelphia.

F. D. Sweeten, representing Sweeten-Crossan Electric Company, Philadelphia.

T. E. Hughes, representing Standard Underground Cable Company, Pittsburg, Pa.

G. S. Smith, representing J. F. Buchanan & Company, Philadelphia.

L. P. Dickey, representing Lawrence Gas Fixture Manufacturing Company, Philadelphia.

E. A. Symmes, secretary-treasurer.

The William J. Hammer Collection of Incandescent Electric Lamps.

The report of the committee on science and arts of the Franklin Institute, Philadelphia, Pa., on the historical collection of incandescent lamps made and exhibited at the St. Louis Exposition of 1904 by William J. Hammer, of New York city, is presented in the *Journal of the Franklin Institute* for November. Mr. Hammer received the grand prize for his collection at the St. Louis Exposition. Over 200 of the foremost engineering and commercial men of the day have communicated with Mr. Hammer with regard to the value of this collection, and the report includes a number of extracts from these letters.

The report concludes as follows: "In consideration of the great historical and educational value of this collection, of the years of unselfish labor and energy devoted to it, of its unreplaceable and monumental character, the committee recommend the award of the Elliott Cresson medal to Mr. William J. Hammer, of New York, for his 'Historic Collection of Incandescent Electric Lamps.'"

Digitized by Google

Vol. 49—No. 21

Electrical Notes from Europe.

(By Our Special Correspondent.)

TWO hydroelectric plants of considerable size have been erected in Switzerland in the region lying between Lake Leman and the Neuchatel lake. They are designed to supply a district which includes a number of towns and villages, among which is the town of Fribourg and the much-frequented resort of Montreux, on Lake Leman. Power for both these plants is secured from the mountain stream of the Sarine, which has a number of falls along its course. The two stations of Hauterine and Montbovon are located upon this stream at some distance from each other, and have been laid out on the same general plan so that they can work together upon the general network of lines. At Hauterine is erected the largest of the two plants, and it is intended to enlarge it in the future so that it may eventually become one of the largest stations of the country. Here a masonry dam is erected across the Sarine having about 200 feet length. From the dam leads an offtake canal which runs for a distance of 1,200 feet and then connects with a tunnel which forms one of the most important parts of the enterprise. The tunnel is about five and one-half miles long and has a total section of sixteen square yards, of which the water section is ten square yards. At the end of the tunnel is a large settling chamber, from which three penstocks lead down to the station. Two of the penstocks are installed at present and they have a length of about 400 feet.

The station building is of considerable size, as it is laid out to receive eventually ten principal turbine-alternator groups and three exciter groups. At present there are erected four alternator and two exciter groups. The turbines are placed in a series of chambers below the station floor, and the alternators are mounted above on the ends of the vertical shafts. Piccard & Pictet, of Geneva, supplied these wheels and they give a speed of 300 revolutions per minute. Alternators of the Alioth pattern are used in the plant. They are vertical-shaft machines with revolving interior field having twenty poles and run at 300 revolutions per minute. A star-connected armature is used, as the alternators are of the three-phase type. They will furnish about 1,000 kilowatts each at fifty cycles and a voltage of 8,600, or 800 kilowatts with a lag corresponding to $\cos \phi = 0.80$, taking 1,100 horse-power. The exciting current is 120 volts and sixty amperes and is furnished by exciters of sixty kilowatts capacity, mounted also upon vertical-shaft turbines. Each of the alternators weighs about fifty tons and has eleven feet outside diameter. An extensive switchboard system is used for the machines and feeders.

Of a somewhat similar arrangement is the second hydroelectric plant, which is located on the same river at Montbovon. An underground canal, some two miles long, takes the water from the dam to the settling chamber, from whence two penstocks, 600 feet long, lead to the dynamo house. About 5,000 horse-power is given by the plant, and it has erected four main turbine-alternator groups of 1,100 horse-power each and two exciter groups of 100 horse-power. The turbines come from the Rieter firm, of Winterthür, while the alternators, of the same type as above, are furnished by the Alioth Company. For the overhead lines running throughout the region a voltage of 8,000 is used, and the lines are mounted on wood poles. Proceeding from the Hauterine plant run several main lines which go to different feeding centres located in the large towns. The Hauterine-Romont line is designed to connect the two plants together. Eight lines start from the Montbovon station and run throughout the county in three general directions. The main centres are supplied from the 8,000-volt lines from transformer posts, which lower the voltage to 110 or to 190 volts, according to the length of the secondary mains. Some of the rural districts use a long secondary line working at 500 volts, and on it are placed small transformers for reducing to 115 volts.

Light and power are distributed by these two plants in the cantons of Fribourg, Vaud and Berne, covering an agricultural country for the most part. Besides the lighting, the motor current is used for tile works, farm machines, sawmills, small shops, etc., and the low price of the current leads to an extensive use of it, which is all the while increasing. Electric railroads use part of the current. Among these are the Fribourg-Morat electric road, also the Gruyère line and the Montreux-Bernese Oberland, with some others.

A new petrol motor which has attracted some attention in France is the Bourdreaux-Verdet duplex, and it is well adapted for driving small dynamos. What distinguishes the new motor is the fact that the inventors succeed in securing all the advantages of the usual four-cylinder gasolene motor by using only two cylinders, thus reducing the number of working parts to a great extent. This is carried out by using a cylinder which has an upper or narrower part and a lower part of larger diameter. In each part works a separate piston, but these are placed together so as to form a single piece, mechanically considered. The explosions take place in each of the cylindrical portions, and the effect is that of a two-cylinder motor, with but one crank going to the shaft. Placing two such cylinders on a common crank-shaft they secure the same effect as a four-cylinder motor, but here the weight is lowered twenty-five per cent, the space by one-half, and the cost by forty per cent. The inventors claim that the fuel consumption is lowered from ten to thirty per cent in this motor. It has already been run with dynamos very successfully and has made a good showing in actual practice. With a dynamo it produced sixty amperes at 120 volts, or 7.2 kilowatts, consuming only 300 grammes of gasolene per horse-power-hour, which is a remarkably low figure.

According to recent reports, the town of Wellington, New Zealand, has a well-equipped system of tramway lines, covering a total length of twenty-two miles of track. The overhead trolley wires are supported from steel poles. A generating station of some size is erected in the town for use on the tramway system, and one group is also used for the lighting current. Three machines give the current for the tramway lines, these having 370 kilowatts capacity each, and there is now erecting a 750-kilowatt machine to provide for the increasing current. On the lines the rolling stock consists of fifty motor-cars, using Brill trucks and fitted with General Electric Company's motors of eighteen horse-power.

The La Gruyère electric railroad has been recently laid out through a picturesque region of Switzerland not far from Lake Leman, and has already a large tourist traffic. Several years ago two companies obtained concessions for railroads, one running from Chatel Saint Denis to Paleyieux and a second from the former

Digitized by Google

point to Bulle and Montbovon. These companies were consolidated, and the electric equipment of the system, which makes a single continuous line, was carried out by the Alioth company, of Bâle. The total length of the three sections of the road is twenty-eight miles, and the road uses Vignole rails, weighing fifty-three pounds per yard, except within some of the towns, where a groove rail is employed. Motor-cars of some length, either separate or coupled together to form a train, are used in this case, and the current is taken by overhead trolley from a suspended wire. A single wood pole, with a long bracket arm reaching clear across the track, supports the wire, and the trolley, mounted on the car roof, is of the arched or bow form.

As regards the motor-cars, these are mounted on two bogies. Each axle of the bogie is fitted with a motor of thirty-five to fifty horse-power, making four motors per car, or a total of 140 horse-power at least. The motors are calculated so that they will take upon a thirty-two per cent grade a train weighing fifty tons at a speed of twelve miles an hour, or a freight train of sixty tons at eleven miles an hour. Some of the newer cars are equipped with four motors of eighty horse-power, and are used for long passenger trains or freight trains up to 140 tons. As the motors are coupled in two series-parallel groups, each one is wound for one-half the line voltage, or 375 volts. The new eighty-horse-power motors are, however, connected for two motors in parallel and two such groups in series-parallel, so that the motors are built for the whole line voltage of 750. A controller of the Alioth type makes the coupling in each case. Four substations feed the line, and the main current comes from the Montbovon hydro-electric plant. A set of transformers lowers the three-phase current to 500 volts. Two rotary groups, each formed of a three-phase motor and a generator, give the current for the traction feeders. These groups are made up of a non-synchronous motor giving 100 horse-power at 500 volts and running at 580 revolutions per minute, fifty cycles, and a 750-volt generator. A 375-cell storage battery is run in parallel with the generators.

A Swiss engineer, Feldmann, has brought out a project for a suspended electric road to run to the summit of Mont Blanc, in order to avoid constructing a number of tunnels such as had to be done on the Jungfrau. Above the Glacier Des Bossons he proposes to suspend the car upon a double cable which is permanently stretched and mounted upon a viaduct of appropriate form. The two cables lie one above the other and the car runs between them, using a set of rolling wheels to support it. A motor-driven cable will draw the car up the slope, as it will not have motors mounted upon it.

The city of Munich is to have an additional source of current in the new hydroelectric station which is now under way. Here the Aar stream is selected to give the power, and at Moosberg an extensive dam, canal and other hydraulic work have been carried forward for some time. Leading from the dam is a canal of 2.4 miles in length. The station building, however, is located at the middle point of the canal. It will utilize a net water head of 24.5 feet. Three main turbine sets will form the first part of the outfit, and they will furnish some 6,000 horse-power in all, working at a voltage of 5,000. A double overhead line is erected from the Moosberg plant to the city. It uses 30,000 volts, which is furnished by a bank of step-up transformers in the station. The turbines are supplied by the Voith firm, and the electric outfit by the Siemens-Schuckert company. At Munich the line enters a large substation which contains an outfit of transformers for reducing to 5,000 volts. This current will be turned into the city mains, which are now using that voltage. It will give a new supply which has been much needed for some time, owing to the increase in the use of current.

C. L. DURAND.

Paris, November 10.

Absorption of Radioactive Emanations by Charcoal.

Sir James Dewar gives here a résumé of some experiments made some time ago, dealing with the condensation of gases by charcoal in vacua. He has shown that charcoal, cooled in solid carbonic acid at the temperature of 195 degrees absolute, is capable, for a time, of absorbing the carbonic acid present in the air, amounting to 0.003 of an atmosphere, until the concentration rises to about one per cent of the weight of the charcoal. If, on the other hand, the separation of the carbonic acid from the air must be done by cooling alone, the temperature of the air must be reduced below 129 degrees absolute, at about 100 degrees absolute, it would for practical purposes be nearly all removed. Thus charcoal, at about twice the absolute temperature required for condensation by mere cooling, is, for a small concentration of the gas undergoing absorption, equally effective. Compare this with the behavior of radium emanation. Rutherford and Soddy have shown that to condense radioactive emanation the temperature must be below 138 degrees absolute, and it is complete at 123 degrees absolute. By analogy it might be expected that at twice this temperature charcoal would act as a condensing agent. This brings it up to about the ordinary temperature, which is just what Rutherford has found to be sufficient. Such comparisons, however, do not necessarily mean that the radium emanation is comparable in volatility with carbonic acid at low temperatures. The results of Rutherford and Soddy seem to show that the radium emanation has a high latent heat of volatility, and consequently, by analogy, a high boiling point. This view supports the opinion that the molecular weight of the emanation must be high and of the order of 200 or more. —*Nature* (*London*), *November* 1.

National Convention for the Extension of the Foreign Commerce of the United States.

A special committee of the New York board of trade and transportation announces that a national convention for the purpose of considering and devising measures for the enlargement of the foreign trade of the United States and to promote the demand abroad for the products of our farms, workshops and mines, will be held in the New Willard Hotel, Washington, D. C., beginning at 10.30 A. M., Monday, January 14, 1907. All national, state and local associations interested in the objects of the convention are invited to send at least five delegates each. The governors of the different states are invited to appoint ten delegates to the convention and furnish them with a credential. Each association represented will furnish its delegates with a credential duly certified by its president and secretary.

The committee announces that the Hon. Elihu Root, secretary of state of the United States, has consented to address the convention and will give it the benefit of his observations and experiences and of the information acquired on his recent tour of the South American countries.

The committee is made up as follows: E. S. A. de Lima, chairman; Cornelius N. Bliss, Franklin Murphy, Herman A. Metz, Charles A. Moore, William McCarroll, Lewis Nixon, Henry W. Peabody, Charles A. Schieren, Isador Straus. Frank S. Gardner, 203 Broadway, New York city, is secretary of the committee.

Digitized by Google

ADJUNCTS TO THE POWER LOAD.[1]

BY C. J. RUSSELL.

The field for electric welding and tempering is unquestionably a large one, but machines for this purpose have not been as generally introduced as the publicity given to this class of apparatus and the remarkable results accomplished by its use would lead one to anticipate. It is also to be regretted that the method of installation generally urged and adopted has been in connection with a special generating equipment.

In the sizes up to thirty kilowatts there can certainly be no valid reason presented for the installation of a special generator. We have several outfits on our system[2] ranging from fifteen to thirty kilowatts capacity, and their effect is not greater than that of a motor of similar capacity.

The load-factor of these outfits is low, averaging three hours. The reason for this is understood when we consider that the longest period of welding in average work will not exceed forty seconds, whereas the operation of adjusting and removing the work may occupy three to four times this length of time.

Proper presentation of the advantages of these outfits to accomplish specific results in large manufacturing establishments making metal articles of special shape should result in their more general use. There would also appear to be room in each large city for a jobbing shop to handle the work for smaller concerns which could hardly afford to make individual installations on account of the royalties charged upon the machines of a fixed sum per annum.

While most of the welding done is of the butt type, some special machines have been developed, one for making wire fencing and another for making longitudinal welds on pieces of large diameter, such as the joints in the shell of hot water boilers for domestic use.

The electric tempering process by use of the electric welding machine does not appear to have been developed to such an extent as its advantages would seem to merit. The heating of special-shaped pieces by the ordinary means is often accompanied by distortion, which is fatal to the article itself. When heated by the passage of an electric current this is not the case, and the tempering of such delicate articles as the rolls used for drawing cotton is successfully done by means of this process. The uniformity of the heat generated in this way in metal of small cross-section and the excellent tempering results obtained have proven eminently satisfactory in such special lines as have come under our observation.

The electric furnace has come to be regarded as one of the most important tools of the electrochemist and is generally classified under that branch of science. Strictly speaking, it may be regarded as misplaced, since in itself it is simply a form of apparatus for the utilization of heat transformed from electrical energy. As from present point of view, however, such furnaces will have principal use in industries dependent upon physical and chemical changes in their materials, the classification is probably both correct and proper.

From a commercial standpoint the electric furnace is a piece of apparatus for the generation and utilization of heat. The comparison between various types designed to accomplish specific results must proceed along these lines as far as efficiency and economy are concerned.

The heat may be used to accomplish physical changes alone, or physical and chemical changes. In the latter case a certain proportion of the energy may be absorbed in the chemical reactions necessary, and it may be aided by the chemical reactions occurring during the operations. As the heat units actually utilized to accomplish given results can be readily calculated, the real efficiency of any process can be determined with accuracy.

The transformation of electric energy into heat energy by means of resistance may be utilized in an electric furnace directly or indirectly, according as the materials to be treated are or are not conducting.

In the direct method the heat is generated within the material itself, which in this case is part of the circuit, current being led to it by suitable electrodes which are provided with means to prevent their fusion, such as water circulation; and in the direct induction furnaces the heating currents are generated within the materials themselves, they constituting the secondary of a transformer circuit.

In the indirect method the heat is utilized by radiation or conduction. In the arc types, the resistance is gaseous and the arcs are formed between electrodes or between the electrodes and the materials to be treated if they be conducting. These arcs may evidently be formed within or outside of the receptacles containing the materials to be treated, or the latter may be made to pass through the arcs while being fed into the receptacles. In the solid resistance types the heat may be generated within solid conductors contiguous to the mass to be treated. These conductors may be solid or molten at the temperature at which the furnace is run; may be arranged within the refractory walls of the receptacle, within the mass of the material itself, or may be superimposed upon the mass as in those processes utilizing heat generated within a slag resistance floating upon the bath to be treated.

Division and subdivision of these classes may be elaborated, but as efficiency must become an all-important factor in the ultimate development of the electric furnace, it is probable that the classification mentioned will be convenient for purposes of comparison.

The maximum temperatures attained in commercial furnaces range from 2,000 degrees centigrade to 3,500 degrees centigrade, or from 3,632 degrees Fahrenheit to 6,332 degrees Fahrenheit. The latter figure may be anticipated, since the latest determinations of the temperature of the arc approach 3,700 degrees centigrade, as given by the United States Bureau of Standards working with the Wanner, Holborn-Kurlbaum and le Chatelier pyrometers.

An examination of the history of the development of the electric furnace is principally interesting from the early dates of disclosure of the vital principles of existing furnaces, and as showing that it was retarded only by the absence of suitable means for the generation or supply of the necessary amount of electrical energy.

Within the past six months considerable electric-furnace work has been done in our city with current supplied from our generating stations.

One installation is of especial interest as being the first to produce high-grade crucible steel upon a commercial scale on this side of the water, by heat from electrical energy.

The furnace is of the induction type, of 131-kilovolt-ampere capacity, and is supplied with single-phase, sixty-cycle current at 240 volts.

It is in principle a transformer, the secondary of which is constituted by a circular trough-shaped crucible and its contents. The primary consists of twenty-eight turns of copper tube, cooled by internal water circulation and insulated by sectional layers of heat-insulating materials.

The furnace is shown in Fig. 1, the crucible in Fig. 2 and the furnace tilted

[1] Abstract of a paper read before the Association of Edison Illuminating Companies, Thousand Islands, N. Y., September 4-6, 1906.

[2] Philadelphia Electric Company.—[Ed.]

Digitized by Google

as in the operation of making a pour in Fig. 3.

The construction is simple and rugged, as can be readily seen from the cuts. The transformer frame is mounted upon trunnions and fitted with gears and a hand-wheel for convenience in tilting. The top member, which is removable, is provided with cams at each end for the application of pressure to insure good magnetic contact, and the handles operating these cams can be seen in Fig. 1, lying parallel to and just above the top of the transformer frame. Bolted to each side of the lower part of the frame are brackets, upon which rests a circular piece of soapstone which serves as a foundation for the crucible.

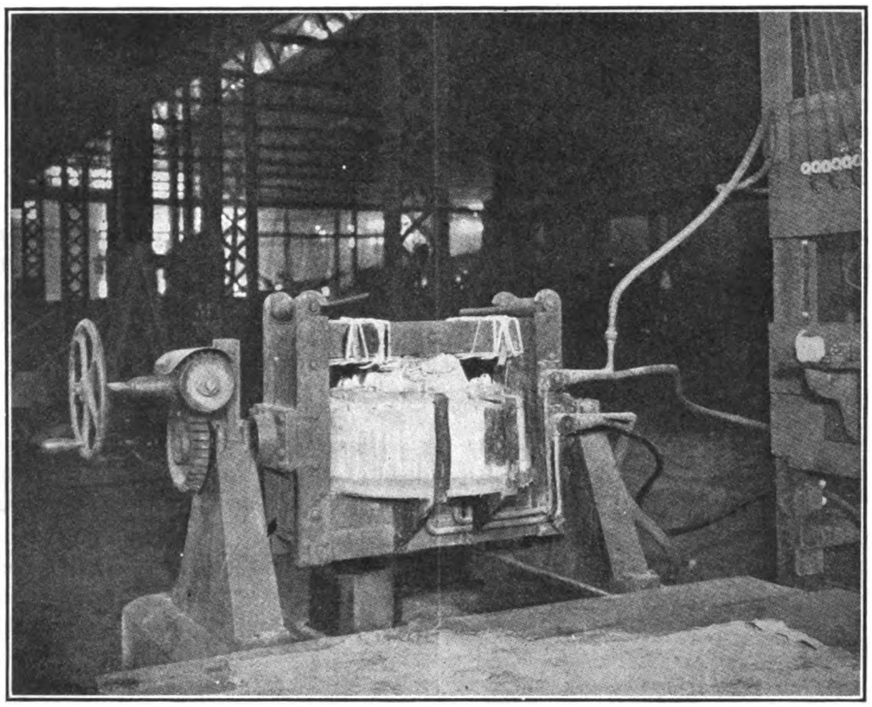


FIG. 1.—ELECTRIC FURNACE.

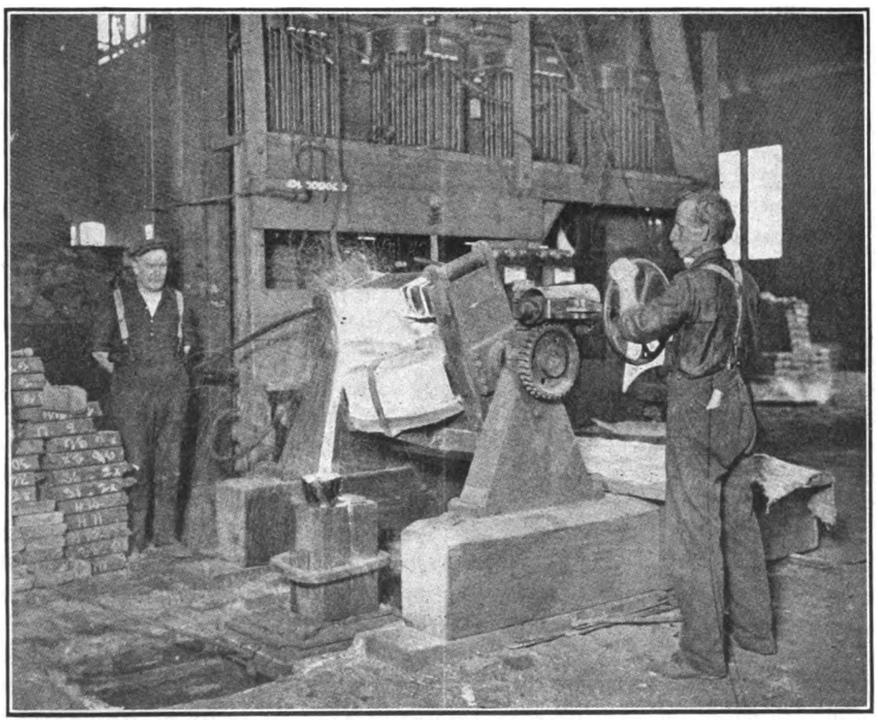


FIG. 3.—MAKING A POUR.

The top lid, or covering, of the crucible is made in sections for convenience in introducing materials and for observing the process.

The manipulation of the furnace is very simple. In starting operations, a cast ring may be placed in the crucible or a pot of melted metal poured in from another furnace, and the current turned on. When this metal is at the proper temperature, materials are added in the right proportion and the whole brought to the condition desired and an ingot is poured off.

When a pour is made, sufficient metal is left in the crucible to maintain the circuit and new materials are at once introduced.

Charging is done gradually in order to prevent freezing the mass.

The fusion of the new charge ordinarily takes about thirty-six minutes, and the total time between pours is from an hour to seventy minutes, according to the character of steel to be made.

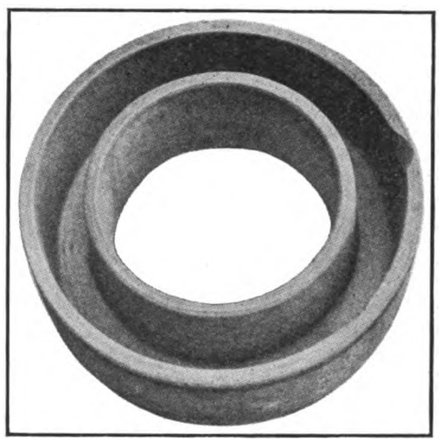


FIG. 2.—CRUCIBLE.

The secondary current is, at a maximum, 15,148 amperes at 8.57 volts.

The current consumption varies with the percentage of carbon in the charge and finished steel, but it will average about twenty-eight kilowatt-hours to melt and a total of thirty-six kilowatt-hours to a pour per hundred pounds of steel.

The temperature of the cooling water is only raised from ten to twenty degrees from inlet to outlet, with a very moderate flow.

The heat insulation of the crucible is so perfect that the outside of the casing is barely warm to the touch while the furnace is in full operation.

Starting cold, the power-factor of the apparatus is rather low, but as soon as the metal in the crucible is heated to such a degree as to lose its magnetic qualities, it improves rapidly. When in full operation the power-factor ranges from ninety-three to ninety-seven per cent.

Careful observations of about sixty heats

Digitized by Google

were taken with standardized instruments and much valuable data have been obtained.

Several thousand pounds of each kind of high-grade steel of different composition used for cutting tools have been made in this furnace, and samples submitted to chemical and mechanical tests.

Since the heat is generated in the crucible without external contact or influence, it is obvious that the resultant product will be free from contamination other than that due to the materials themselves and to the lining of the crucible. For this reason the character of the steel can be absolutely predetermined.

The high temperatures attainable in the furnace render it possible to thoroughly remove all gases, and the steel is very fluid and still in the mold.

The ingots are very dense and homogeneous, and tools made from them present a grain and silvery lustre unlike that of the ordinary crucible steel. The metal also has valuable characteristic qualities for the manufacture of high-grade tools requiring uniform temper.

The results obtained have been so satisfactory that it is proposed to install a five-ton furnace calling for about 750-kilowatt current capacity.

The magnetic effect produces some difficulty in charging, but this is not serious when understood and properly avoided.

It is evident that furnaces of this type can be readily designed for use on two or three-phase circuits. While no large furnaces of polyphase type have been manufactured in this country, two different forms have been brought out in France, one of which is much on the order of the one just described.

We also have on our system a furnace of 100 kilowatts capacity used for the smelting of special ore. This is of the combined direct and indirect type, arcs being used to start the process and the current being subsequently passed through the materials which are conducting when heated.

The work with this furnace has not reached such a point as to admit of more than a general reference to it. If as successful as the results abroad indicate, it is hoped that the preliminary work will result in a large installation with central station supply.

There are also two smaller furnace equipments on our system, both used for tests in the smelting of various ores and for experimental purposes.

The electric furnace presents marked advantages over the old crucible methods.

The first cost is from twenty to twenty-five per cent of that of gas furnaces of similar capacity.

There is no great mass of surrounding and containing materials to be heated to a temperature even higher than that necessary for the operation of fusion and refining.

Repairs of all kinds are cut down to a small figure. The expense of crucibles in the gas processes amounts to from $10 to $16 per ton of steel as against $2 to $4 per ton with a built-up induction furnace.

The cost of labor is radically reduced and the discomforts of the old process are almost entirely done away with.

The subject of electrochemical processes is closely allied to the electric furnace and requires similar consideration.

Leaving aside for the moment the question of central station supply of electric current for the purpose of the manufacture of various chemical compounds on a large scale, there are many processes which are applicable on a moderate scale to several industries with which we come in contact in the light and power field.

The various compounds and solutions used for bleaching interest our textile customers. In certain lines the use of chlorine for this purpose is universal and most of us are familiar with the disadvantages of the method of bleaching by the use of bleaching powder or chloride of lime.

By passing a current of electricity through a solution of common salt, hypochlorite of sodium, or electro-chlorine, is obtained. In properly arranged apparatus no gas escapes, which is a point of vast importance to the manufacturer.

The activity of nascent products is well known and it can be readily understood that the work done in this manner is superior and much more permanent than that done by the older methods.

This process has been widely adopted abroad, where 2,000 horse-power is used for this purpose in various establishments in a type of cell put out by the Siemens-Halske Company. It has also been adopted by several leading manufacturers in this country and is highly recommended in the linen and cotton trades. The process is also applicable to the bleaching of fibres for paper, artificial silk, oils, etc.

Some work of this character has been done on our system and a motor-generator outfit of fifteen-kilowatt capacity has been found ample for the satisfactory bleaching of a ton of fibre per day of ten hours.

The expansion of electric processes for bleaching, finishing and waterproofing fabrics will be an interesting subject to follow up for central stations desiring to sell current for electrolytic work.

Another promising outlet for the sale of current is the industrial application of ozone.

Regarded as a rare product until recently, and its production as a laboratory experiment, several large establishments are now producing this powerful agent in large quantities for bleaching and purifying purposes.

The applications for this, Nature's own bleaching and sanitary agent, seem to be almost unlimited. Some of the most practical of its uses are in the bleaching of flour and starches, of textile yarns and fabrics, of paper pulp intended for the higher grades of product, the refining of alcohol and spirituous liquors, the treatment of varnishes and oils and for the improvement and purification of water used for drinking or manufacturing.

The last-named application is the widest one, and here ozone has proven its superiority over all known methods. The purification and sterilization of water without destroying any of its natural qualities, without the addition of any chemical compound, and at a minimum cost, is a subject that vitally interests all classes of industries and individuals.

A gramme of ozone may be obtained with the expenditure of about sixty watt-hours. Two hundred and fifty gallons of water of average river variety can be treated with this amount of ozone.

Naturally, the amount of ozone required depends upon the number of colonies, or thousands, of bacteria present in the water. With an average of 200 per ounce, none remain after the amount of treatment described. With 2,000 to 4,000 per ounce, from three to thirty remain if the process stop at this amount of ozonization.

Two types of ozone generators have been used upon our system. In one the dielectric was of glass and the discharge plates in multiple, each provided with a high-series resistance which permitted of the cutting out of any which developed defects. In the other the discharge took place across air-gaps, and a choke-coil and condenser were provided to prevent the formation of an arc and to raise the secondary voltage.

It has been our privilege to witness many chemical and bacteriological tests of the results obtained in the purification of water, both by the Webster process, employing iron electrodes, and by the ozone process. The former is principally efficacious in practice by coagulation, and the water needs aeration afterward. The latter

Digitized by Google

process provides aeration, improves the quality of the water and is, by microscopic observation, much like machine-gun practice to the unfortunate bacteria.

One of the installations mentioned was put in for the purpose of improving spirituous liquors. The method of treatment is similar to the water-purification process, and the object is to produce within a brief period all the qualities given by age to liquor of different sorts.

With the expenditure of a few kilowatt-hours per barrel, very crude raw liquor can be made equal to that which has been aged in wood for several years.

The purification of water used in breweries, both for the brewing and for sterilizing receptacles for the product, should offer quite an extensive field for the exploitation of the ozone process.

Considerable discussion has taken place as to the desirability of this class of business to fill in the hours between peaks and thus to equalize the station load. In these discussions great importance has been attached to the alleged fact that such business need not cross the peak and could be supplied with large or small volumes of current according to the capacity of generators in service and the amount of other load upon the system at a given time.

There is no question that such a class of business would enable a station to operate under ideal conditions. It is evident that the question, however, must be dealt with according to the exact conditions of capacity and load of each individual station contemplating such supply. General statements may lead to a serious misconception of the true possibilities in this direction.

The character of load diagrams of all central stations which have cultivated the electric-power field have undergone a radical change. In such cases the old condition of morning and evening peaks which represented almost the total generated load has passed. In the present load diagrams the kilowatt area of such peaks as exist bear a much smaller ratio to the area of the daylight load.

As a matter of fact, electrothermic processes require for their successful and economical operation nearly continuous supply. The initial operation of bringing the furnace and materials up to the proper working temperatures may involve three times the energy required for their operation thereafter. Not only is this true, but the chilling and reheating of such furnaces is an operation quite as destructive to them as to the older types of apparatus.

Electrolytic processes are mostly continuous. They depend for their successful operation upon a certain ampere density at a fixed voltage, and from this it is obvious that the only method of control would be to cut out cells or sets of cells when the current supply must be reduced. Many of these operations are chemically reversible, and the effect of shutting down the process would involve considerable attendance.

The suggestion has been made of the use of storage batteries for the purpose of handling electrolytic work. As the current for such purposes must be sold at a low rate, and the storage equipment is rather costly, this method of handling such a proposition would seem to merit little consideration.

It may be concluded that electrothermic and electrolytic propositions must be considered on a straight twenty-four-hour basis and handled in all respects as any other business of similar load-factors.

It may also be concluded that for purposes of load equalization, it would only be possible to add such processes to any system as should be under the absolute control of the central station interests which were to supply them with electric current.

One of the most important points in connection with such processes as involve the supply of large volumes of electrical energy is the question of location with regard to the station. The elimination of distribution expense to a large extent, as well as the fact that the service investment would be very low, should make quite a difference in the rates central stations would offer to such industries as located in their immediate vicinity.

There is one point in considering these electrochemical and electrothermic propositions which should be represented in its true light in every possible case. In estimates of the current used for any given operation, either furnace or electrolytic, foreign usage, sanctioned by adoption on this side of the water, has adopted the unit "electrical horse-power-year." In estimating, if a pound of finished product requires the expenditure of 746 watt-hours, for example, the cost of an electrical horse-power for one year is divided by 8,760 (24 hours by 365 days), and the result is assumed as the cost of energy per pound of finished product.

The originator of this method was probably an optimist along the same lines as ourselves, in that he hoped to utilize every horse-power of generator capacity during 8,760 hours per annum.

Experience has taught us the true possibilities in this direction, but the truth does not seem to have penetrated deeply enough to make any change in the estimating methods of our sanguine electrochemists and electrometallurgists.

No process can continue at its maximum for twenty-four hours a day and 365 days per year. Furnaces need repairs, baths need renewing and overhauling; in fact the very processes themselves require considerable current regulation and are not prosecuted at a maximum rate.

These, as well as humane reasons, prevent the fulfillment of the figure named. If the actual use averages from fifty to seventy per cent of the maximum, and we have never seen the latter figures continually exceeded, quite a radical change in the estimated cost per pound of finished product as well as per kilowatt-hour utilized has been effected.

As a practical check upon this it is rather satisfactory to learn the electrical capacity of an installation, the amount of energy estimated per pound of product, and then to learn the actual amount of finished product turned out in a year. The results of this character of information received from several operations in different parts of the world would seem to indicate that, if the amount of calculated energy per pound is correct, the actual load-factor of the plants runs from thirty to fifty per cent, based upon a twenty-four-hour day and a calendar year.

The kilowatt-hour is the only true basis for calculation, and the cost of this unit for purposes of estimation should be based upon the cost of a kilowatt-year, modified by the actual or calculated load-factor.

Computation along these lines, taking into account the cost of transportation of materials, will show the range of possible business in the field of large electric-furnace and electrochemical operations.

As adjuncts to the power-load, electrothermic appliances and electrochemical processes offer means of increasing the usefulness of the central station and broaden the field of salesmanship.

The commercial departments which have for their motto "Electricity for everything everywhere" must view with some satisfaction the record of every new adaptation which brings them closer to their ideal.

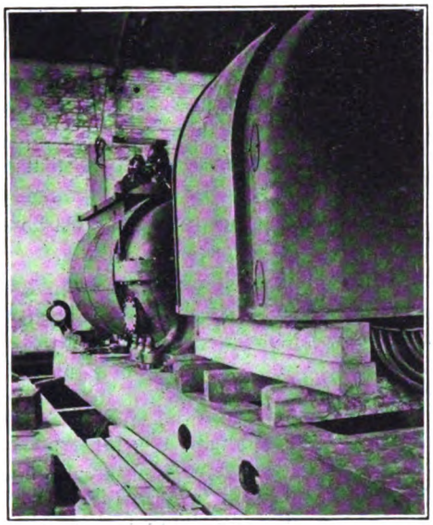
A Good Year for the Boston Elevated Railway Company.

The report of the Boston Elevated Railway Company for the year ended September 30 shows increases in both gross receipts and number of passengers carried. For the twelve months ending September 30 the gross business increased $837,509, or 6.6 per cent. With an increase of $689,297 in operating expenses, the net earnings increased $203,745. The number of passengers carried for the year amounted to 262,267,240.

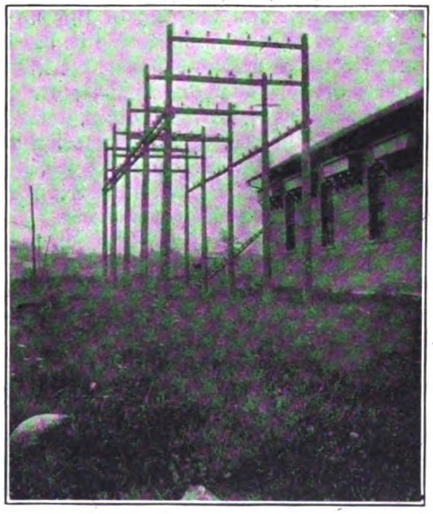
Digitized by Google

The Indiana, Columbus & Eastern Traction Company.

The Indiana, Columbus & Eastern Traction Company is doubling the capacity of its plant at Medway, Ohio. This work was begun about three months ago. The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., is installing two steam turbines, one of 1,500 kilowatts capacity, and one of 750 kilowatts capacity, and a 300-kilowatt rotary converter. This installation necessitates an increase in boiler capacity and two 550-horse-power Babcock & Wilcox boilers are to be installed. The company is erecting a new stack. The base is fourteen feet square, with an inside diameter of nine feet, and the stack is 180 feet high. New Wheeler pumps and surface condensers will be installed.



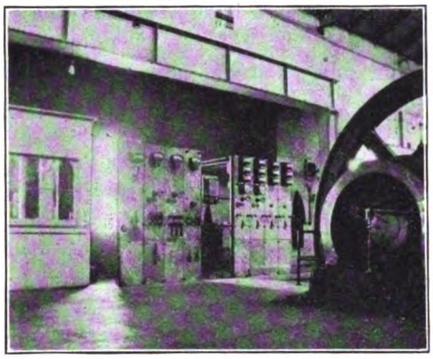
PARTIAL VIEW OF 1,500-KILOWATT TURBINE BEING INSTALLED AT MEDWAY POWER-HOUSE OF THE INDIANA, COLUMBUS & EASTERN TRACTION COMPANY.



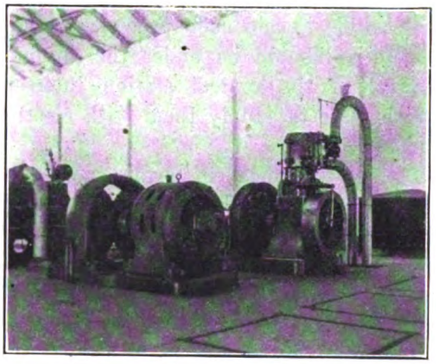
LINE ENTRANCES, SPRINGFIELD SUBSTATION OF THE INDIANA, COLUMBUS & EASTERN TRACTION COMPANY.

The water supply for the plant is obtained from wells, and the condenser supply is taken from a mill-race.

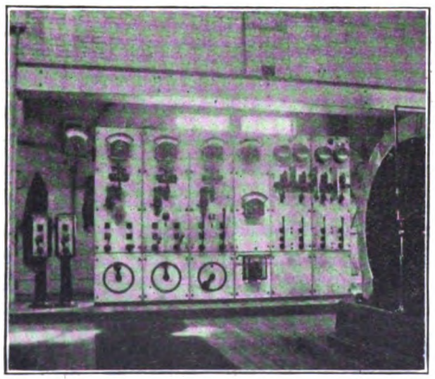
After the new installations are made the Medway plant will be one of the largest in the state. The boiler equipment will include seven 250-horse-power, one 500-horse-power and two 550-horse-power Babcock & Wilcox boilers. The engine room will have two 1,250-horse-power Hamilton-Corliss engines, two 400-horse-power Slater engines, one 1,000-horse-power, and one 2,000-horse-power steam turbines. The electrical output will amount to about 4,500 kilowatts.



ALTERNATING-CURRENT CONTROLLING BOARD ON RIGHT, EXCITER BOARD ON LEFT, MEDWAY POWER PLANT, INDIANA, COLUMBUS & EASTERN TRACTION COMPANY.

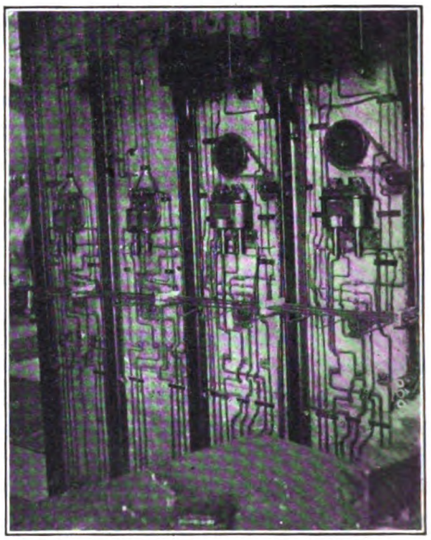


STEAM-DRIVEN AND MOTOR-DRIVEN EXCITERS, FOR 800-KILOWATT ALTERNATORS.



DIRECT-CURRENT SWITCHBOARD, MEDWAY POWER PLANT, INDIANA, COLUMBUS & EASTERN TRACTION COMPANY.

Part of the equipment includes two 800-kilowatt, three-phase, 2,300-volt, twenty-five-cycle alternators made by the General Electric Company. This voltage is stepped up to 26,400 volts and transmitted at present to six substations. The two 325-kilowatt generators are direct-current machines generating 550 volts. The new Westinghouse generators will have a capacity of 2,000 kilowatts. These are twenty-five-cycle machines and will generate 390 volts. Three 110-kilowatt transformers are being installed, 2,300 volts on the primary and 390 volts on the secondary. This arrangement is being effected so that the rotary can run either from the 390-volt bus-bar or from the 2,300-volt bus-bar. The current generated by the 390-volt generators of the Westinghouse make will be stepped up to 26,400 volts through three 750-kilowatt oil and



REAR VIEW, SWITCHBOARD, MEDWAY POWER-HOUSE, INDIANA, COLUMBUS & EASTERN TRACTION COMPANY. TWO PANELS AT LEFT LINE PANELS WITH LOW VOLTAGE CONTROL CIRCUITS. TWO PANELS AT RIGHT, 800-KILOWATT GENERATOR CONTROL CIRCUITS.

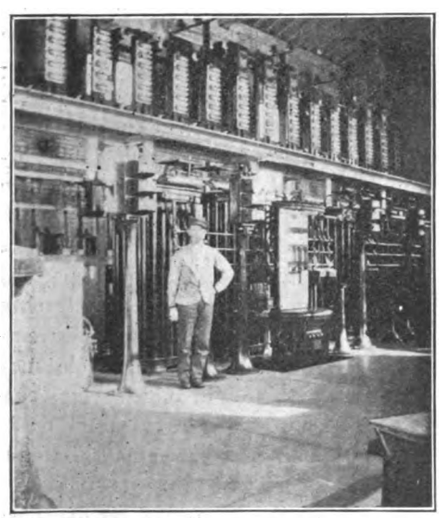
SPRINGFIELD SUBSTATION, DAYTON - SPRINGFIELD DIVISION, INDIANA, COLUMBUS & EASTERN TRACTION COMPANY.

Digitized by Google

water-cooled transformers. The 26,400-volt leads will then be tapped in to the old station bus, where the current will be switched on to the transmission line by General Electric type H switches electrically operated from a low-voltage board.

The company has a seventy-eight-mile, three-phase transmission line. The insulators are Hemingray Glass "Provo" type, No. 1, arranged so that they form an equiangular triangle, two on the cross-arm and one on the top of the pole. The poles are cedar, octagonal, and support No. 1 wire. Each span is 100 feet, with some few exceptions where rivers are crossed and the poles can not be set so close. In one case the span is 320 feet. Special cross-arms were not used in these cases. The only precaution taken is in watching the line-sag, so that the wires may be kept from swinging together.

Most of the line is on track right of way. At Springfield the transmission line is built around the city for a distance of eight and one-half miles. In order to keep a constant watch on the insulators the line is inspected every day except Sunday. For the benefit of the service a telephone line has been strung on the high-tension poles, so that long delays never occur. This telephone line serves no other purpose, and the linemen carry testing



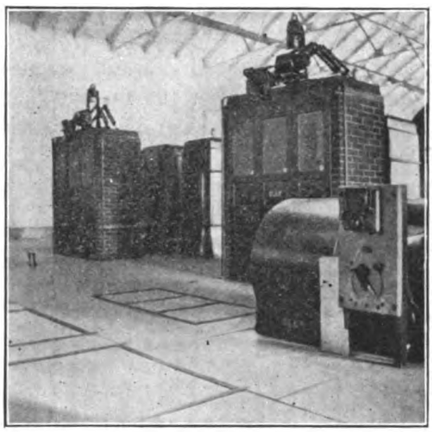
ALTERNATING-CURRENT LIGHTNING ARRESTERS, TRANSFORMERS AND LINE SWITCHES, SPRINGFIELD SUBSTATION, DAYTON-SPRINGFIELD DIVISION, INDIANA, COLUMBUS & EASTERN TRACTION COMPANY.

sets, connecting them on the line at the point of difficulty and getting into immediate communication with the switchboard attendant.

In the near future the company expects to construct sixty miles of transmission line in addition to the seventy-eight miles already in operation. There will also be added six Westinghouse substations. This will bring the rotary equipment up to fourteen 300-kilowatt machines. At the present time there are eight rotaries in operation, all of the General Electric make.

SPRINGFIELD, TROY & PIQUA ELECTRIC RAILWAY.

The Springfield, Troy & Piqua Electric Railway has a 1,700-kilowatt plant located at a most beautiful as well as convenient point about two miles west of Springfield,



26,400-VOLT SWITCHES, MEDWAY POWER-HOUSE, INDIANA, COLUMBUS & EASTERN TRACTION COMPANY.

Ohio. This is on the banks of the Ohio river. The Erie Railroad tracks are 100 feet to the east of the power station, and the Detroit, Toledo & Ironton tracks the same distance to the north. The connecting tracks to these two steam roads afford the company good coaling facilities. Most of the coal, however, is received over the latter road.

The water for the plant is secured from the river through a twenty-four-inch pipe and from one deep well.

The power installation, which was made about two years ago, includes four 300-horse-power Babcock & Wilcox boilers, Worthington feed pumps and a Stillwell-Bierce vacuum pump. The heater and heater pump were made by the Hoppes Manufacturing Company, of Springfield, Ohio. There is also a Hoppes jet-condenser. The two 1,200-horse-power engines are Cooper cross-compound, direct-connected to two General Electric twenty-five-cycle, three-phase, 2,300-volt generators. Each generator has a capacity of 850 kilowatts. The 2,300 volts is stepped up to 6,600 volts and 26,400 volts by banks of General Electric transformers. The 6,600-volt circuit feeds two substations, one on the Springfield & Xenia, and the other on the Springfield & South Charleston traction lines. The power contract is made with the Springfield & Xenia, which company supplies the Springfield & South Charleston. The 26,400-volt line supplies three substations on the Springfield, Troy & Piqua line, one at the plant and two located between Springfield and Troy.

ECONOMY IN CENTRAL STATION OPERATION,[1]

BY GEORGE WILKINSON.

As a supply station engineer, much of my time is taken up in carrying out the varied duties connected with the supply of electrical energy, and in endeavoring to solve, in the most direct and economical way, problems that arise in connection with such supply. Such economical solutions are necessary if the substantial benefits which electricity can furnish are to be available at a price which all can afford to pay. I offer the following suggestions to my colleagues who are interested in the supply of electrical energy to the general public, and who recognize that their duty is not merely to make a profit on the business, but also to secure a reliable, effective and cheap service available to all residents and business people in the districts.

Considering, first, the power station. It will often be found that while reasonable economy is secured in the generator room, and care is taken to employ efficient plant and skilled labor therein, the boiler house, being a less congenial sphere, is a department that receives less attention, the details are not so carefully considered, and the equipment, unfortunately, is worked by men who are often below the average mechanic in intelligence and education. An investigation of supply station records will show that from one-half to four-fifths of the works cost of generation is incurred in the boiler house, and this is chiefly for coal; also it is obvious that in places where electricity supply stations are already in operation, and where a fixed sum must be allocated annually for the repayment of capital charges, the only possible chance of cheapening the cost of production to any substantial extent lies in reducing the consumption of coal, and it is an index of healthy progress in economy if, while continuing to use the same plant, the annual ependiture on fuel is decreasing while the number of units sold is increasing.

The free use of steam traps is a source of heavy loss in some generating stations. Due to their liberal use and to the scattered positions they occupy, the hot water they discharge is frequently led into the nearest drain and runs to waste. A long experience has shown that an equally satisfactory and more economical arrangement is to connect all the water separa-

[1] Address of the chairman of the Leeds (England) section of the Institution of Electrical Engineers of Great Britain, delivered October 25. Slightly condensed.

Digitized by Google

tors, valve casings, cylinder jackets, etc., to a small pipe, from which steam is taken to operate a bank of boiler-feed injectors. By this means all the steam required to work the injectors is derived from points where condensed water collects, and it is thus all saved and expeditiously carried back with the steam through the injectors direct into the boilers. The injectors used should be of varied sizes, the smallest, when at work continuously, being equal to feeding the boilers on low loads. One steam trap of suitable size is provided at the end of the injector block, and this trap comes into action during the short and infrequent intervals when the injectors are out of action for repairs. Another advantage of this arrangement is that the large and often wasteful steam-driven feed pumps can be shut down and maintained as reserve plant.

An economical standby boiler-feed arrangement is obtained by employing three throw pumps, driven by electric motors and fitted with variable-stroke gear which allows the use of a constant-speed motor and permits the stroke of the plungers being graduated from the maximum to zero, or *vice versa,* whilst in action. An indicator should be fixed on each pump to show the amount of water delivered per hour.

A further easily realized and very substantial economy is to employ steam temperature water to feed the boilers—*i. e.,* to bring the boiler-feed water, after it has left the economizer or other preliminary heating device, into direct contact with live steam, so that the feed-water temperature is raised before it enters the water space in the boilers to a point equal to that of the steam itself. Its adoption will secure a greater output of steam from any steam boiler using ordinary hot-feed water and at an increased economy averaging at least seven per cent, and in most cases considerably more. Effective plant for securing steam temperature feed is simple, easily applied, and neither costly nor cumbersome. Where steam temperature feed water is introduced, a further step in point of output and efficiency may be expected if the boiler furnaces are enlarged and fitted in every case with a brick arch, so that the flames do not directly impinge upon the heating surfaces. This will not only reduce the smoke, but will raise the furnace temperature and increase the steam output of the boiler. Practical objections to such enlarged furnaces are (1) the difficulty of covering the bars with fuel; (2) the liability of the fire to burn in holes. These objections may be efficiently met in tubular boilers by employing the well-known chain-grate bars of extra length and width, and in Lancashire boilers the most effective remedy appears to be the removal of the furnaces from the narrow flue tubes to the front of the boiler, larger furnaces being built out on the boiler front by wrought-iron plates well lined inside with firebrick and provided with firebrick arches, and on the outside by ordinary brickwork, a cavity being formed between the outside brick lining and the metal shell of the furnace. Air for supporting combustion will be drawn through this cavity, entering by an aperture located over the furnace and round the sides thereof, thereby picking up any waste heat and passing at a high temperature through the grate bars to the fuel. By these methods not only will a higher furnace temperature be reached, but the heat upon the boiler plates will be better distributed and the ebullition area thereby extended. In many boiler houses forced hot-air draught could be easily applied, the heat to the air being derived from the hot gases leaving the boilers for the chimney. The economy so produced is often very substantial, but the equipments at present used for this purpose are often cumbersome and very costly.

So long as carbon-filament lamps continue to be used, and in view of the improvements in efficiency and grading, which will be effected in these lamps in the near future by British manufacturers, it is important that more uniform pressure should be obtained upon electricity supply mains. My experience is that pressure regulation by automatic apparatus is the only satisfactory and effective method of obtaining good and dead-beat regulation. In addition, it is necessary to have distribution mains of ample section, as pressure regulators can maintain uniform pressure only at predetermined points upon the network. The too frequent practice of increasing the pressure to an excessive degree at feeding points, in order to compensate for abnormal drop upon the distribution mains, is to be strongly condemned; the proper remedy for poor lighting at the extremities of distribution mains is to put down more copper. Formerly a remedy for drop in pressure was found by doubling the pressure of supply, and large sums have been expended by supply undertakers in this direction.

Works which still give a low-voltage supply, say, near 100 volts, are likely to reap a rich reward in the near future, as the consumers are in a position to obtain the economic benefits offered by the metallic-filament incandescent lamps. I have had lamps of this type in use in my house since July last, each giving a light equal to thirty-two British candles for an expenditure of under forty watts. With current at six cents per unit, and including the extra retail price of the metallic-filament lamps as against the carbon lamps, and assuming an average life of 600 hours only for the metallic-filament lamp, the relative cost comes out for thirty-two-candle-power lamps for the 600 hours at $2.75 in the case of the former as against $4.43 for the latter. As far as I can judge from results in my house, the useful life of the metallic filaments will average at least double that of the carbon lamps, while they are not so sensitive to voltage variation, give a more brilliant quality of light, and the bulbs on normal voltage do not blacken, hence the candle-power is more uniform throughout the life of the lamp. The advent of these lamps justifies the hope of a vast and early extension of the electrical industry throughout the whole country.

The question of tariffs is one which might with advantage be considered by an organization representative of the whole supply industry. The issue of recommendations by such an organization would be useful to engineers, and especially to directors and committeemen, many of whom appear to be in utter ignorance of the fundamental principles governing the vital question of tariffs. In my view the adoption of flat rates with graduated discounts, according to the number of units used during a specified period, is fundamentally wrong. Such a tariff can not be fair and equitable; customers who are quite unprofitable may get a substantial discount, while customers who are exceedingly profitable to the supply may get a very small discount. Attempts to get over this inequality of treatment, due to flat-rate tariffs, have been made by varying the discounts according to the class of consumer under consideration, but this is only lessening the evil, and is in no sense a cure. Again, there is often a big discrepancy in the prices charged for lighting and for power, the former being frequently too high, while the latter is certainly often too low. The present alternative to the flat rate is the well-known maximum demand tariff, which is a more equitable method. Inasmuch, however, as the method of calculating the amount due is unintelligible to many consumers, it has become un-

Digitized by Google

popular; moreover, a customer charged on the maximum demand tariff does not know until the end of the quarter, or the half-year, to what extent he will benefit, or, in some cases, he does not know if he will benefit at all, as this is not determined until the quarter or half year has expired, whilst he is often nervous about switching on his lamps lest he should increase his maximum demand. There are, of course, other systems of charging in use to a limited extent, some of them being the result of expediency, rather than of equity.

In some cases demand indicators have been used to develop business in its early stages, but when the business has reached a point at which the engineer can afford to make a change, a flat-rate tariff has been introduced and the demand indicator system abolished. The change, while simplifying the accounts and appealing as it does by its simplicity to the consumer, has no serious prejudicial effect upon the receipts, as the losses made on some consumers are counterbalanced by the extra profits obtained from others. This condition of affairs is satisfactory so long as the supply authority is content to make excessive profits on some consumers and to apply a part of them in making up the losses on other consumers; but the former are likely to rest content with flat-rate tariffs just so long as they remain in ignorance of the true condition of affairs, and no longer. The fact is gradually dawning upon the general public that the longer they use electricity per day, the less average price per unit should be paid, and I venture to say that in a few years, when this equitable principle becomes generally recognized by users, flat rates, even when modified by graded discounts, will not be tolerated either for lighting, heating or power purposes, unless some economical system of electrical storage is meanwhile evolved.

The chief factor in the cost of supply is made up by the "fixed charges." Exactly how much this is per annum is easily ascertainable in every case, and it probably varies from year to year. Each consumer should be charged his fair proportion of this sum. The exact amount to be paid should be recorded on each consumer's premises, not in the form of so many units chargeable for half-year at an increased price per unit, which is the clumsy and perplexing method of the demand indicator, but by an instrument which records the consumer's proportion of standing charges clearly in pounds, shillings and pence.

The remaining item in the total cost of supply is the "generation cost," which is by far the smaller item, and is practically a uniform and unvarying cost per unit, to cover which a very low flat-rate can be fixed. Considerably less than one penny per unit will cover this item, and also afford ample profit to the supply authority.

As illustrating the present wide divergence in the matter of tariffs, I set forth below the published scale of charges of four of the largest and most important municipal undertakings in the country, which may be taken as fairly representative of the whole kingdom. These I designate A, B, C and D:

A. The rate payable by a consumer for a supply of electrical energy for lighting in any one establishment (whether used direct from the mains or through a motor-generator or other apparatus) shall be three and one-half pence for each unit up to 3,000 units per quarter, three pence for each unit in excess of 3,000 units to 10,000 units per quarter, and two and one-half pence for each unit in excess of 10,000 units per quarter. A reduced rate shall be charged for electrical energy supplied for power, or for cooking or heating, when measured by a separate meter—namely, two pence for each unit up to 3,000 units per quarter; one and one-half pence for each unit in excess of 3,000 units per quarter to 10,000 units per quarter, and one penny for each unit in excess of 10,000 units per quarter.

B. Electrical energy used for lighting: for first 300 units per quarter, five pence per unit; for any further quantity used in the same quarter, three and one-half pence per unit. Electrical energy used for long-hour lighting: for first 300 units per quarter, three pence per unit; for any further quantity used in the same quarter, two pence per unit. (NOTE—This special low lighting rate has been fixed to encourage a day load, and is for the benefit of consumers who use their supply of electrical energy for lighting during a large number of hours per annum. In order to avail themselves of it, consumers will be required to enter into an agreement in which they guarantee a minimum payment of £15 per annum for not more than twelve sixteen-candle-power lamps, or their equivalent, connected to the circuit; a further guarantee of twenty-five shillings per annum for every additional sixteen-candle-power lamp, or its equivalent, connected to the circuit will also be required. Current reckoned at the above rate per unit can be used up to the value of the sum guaranteed, any additional current being charged at the same rate per unit. Consumers will be required to have all lamps so guaranteed connected to a circuit kept distinct from the ordinary lighting supply, and a separate meter will be installed upon this circuit. Should any alteration be made in the number or candle-power of the lamps so guaranteed, notice must be at once given to the department, or in default the consumer will be liable to have the supply charged at the department's current rates for ordinary lighting purposes.) Electrical energy used for motors: for first 300 units per quarter, two pence per unit; for any further quantity used in same quarter up to 3,000 units, one and one-half pence per unit. Where 3,000 units or over are used per quarter (after the first 300 units at two pence per unit), one and one-quarter pence per unit.

C. Private lighting; maximum demand system, with initial charge of four and one-half pence per unit with daily average of one and one-half hours and two and one-half pence per unit after, or flat rate of four and one-half pence with discounts from two and one-half to forty-four and one-half per cent. Power and heat: maximum-demand system, two and one-half pence per unit for daily average of one and one-half hours, and one and one-half pence after, or flat rate of two and one-half pence per unit with discounts from five to sixty-five per cent. Traction supply: one and three-quarters pence per unit. Special purposes: shipyards with thirty per cent load factor, one and one-eighth pence to seven-eighths penny per unit.

D. Charge per unit: for lighting, five and one-half pence, or a fixed charge of £7 per annum per kilowatt of maximum demand and one and three-quarters pence per unit; for motors, one penny to one and seven-eighths pence per unit, according to hours of user.

The perusal of these tariffs will be convincing proof that present-day methods of charging are unsatisfactory, and they must appear unintelligible and chaotic to the general public.

An ideal tariff would fulfil the following conditions: (1) Protect all consumers from unfair or excessive charges; (2) secure from every consumer a reasonable and readily assessable profit to the supply authority; (3) be applicable without variation to all conditions and for all purposes for which electrical energy is used; (4) be capable of easy explanation, and its equity should be apparent to all persons of average intelligence.

Digitized by Google

RECENT STORAGE BATTERY IMPROVEMENTS.[1]

BY SHERARD COWPER-COLES.

It is not the intention of the author to deal with the historical side of accumulator development and manufacture, as this has been so often recorded, but only so far as it applies to electrodes that retain a large quantity of the electrolyte in themselves, and in which the active matter is not necessarily porous; this is a distinction of great importance.

THE ALKALI NICKEL CELL.

No radical changes have been made in the electric accumulator in recent years which have come into practical use, and it is many years since alkali nickel cells were brought into prominent notice; although having many promising features they have not so far fulfilled the hopes entertained. The company, which controls the rights of the alkali nickel cell in Germany, has decided to abandon for the present the development of an iron nickel cell which would be superior to a lead cell with regard to durability and life. The best result obtained up to the present with an accumulator having the same weight as an average 100-watt-hour lead accumulator is seventy watt-hours per kilogramme.

Fig. 1 is a typical diagram of an average four-hour charge and discharge of an iron nickel cell; on the same diagram is shown in dotted lines an average four-hour charge and discharge of a lead cell. The annual monetary output for storage batteries in England and Germany is estimated at the present time at about one million pounds, so any economy effected in the manufacture and life of accumulators is of great importance to the commercial world.

VARIOUS TYPES OF GRIDS.

It will be necessary in dealing with the special forms of plates to be described to refer briefly to some of the principal types. The lead plates or grids for use as conductors of electricity and as carriers of active matter now in use may be classified under five general types, as shown in Fig. 2, which does not include the Thomassi, the Peto and Radford, the Niblett Solid, or the Panthode, as they have no grid or frame to support the active matter, and the electric conductors to the active matter are independent of the frames or supports.

A large number of modifications have been made in these five general types from time to time, but little change has been made in the general design, unless the Tudor negative box-grid, type 4, is considered an exception, which is a sheet-lead box, perforated with small holes placed close together, to retain the spongy lead which is of an extremely fragile and porous nature. In more recent practice the holes are made square and very much larger. It is claimed for this construction of battery that all parts of the active matter are brought into contact with the electrolyte. Rudolph Gahl, in a paper recently read before the Colorado Scientific Society, expresses the opinion that the box negative marks a fresh era of improvement, as such

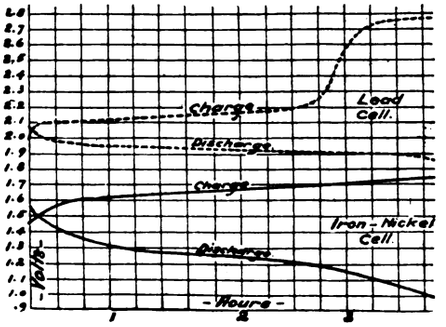


FIG. 1.—TYPICAL DISCHARGE CURVES OF AN IRON-NICKEL CELL.

negatives have a longer life than Planté positives, where as formerly the life of the battery was limited by the life of the negative plate. The latest Fulmen negative (of a design intermediate between type 1 and type 2) consists of two semi-grids of antimony lead riveted together, interlocking the active matter. The bars of each half-grid are triangular in cross-section, the bases of the triangles are turned outwards and the apex inwards. Owing to

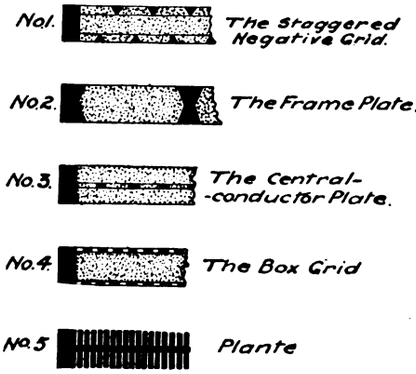


FIG. 2.—TYPES OF LEAD GRIDS.

the arrangement the active matter is firmly held, yet each pocket is isolated or separate, so that in case of shrinkage the risk of breakage is reduced to a minimum.

THERMOELECTRIC AND CONCENTRATION EFFECTS.

Thermoelectricity has a considerable bearing on accumulators or secondary batteries, whether considered from the point of view of the electron theory which Drude and Riecke and Liebenow and others have propounded (to account for the thermoelectric force and other properties of metals), or from the point of view of Carhart and others, who have sought to show that all the effects in a voltaic cell have a thermoelectric origin. Thermoelectric effects are intimately connected with the reaction of the accumulator, and when more is known regarding thermoelectricity, it should lead to important developments in the voltaic cell. There is no reason why, in the present state of knowledge of the subject (and assuming that the osmotic pressure theory will explain all concentration cells), a cell could not be designed in which the known effects could be combined to increase the output. Suppose it is assumed for the moment that the thermoelectric force of solution has nothing to do with the electromotive force resulting from the difference of concentration, and that they are disconnected, the thermoelectric, the concentration and the electrochemical effects could still be combined.

IGNITION TYPE OF CELL.

The obvious criticism is that when electricity has to be generated it can be far more efficiently done than by thermoelectric effects, and that when electricity has to be stored, the additional generating effects are a complication. But there are many cases in which economy is not of primary importance, but where simplicity and convenience are. A conspicuous example is the ignition cell for motor-cars, which is an industry of considerable importance, one company alone having sold over 40,000 in twelve months. It might be possible by judicious choice of electrodes and electrolytes, and heating and cooling effects, to design a generator which would fit in with the utilization of the waste heat of the petrol engine.

There are at present three different methods of supplying electricity on motor-cars: dry cells, storage batteries and magneto devices. Dry cells are used very largely in the United States, but they are expensive and not very reliable; storage batteries are at present used more than anything else for ignition, at any rate in this country; but motorists are complaining of their short life and unreliability, and also of the trouble and expense of recharging. Magneto devices are certainly the most scientific method, and great improvements have been made in them lately. In one account of the autocycle racing trials it is stated that accumulators were used for ignition by the first three to finish. Of all who entered, fifty-one used accumulators, twenty-two magnetos, and five magnetos and accumulators.

An entirely new type of cell for igni-

[1] Paper read at the Royal United Service Institution, London (England) before the Society of Engineers, November 5.

Digitized by Google

tion is wanted, which will fulfil the following conditions: (1) the difference of potential at terminals must have little variation; (2) it should not be necessary to stop the car to replenish the supply of electricity; (3) the available energy for producing spark shall be as great at starting as when running. Dry cells fulfil conditions 2 and 3, accumulators 1 and 3, magnetos 1 and 2. If a battery can be devised to fulfil all three conditions, it would take precedence over all other sources of current. It should be possible to devise a battery in such a way that the electrodes and the electrolyte can be renewed or restored in a few seconds, and that these renewals can be of such a form that they may be conveniently carried. It might be objected that this would be an expensive way of supplying current, which could be true so far as the current alone is concerned. When, however, a motorist has his accumulator recharged, he is not paying for current, but for labor and convenience; suppose, for instance, he pays one shilling to have a forty-ampere-hour, four-volt accumulator charged, only a fraction of the shilling is for current. The back electromotive force when charging may be called 2.5 × 2 cells equals 5 volts × 40 ampere-hours equals 200 watt-hours, or one-fifth of a unit. At five pence per unit the current will come out at one penny, and the other eleven pence will stand for labor, convenience and profit. One pound of zinc costs two pence or three pence, and represents several hundred ampere-hours, so that it will be seen that if a practical primary battery could be devised for ignition purposes, it would be far cheaper than a storage battery.

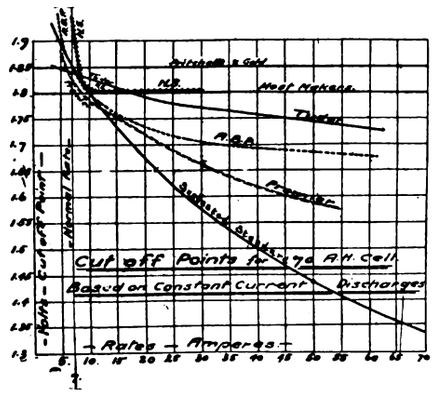


FIG. 3.—CURVES SHOWING PROPER CUT-OFF POINTS FOR VARIOUS RATES OF DISCHARGE.

CUT-OFF POINT OF DISCHARGE.

The next point to which the author will draw attention is the cut-off point of discharge. The author had recently to make tests on a new battery to determine its output and efficiency. As several batteries were to be compared at the same rates of discharge, it was important to determine at what point each should be considered discharged. It was found on comparing the figures given by various manufacturers that each maker chooses arbitrary figures for stopping the discharges, hardly two manufacturers being in agreement.

On Fig. 3 are plotted curves, each of which shows the points at which the discharge of a given make of cell is stopped, at the various rates. Some of them use the same figure at all rates; the inaccuracy of such a system is made apparent by the curve, Fig. 4, which is a discharge of a seventy-ampere-hour cell commencing at forty amperes, and finishing at seven, the current being broken four times. From the figures obtained, it was considered necessary to fix a new graduated scale of potential differences at which to cut off the discharges.

There were two factors to be considered in fixing the suggested standard cut-off curve: (1) at a given rate, the difference of potential below which the plate is injured; (2) at a given rate, the lowest voltage at which the cell can perform the work called for. When used for electric lighting, for instance, the point of cut-off is fixed (unless regulating cells or boosters are used) by the lowest voltage which is sufficient to maintain a given difference of potential across the terminals of each lamp.

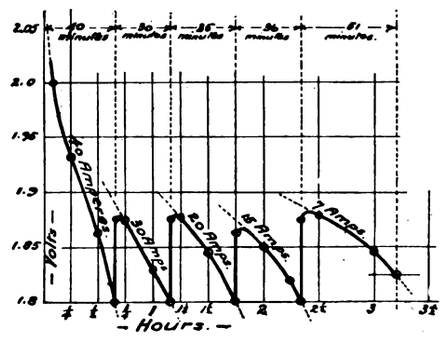


FIG. 4.—DISCHARGE CURVE OF A SEVENTY-AMPERE-HOUR CELL.

The second consideration will, of course, be always limited by the first, the point below which the cell will be injured. Some point of agreement among the makers was then sought for and was found at the ten-hour rate of discharge. Manufacturers all appear to agree that it does no injury to a cell to discharge it at a ten-hour rate down to 1.85 volts. This, then, was a starting point, and experiments had to be made to determine at what voltage at any given rate the cell would be in the same chemical condition, that it would be at a ten-hour rate at 1.85 volts. Take, for instance, a 100-ampere-hour cell, *viz.*, one that will give 1.85 volts on closed circuit at the end of a ten-hour discharge at ten amperes. Supposing the cell is now discharged at forty amperes, and that the cell, when discharged, is in apparently the same chemical condition as it would be at a ten-ampere rate when the volts read 1.85, by occasionally switching back the current to ten amperes during the discharge, the state of the cell is readily determined. When the cell, according to this method, is just at the end of the discharge, if the current is switched back to ten amperes, the needle of the voltmeter will move up very quickly for little less than a second, and will then suddenly commence to move at a slower rate, as shown in Fig. 5.

The lower potential difference of a cell at a higher rate of discharge is due to two causes: (1) the loss of pressure in the cell due to the change in the ratio of external to internal resistance, and (2) the lower electromotive force due to extra polarization. The lower electromotive force, due to polarization from an increased current, can be accounted for by the extent to which the negative electrode has been temporarily converted into a hydrogen electrode. The hydrogen ions bombard the surface of the active matter more quickly than they can be absorbed in the purely chemical reaction. When there is a thick layer of material this action is, of course, actuated by want of circulation in the electrolyte. At high rates, gas is actually given off, which increases as the ratio of current to surface.

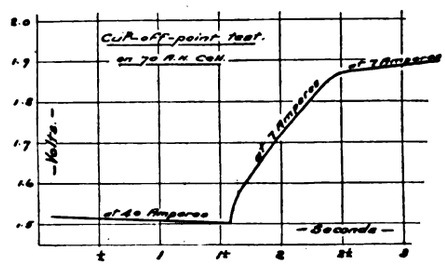


FIG. 5.—DISCHARGE CURVE SHOWING EFFECT OF DECREASING THE CURRENT.

It is assumed that the sudden rise of potential difference on reducing the current is due to the restored ratio of resistance and the slower movement to the gradual recovery from the extra polarization. The discharge was stopped in each case when the needle was at 1.85 volts at the end of the rapid movement. No doubt the lower rate should have been left on for a longer period, but this was not done because at the ten-hour rate polarization is not important, and it might have been claimed that the extra polarization at the higher rate would cause an additional change in

Digitized by Google

the chemical condition of the active matter, so that practically its equivalent was added to the cut-off point in order to be on the safe side. Moreover, a too-long interruption would vitiate the high-rate test.

The curve shown on Fig. 3 and marked "suggested standard" was plotted from a great number of observations, and was used for the cut-off point for all subsequent tests, and in every case at the end of discharge on switching back to the ten-hour rate the needle immediately went well above 1.85, so that it may be considered perfectly safe to continue discharging down to the voltages shown on the curve for various rates of discharge. According to the rule which most manufacturers adopt (of discharging down to 1.8 for all rates), it would be incorrect to discharge a 100-ampere-hour cell down to 1.5 volts at a forty-ampere rate, but, on the other hand, it would be correct to discharge down to 1.8 volts at a 0.01-ampere rate. If, however, after the latter discharge the current is switched up to ten amperes, the reading will be below 1.7 volts, at which point at the ten-hour rate

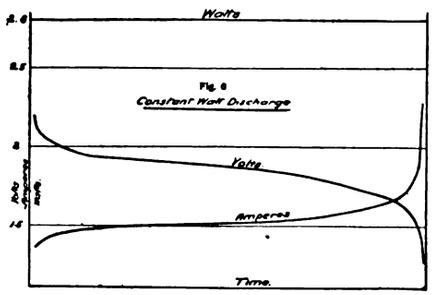


FIG. 6.—CHARACTERISTIC DISCHARGE CURVE AT CONSTANT OUTPUT IN WATTS.

(according to the 1.8-volt rule) the cell is very much overdischarged. It is in this way that the misleading figures as regards capacities are obtained, which are to be found in so many publications.

CUT-OFF POINT FOR TRACTION CELLS.

The motor-car traction cell calls for special treatment in deciding the cut-off point. In the motor-car cell there are, of course, no regulating cells or booster, and in order, therefore, to obtain the same power, the driver must increase the current as the voltage drops. The cells are, in fact, in practice discharged at constant watts rather than constant current. What more natural, then, than that the final volts at various rates should be determined by a series of discharges at constant watts. It will be observed that the constant watt discharges end very suddenly, because the rising current and dropping voltage react on each other, therefore it is comparatively easy to plot a well-defined curve. Fig. 6 is a characteristic diagram of a constant watt discharge. Cut-off points, determined on this basis, would be very useful for automobilists. The resulting constant watt curve should not differ very greatly from the constant-current curve for indicating final volts.

DEFECTS OF NEGATIVE PASTED PLATE.

The Planté positive plate has improved so much in capacity and life of late years that more attention has been drawn than heretofore to the defects of the negative pasted plate. The most prominent amongst the defects is the shrinking and cracking of the spongy lead with the resultant fall in capacity. There seems to be very little doubt that it results from the solubility of sulphate of lead in very concentrated sulphuric acid. This view has been confirmed by experiments and tests made by Diamant, who substituted calcium

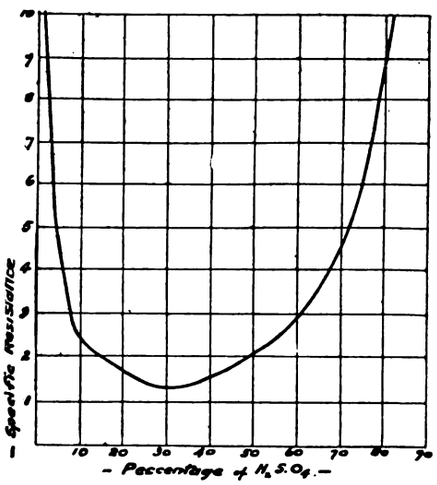


FIG. 7.—VARIATION IN SPECIFIC RESISTANCE WITH CONCENTRATION OF SULPHURIC ACID.

sulphate for part of the negative active matter, which has a similar solubility in a concentrated solution of H_2SO_4, to sulphate of lead, and which was, after several discharges, actually diffused out and deposited on the surface of the plate. The strongest acid during charge is to be found in the interior of the plate, or where it has least chance to circulate, and dissolves the discharged active matter (sulphate of lead) and diffuses toward the outside of the plate. Exactly what happens now is not quite clear. Certainly the sulphate of lead can not remain in solution in the lower density acid outside the plate. Probably part of the solution electro-deposits its metallic lead, and the remainder is chemically precipitated in that part of the plate near the surface, only to be later on also formed into metallic lead, so there is a constant movement of active matter from the interior of the plate toward the outside, and the pores at the surface become more and more congested, and the passages for the circulation of the electrolyte more and more attenuated. This action increases at a progressive rate, and is much quicker at higher rates of charge and discharge, while, on the other hand, at very low charge rates it is negligible. The usual explanation is that the lead changes by reason of the forces of expansion and contraction from spongy to non-spongy lead. Figs. 7 and 8, which are curves plotted by Wade, show the ratio of resistance to density of H_2SO_4.

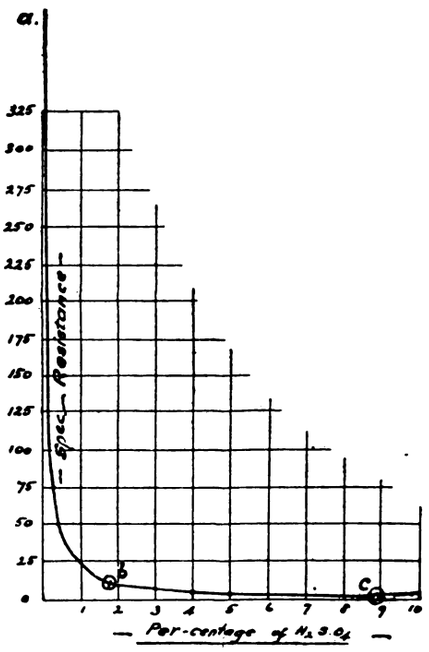


FIG. 8.—VARIATION OF SPECIFIC RESISTANCE OF WEAK SULPHURIC ACID.

It will be observed that there are two quick turns in the curve, and that at one of them at about two per cent strength of H_2SO_4, the resistance suddenly increases. When a negative electrode is being discharged, sulphuric anhydride (SO_3) is constantly being absorbed from the electrolyte into the interior of the plate. It is clear that this absorption must continue so long as there is any unsulphated lead left, and sulphuric anhydride available to sulphate it. So long as this is the case the discharge continues with a comparatively even drop of potential. Bearing in mind that a considerable percentage of the spongy lead remains unsulphated at the end of discharge, we may assume that the sudden bend in the discharge curve is due to the failure of the sulphuric anhydride to reach the unsulphated lead in the interior. As the discharge proceeds, and the average density of electrolyte becomes lower, it becomes more and more difficult for the supply of sulphuric anhydride

Digitized by Google

(through the long-attenuated passages of the plate) to equal the demand. A point is at length reached when the percentage of acid in the interior of the plate reaches two per cent, when, the resistance of the electrode begins to increase at a rapid ratio, at the same time the potential difference at the terminals of the battery will as quickly drop. With each charge of a negative electrode the pores, through which the sulphuric anhydride has to be supplied, become less in number and more attenuated. The quick bend in the discharge curve is reached sooner, and the electrode steadily drops in capacity.

It is obvious that if this sort of thing is to be remedied, the long-attenuated pores must be done away with, and the electrolyte be afforded facilities for freely diffusing between the reserved space between the plates and the interior of the plate. If this can not be done, then some way must be provided for keeping each particle of active matter in contact with its own quota of electrolyte, so that the electrolyte will not have to run back and forth to do its work. Dolezalek, in his work on the "Theory of the Lead Accumulator," forcibly brings home in a convincing way the importance of affording every part of the active matter perfectly free access to its share of electrolyte. Exception must be taken to his statement that a single charge and discharge are sufficient to characterize a cell.

As the generation of electric current in the storage cell is the result of the chemical reactions which take place between the active materials and the electrolyte, any part of the active materials which is not in actual contact with the electrolyte is useless; so not only must they be porous, but this porosity must be thoroughly molecular; that is to say, in addition to the spaces of appreciable size that exist between the small visible particles, each of these particles must itself be chemically permeable, in order to include every molecule in the electrolytic circuit. Active materials, as usually prepared, appear (at first sight) to fulfil these conditions, for if the electrolyte had not had access to the individual molecules, their conversion into spongy lead or lead peroxide would not have been possible, and presumably each molecule is left surrounded by a space (also of molecular proportions) which had been previously occupied by the elements which had been liberated in the process of formation. These spaces, however, are quite insufficient to contain the electrolyte necessary to discharge the active material. Solid lead requires about eight times, and solid peroxide about six times, its own volume of a solution of sulphuric acid, specific gravity, 1,200, for it to convert half into sulphates. As, however, it is necessary to leave an electrolyte of reasonable strength when discharged, double this space, or sixteen times and twelve times respectively, will be required. It has so far been found impossible to make a practical active material which is able to absorb electrolyte equivalent to much more than sixty per cent of its bulk, and in many cases the figure would be under thirty per cent. Any attempt to increase these spaces by making holes in the active matter itself is not to be recommended, as it reduces its mechanical strength, of which it already has none to spare.

The Tudor Accumulator Company have done much useful work in this direction, and their box-grid is designed solely for the purpose of enabling them to use extremely porous and fragile active material. This method of assisting diffusion even in the ordinary grid is to a limited extent useful. The carbonode plate of the Electrical Power Storage Company, in which carbon is mixed with the active matter, is still holding its own, and the Niblett Solid Accumulator Company use graphite in the same way. Opperman mixes in hairs, which are afterwards dissolved out by the electrolyte. The Ekstromer, the Sedniff and the Zedeco, and other new cells produce porosity by similar means. It is quite impossible, however, to do more than slightly mitigate the evil in this way. So long as the present design of plate cell is used, the balance of the electrolyte must be provided in a space between the plates. This method, which has so far been the universal practice, primarily increases the resistance by increasing the distance between the electrodes; it further increases the resistance in the following way. The reserve of acid between the plates is useless unless it can readily diffuse and circulate into their interiors. The current rates of charge and discharge vary with the chemical reaction taking place, and also the maximum current rates permissible must always bear a definite ratio to the rate at which the particles of active matter in the interior of the electrode can be supplied with fresh electrolyte.

The chemical reaction involves a steady abstraction of sulphuric anhydride from the electrolyte, and if this goes on faster than it can be replenished by the diffusion, the resistance of the electrolyte will rise. An electrolyte containing about thirty per cent of H_2SO_4, and having a specific gravity of 1.24, has the least resistance of any proportion of water to sulphuric acid. The resistance rises at an increasing ratio with decrease of specific gravity, until, as pointed out before (see Fig. 8), the two per cent strength of acid soon cuts the current down to a useless figure. In this lies the chief defect of the lead accumulator, as hitherto constructed, *viz.*, that the current rates of charge and discharge are limited to the degree of porosity of the active matter. This porosity can only be increased at the expense of the life and efficiency of the cell so long as the active matter has to depend entirely on its own mechanical strength for support.

It is true that Gulcher and others have assisted in supporting the active materials by either embedding in them or mixing with them woven glass, fuller's earth, powdered pumice and other inert materials, but they have made little or no attempt to increase the contact with, nor the space for, the electrolyte, and this is by far the most serious difficulty. In the ideal lead electrode each particle of active matter should be completely and permanently supported, and should at the same time have its share of electrolyte in contact with it in such a way as to avoid all necessity for circulation. As has already been pointed out, the nearest approach to these conditions occurs in Planté-formed electrodes; but in this case fresh active matter is constantly being formed at the expense of the lead support, which ultimately destroys it. Before describing the solid network cells suggested by the preceding remarks, the author will deal with the attempts to make the cell solid without providing for access of electrolyte to active matter.

(To be concluded.)

New York Electrical Society.

The 263d meeting of the New York Electrical Society will be held at the Edison Auditorium, 44 West Twenty-seventh street, Tuesday, November 27, at 8 P. M. Charles W. Stone, of the General Electric Company, Schenectady, will deliver an address on "Some Aspects of Modern Switchboard Engineering."

Mr. Stone will discuss the different instruments used in both direct-current and alternating-current work and their application; the different kinds of direct-current switches and circuit-breakers, and their respective uses; the different types of oil switches in use will be described, the theory of their operation explained and their recent developments discussed; a description will be given of the different relays used for the protection of modern systems, their use and their general functions; suggestions will be given in regard to the best method of installing switchboard apparatus, and points to be avoided will be indicated, as well as the dangers resulting from improper installation of such apparatus. The lecture will be illustrated with lantern slides.

Digitized by Google

Standardization of Tramway Motors.[1]

At the Milan International Conference, held in September last, the following report on standards for direct-current tramway motors was presented by a representative committee consisting of Professor G. Kapp, of the Birmingham University, ex-secretary of the Verband Deutscher Elektrotechniker; Professor G. Rasch, of l'Ecole Polytechnique d'Aix-la-Chapelle; Professor A. Blondel, of l'Ecole des Ponts et Chausseés, Paris; E. d'Hoop, managing director of the "Les Tramways Bruxellois" Company; C. H. Macloskie, chief engineer of the Allgemeine Elektricitäts-Gesellschaft; James Swinburne, past-president of the Institution of Electrical Engineers, and Professor W. Wyssling, of the Zurich Polytechnic.

GENERAL.

1. The following rules should be observed when machines are offered for sale, and when the sale is effected, except where the seller and buyer by mutual agreement wish to modify them.

DEFINITIONS.

2. Rating—The mechanical power developed by a motor or simply the power of the motor, is that power which is developed at the car axle, in accordance with conditions as given below. (In certain special cases it may be desirable to know the power of the motor itself, exclusive of the gearing, axles, etc. In this case the word "propre" is added to each of the below-described methods of rating.) The continuous rating of a motor is that power which can be developed for ten consecutive hours without undue heating, as prescribed in paragraph 6 on "Heating," the current being supplied at normal voltage. The normal rating of a motor is that power which would be developed for one hour without interruption, and without undue heating, as prescribed in paragraph 6 on "Heating," the current being supplied at normal voltage. The maximum rating of a motor is that power which can be developed for five consecutive minutes with practically no sparking at the brushes, the current being supplied at normal voltage.

3. Tractive Effort—The tractive effort of a motor is the tangential force developed at the periphery of a wheel on the car axle of the same diameter as specified for the running wheels of the car for a given gear ratio. (In the case of direct-connected motors the tractive effort will be that developed at the end of an arm fifty centimetres long supposed to be mounted on the motor axle.) The conditions under which this force is developed are set forth in paragraphs on "Acceptance."

4. Speed—The speed of a motor is the peripheral speed of the car wheels produced when the chosen gear ratio is employed.

5. Efficiency—The efficiency of a motor is the ratio between the mechanical power developed by the motor to the electrical power supplied to the motor terminals, the current being supplied at normal voltage.

6. Heating—A motor is said to be overheated when, starting at an atmospheric temperature of twenty-five degrees centigrade, it runs continuously for ten hours at its continuous rating, or for one hour at its normal rating, and at the end of the specified period the temperature of the motor has exceeded that of the surrounding air by the following amounts: (*a*) Windings—cotton-insulated, seventy degrees centigrade; paper-insulated, eighty degrees centigrade; mica-insulated, or other substances having the same insulating and heat-resisting qualities, 100 degrees centigrade. (*b*) Commutator, eighty degrees centigrade. (*c*) The cores in which the windings are embedded should have temperatures corresponding to those given for the windings, according to the nature of the insulation. When the windings are insulated with combinations of the above-given materials, the lowest temperature limit is taken.

SPECIFICATIONS

7. The specifications should contain, in addition to the normal voltage, the following data, all referred to the normal voltage: (1) The continuous rating of the motor and the corresponding value of the current. (2) The normal rating of the motor and the corresponding value of the current. (3) The maximum rating of the motor and the corresponding value of the current. (4) The efficiency when running respectively at the continuous rating and at the normal rating, the temperature of the motor being taken as seventy-five degrees centigrade. (5) The character of the insulating materials. (6) The overall dimensions of the motor. The gear ratio for a given diameter of wheel, tractive effort and speed, both at the continuous and normal ratings, must be given. Performance curves showing the tractive effort, the speed and the efficiency of the motor plotted with current value must also be given. (In certain cases it may be desirable to know the heating and cooling curves of the motor when working at its normal rating and subsequently at other outputs, also those of the field coils and the armature coils when the motor is closed and at rest.)

NAME PLATE.

8. In addition to the above data contained in the specifications, each motor shall bear a plate giving the normal voltage, the normal rating, the speed and the corresponding current value.

CONSTRUCTION.

9. The frame should be so constructed as to avoid magnetic leakage; it must be dust-proof, and also proof against water which might be thrown against it when in service. The frame must be fitted with openings which permit the maintenance of the brushes, said openings being hermetically closed. By maintenance of the brushes is not meant merely the renewal of the brushes, but also the renewal of the brush-holders.

10. The bearings should be so constructed as to prevent the introduction of oil or grease into the interior of the motor.

11. The motor, and notably the commutator and the brushes, should be so constructed that the motor will run equally well in either direction without changing the position of the brushes. The sparking should be practically *nil* for all loads below the maximum rating.

12. The insulation of the windings from the cores and frame should be such that immediately after the motor has attained its maximum allowable temperature it will be able to resist for five minutes an alternating voltage, the value of which is four times that of the normal voltage.

13. All parts of the motor which will be liable to be replaced, in particular the armatures, field coils, the armature coils, the commutators, etc., should be interchangeable—*i. e.*, these parts should be replaced without incurring the least work outside of mere adjustment; the removal of the armature should take place without disturbing the brush-holders.

ACCEPTANCE TESTS.

14. The acceptance tests shall be made before the motors are mounted on the cars. These tests consist not only in an examination into the general conditions of good manufacture and good construction, but especially in the determination of the power, the tractive effort, the speed, the efficiency and the heating.

(A) A DETERMINATION OF THE MECHANICAL POWER.

15. The mechanical power of a motor can be determined with an absorption dynamometer, which may be in the form of an electric generator coupled directly to the motor axle. The efficiency of the generator must be known for each condition of load. The generator can not be re-

[1] *Electrical Engineer*, London (England) November 2.

Digitized by Google

placed by a traction motor similar to the one under test and driven by gearing.

(B) RATING OF POWER BY TEMPERATURE RISE.

16. The rating of a motor is determined, according to definition, by the temperature rise.

17. It is not permissible to take away, open, or modify the case, covers, etc., which should be left as they will be in actual operation. It is also not permissible to produce artificially the current of air which would be caused by the movement of the car.

18. The temperature of the surrounding air should be measured in each existing current of air; if any predominant current did not make itself felt, the mean temperature of the air surrounding the motor should be measured at the height of the middle of that current, and in both cases at a distance of about one millimetre from the motor. The temperature of the surrounding air shall be taken at regular intervals during the last fifteen minutes of the test, and the mean of the readings shall be taken.

19. In case a thermometer is used to measure the temperature, an attempt must be made to get the best possible conduction of heat between the thermometer and the part of the motor, the temperature of which is to be measured—for example, by means of a tinfoil coating. To avoid the radiation of heat, the thermometer wells and the parts of which the temperature is to be measured should be covered with substances which are poor conductors of heat (waste or similar material). A thermometer shall not be read until the mercury has ceased to rise.

20. The temperature rise of all parts of the motor, except the field coils, shall be measured with thermometers. Where possible the temperature should be measured at those points where it is greatest.

21. The temperature of the field coils should be determined by the resistance method. If the temperature coefficient of resistivity of copper has not been determined, it can be taken as 0.004.

(C) DETERMINATION OF THE EFFICIENCY OF MOTORS.

22. In determining the efficiency of a motor alone, or with its gears, the absorption dynamometer method can be employed, fastening the brake on the motor axle in the first case, and upon an auxiliary axle which will take the place of the car axle in the second case. It is also possible, by exercising proper care, to use purely electrical methods as outlined in the following paragraphs:

23. The combined efficiency of the motors and their gearing is determined by the method given below. As described it is not theoretically exact, because of the differences in the methods of connecting the two parts of the system; the error, however, remains within the permissible limits as long as the gear ratio is small.

Two motors to be tested are coupled together mechanically by an auxiliary axle carrying a gear similar to the one on the car axle and engaging with the pinions of the motors. One of the motors should run as a motor and the other as a generator. They should be interconnected electrically so that the only power, P, taken from the external source will be that required to supply the losses. If the total power furnished to one motor is P_1 and the total power delivered by the other as generator is P_2, then $P = P_1 - P_2$, and the efficiency of one motor with its gearing is

$$\eta = \sqrt{\frac{P_2}{P_1}}$$

The quantities P_1 and P_2 should be measured directly and electrically. As a check it is advisable to measure the power, P, furnished the system to supply the losses.

24. In case it is desired to find the efficiency of motors intended to be coupled directly to the car axle, the above methods can be applied by coupling the motors directly together.

The Behavior of Iron Under Weak Periodic Magnetizing Forces.

At a meeting of the Physical Society of London, on October 26, a paper entitled "The Behavior of Iron Under Weak Periodic Magnetizing Forces," by J. M. Baldwin, was read by F. T. Trouton. The behavior of iron in strong alternating fields has been studied by many observers, and the induction in iron when placed in both strong and weak fields has been thoroughly examined by static methods, but up to the present no results have been published of the induction in weak alternating fields. The author has now, however, succeeded, by means of Lyle's wave-tracer (for description of which see *Philosophical Magazine,* Vol. VI., page 549), in examining the induction in periodically varying fields down to extremely low amplitudes. The results are in general agreement with what might have been anticipated from work already done by Lord Rayleigh and others in weak fields by statical methods, at least as far as such results can be extended to periodic fields. The method which was used may be shortly described as one in which the wave-curve of the induction is determined by examining the electromotive force in a secondary coil by means of a commutator arrangement working on the same shaft as a dynamo supplying the primary current to a coil placed on the specimen to be examined. The principal points brought out by Mr. Baldwin's work are as follows: (1) The permeability satisfies a linear law through a considerable range for weak fields diminishing to a minimum, about 150, as the amplitude of the field diminishes; (2) as the field diminishes the difference in phase between the induction and the magnetizing force tends to disappear and (3) at the same time the hysteresis losses become very small; (4) frequency at these low values of the field has practically no influence on the results obtained.

Magnetic Survey of South Africa.

The preliminary report of the committee appointed by the British Association, consisting of Sir David Gill (chairman), Professor J. C. Beattie (secretary), S. S. Hough, Professor Morrison and Professor A. Schuster, to continue the magnetic survey of South Africa commenced by Professors Beattie and Morrison, says the *Electrical Engineer* (London), states that observations were taken at twenty-two stations in the Transkei and at three stations in Bechuanaland. The observations at one of the Bechuanaland stations—*viz.,* Mafeking—extended over four days, and the results furnish important information on the secular variation of the elements at this place. The other twenty-four stations were occupied for the first time. The various astronomical and magnetic reductions have been carried out twice, and the results have been reduced to the epoch July 1, 1903. Maps have been prepared showing the isomagnetics in the Transkei; and at present the magnetic anomalies for that region are being calculated.

Single-Phase Railways in England.

Good progress is being made, says the *Mechanical Engineer* (London), with the work of electrifying the local line of the London & Brighton Railway Company between Victoria and London Bridge. Workmen are busily engaged on that section from Battersea to Peckham which is to be completed first, and on which there is to be an experimental service for the purpose of testing the working without interfering with the main line trains from the terminus. The work is being watched with interest, as this is the first attempt in England to install the overhead single-phase alternating system on a railway. Since the Brighton company decided on adopting this system, however, the Midland company has also adopted it for the electrification of its Heysham branch, and as the latter work is in the country and therefore subject to less interference, it may not improbably be completed before the London line.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Telephone Crossing at Council Bluffs, Iowa.

The Independent Telephone Company, of Council Bluffs, Iowa, in order to give its subscribers connection with South Omaha and other Nebraska cattle markets to the South, has erected a high span across the Missouri river at South Omaha. The span is 1,870 feet in length. By means of it the company secures connection with the lines of the Plattsmouth Telephone Company, which operates the system in South Omaha. Both banks of the river are low, and two steel towers were necessary. These are of galvanized iron, 110 feet high and twenty-four feet square at the base, and tapering to fifteen inches at the top. They are constructed of three-inch double angle iron with cross-braces of five-eighths-inch iron rods. Each tower is capable of supporting a strain of twenty tons. The tops are reenforced with four three-inch angle irons twelve feet long, which extend four feet above the tower proper. On these are fastened four angle iron cross-arms, two at the top of the reenforcement and two twenty inches below, giving the equivalent of two double cross-arms twenty inches apart. Seven hundred feet back of the towers heavy anchoring stubs are set, which are, in turn, anchored to heavy concrete blocks. The wire used for the span is No. 12 plow steel. This is carried on porcelain sheaves, arranged so as to allow of motion back and forth over the tower. The wire was pulled up back of the stub, so that any injury done to it during the process would not remain in the span.—*Abstracted from the American Telephone Journal (New York), November* 10.

Design Coefficients for Dynamo-Electric Machines.

The design coefficient, for the purpose of this discussion by H. M. Hobart and A. G. Ellis, is taken as the ratio of the output of the machine, expressed in watts, to the product of the square of the diameter into the gross core length of the armature and into the revolutions per minute, the dimensions all being in centimetres. Comparison is first made of the progress in machine design during the past six years by means of this coefficient. In the first edition of Kapp's "Elektromechanische Konstruktionen" published in 1898, the coefficient varied from 0.001, with an armature fifty centimetres in diameter, to 0.0017 with a diameter of 300 centimetres. The figures given by Kapp in 1902 show that the output coefficients for continuous-current machines vary from 0.0005 in very small machines with gramme ring armatures, up to 0.0025 in large multipolar drum machines. Fischer Hinnen's "Elektrischer Gleischstrom Maschinen," published in 1904, shows the coefficient to vary practically within the limits of Kapp. Müller, in an article published in the *Zeitschrift für Elektrotechnik,* October 1, 1905, gives coefficients considerably larger than those previously published. For an armature 100 centimetres in diameter it is 0.0037. These latter figures agree very closely with the coefficients which Mr. Hobart has obtained from the designs made in his own practice. Some diagrams are given, showing the effect of various types of design on this constant. In one case, with an increase in the cost of the machine of only eight per cent, resulting from an increase in the diameter of the armature, the output was increased forty-seven per cent.—*Abstracted from the Electrical Review (London), November* 2.

The Influence of Cross-Magnetization on the Electrical Conductivity of Metals.

An interesting paper was presented at the meeting of the German Society of Arts and Sciences, held in Stuttgart during the latter part of September, by L. Grunmach, dealing with the effect of cross-magnetization on the electrical conductivity of metals. The work was carried out with the assistance of F. Weidert, and included measurements with silver, platinum, tantalum, cadmium, tin, gold, paladium, zinc, copper, lead, cobalt, nickel and iron of various kinds. These were in the form of thin wire from 0.05 to 0.3 millimetre in diameter. The wires were mounted in two ways, the thicker wires being wound up in the form of a flat double spiral supported on a hard-rubber plate. The thinner wires were wound around a thin sheet of hard rubber, which was then attached to a supporting rubber plate. The test pieces thus mounted were placed between the poles of powerful electromagnets, and were connected in one arm of a Wheatstone bridge. To determine the intensity of the magnetic field a calibrated bismuth spiral was employed, which was kept within the field throughout the experiment. It was found that the resistance of the diamagnetic metals was increased with an increase in the field strength, and that the ferromagnetic metals were the only ones showing a decrease. For example, a silver wire 0.05 millimetre thick showed an increase varying from 0.00059 to 0.0097 per cent with respect to the resistance in zero field when the field was increased from 3,450 to 16,200 gausses. For tantalum the increase was about 0.00079 per cent for the highest magnetization; for cadmium a little more than 0.068 per cent, and for zinc 0.0058 per cent with a magnetization of 16,080 gausses. These changes were in the positive direction. For cobalt there was a decrease in resistance varying from 0.058 to 0.599 per cent, as referred to the resistance in zero field, when the field was increased from 3,800 to 16,160 gausses. Nickel first showed a slight increase of about 0.01 per cent, then a decrease, the percentage of decrease increasing up to one and one-half per cent with an intensity of magnetization of 16,200. The intensity of field for which the resistance changes sign is between 720 and 1,490 gausses. Of the several samples of iron tested, one showed only a decreasing coefficient; the others first an increasing and then a decreasing coefficient. In one sample the percentage decrease in resistance is 0.114 per cent for a field of 16,210 gausses. Graphical diagrams are given for certain of the samples, which show that the change in resistance is not proportional to the change in magnetization. These curves are all convex toward the axis of magnetization. The following is the order of the diamagnetic metals, arranged according to the degree of resistance change in strong fields: bismuth, cadmium, zinc, silver, gold, copper, tin, paladium, lead, platinum, tantalum. Of the ferromagnetic metals, nickel gives the greatest negative coefficient; then follows cobalt, and then iron.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), November* 1.

Digitized by Google

Electric Phenomena at Very High Tensions.

A brief account is given here of some recent work at very high tensions conducted by E. Jona. This was done by means of a 150-kilowatt transformer constructed by Pirelli & Company. The primary was wound for 160 volts, and was fed from the city system. The secondary was formed of two groups of coils, which could be placed in series and give a total difference of potential of 320,000 volts, or placed in parallel, giving then 160,000 volts. The potential was measured by means of an electrostatic voltmeter which read up to 200,000 volts. For the higher readings this instrument was connected across but one of the secondary coils. By means of this transformer an instructive test was made on a special high-tension cable 400 feet long. The core of the cable consisted of nineteen strands surrounded by successive layers of caoutchouc and paper, and sheathed with lead. This cable was in the form of two coils, which were connected to the transformer and used as the two lines of a transmission system at 160,000 volts. The current transmitted was used to light a number of vacuum tubes. Certain samples of this cable were tested by means of the transformer for the breakdown voltage. These samples were from fifteen to twenty feet in length, and were prepared by stripping back the lead sheathing and covering the exposed insulation with resin and porcelain tubes. The terminals of the transformer were then connected to the remaining portion of the lead sheathing and the core, and the voltage increased until the dielectric was perforated. This occurred for three samples at 208,000, 202,000 and 210,000 volts, respectively. The diameter of the core of this cable was about eighteen millimetres, and the diameter over the insulation forty-eight millimetres, so that the thickness of the insulation was fifteen millimetres. Tests were then made of a high-tension cable recently constructed by Pirelli & Company for a 13,000-volt, three-phase, circuit laid on the bottom of Lake Garde. The circuit consists of three single-core cables. The conductor is stranded and has an equivalent cross-section of seventy-five square millimetres. This is covered by a lead sheathing insulated by layers of caoutchouc five millimetres thick, gutta percha 1.2 millimetres thick. This is then covered by a layer of jute and armored with fifteen steel wires, each one insulated by a jute wrapping. The latter is for the purpose of decreasing the inductance of the cable. The samples of this cable used in testing were nine feet long. They withstood successfully a tension of 100,000 volts. It was not possible to go beyond this on account of the violent sparking which took place from the steel armor and passed along over the surface of the insulation. The transformer was also connected to an overhead line carried on large porcelain insulators. Two thicknesses of wire were used, one seventy millimetres in section, which gave brush discharges at 50,000 volts. The wire 100 millimetres in section showed the same phenomenon at 100,000 volts. The tension on the latter was increased up to 280,000 volts. At the latter potential the discharge was brilliant and flashes took place across the line and over the insulators. Another experiment consisted in connecting the transformer, with the voltage reduced to 90,000, to a spark-gap about ten inches long. The latter was mounted on the axle of a small induction motor driven by the same supply. When the circuit was closed sharp discharges took place between the terminals, which were quickly put out, due to their motion. The result to the eye was the appearance of a series of discharges, forming a sort of cage, which revolves slowly in a direction opposite to the rotation of the motor, and at a speed approximately that of its slip.—*Translated and abstracted from L'Industrie Électrique (Paris), October 25.*

A Peculiar Static Trouble.

A peculiar static trouble is described here by R. P. Jackson, which occurred on a system consisting of two 6,600-volt generators delivering power to a transmission line through three delta-connected transformers giving a ratio of 6,600 to 66,000. It was found that when a ground occurred on one leg of the transmission line static disturbances and breakdown of the insulation occurred on the generators. It is thought that the cause of this trouble is due to the fact that the two windings of a transformer act as the two plates of a condenser. When a single terminal of a transformer is connected to a high-tension circuit the other terminal being idle, there appears a difference of potential between the second coil of the transformer and the earth, which is due to the fact that one winding of the transformer, by being connected to the high-tension circuit, has its potential rapidly changed from positive to negative; consequently the other coil of the transformer, which acts as the second plate of a condenser, has induced in it a charge alternately positive and negative, which may give a spark to ground. If the two terminals of the coil be connected to the two wires of a high-tension circuit, then the average potential of the primary winding will be the mean potential of its two terminals. If these two are alternately positive and negative, and these potentials are symmetrical with respect to the earth, and if the positive value of the one be equal to the negative value of the other, then the potential of the primary is equal to one-half the voltage of the circuit, and a charge will appear on the secondary winding. If the secondary winding of the transformer be connected to an insulated circuit, such as the armature of a generator, then this whole circuit will be subjected to an alternating static charge, provided one circuit of the high-tension winding be grounded. The potential difference between this circuit and the ground will depend upon the numerical relation of the capacity between the high-tension and low-tension windings of the transformers, and the capacity between the insulated circuit, including the high-tension windings of the generator armature and the earth. In the case of a three-phase circuit the same principles apply, with some modifications. Three delta-connected transformers, well insulated from the ground, may be represented by a triangle rotating about its centre. Part of the transformer windings will then be charged to a positive potential and a part to a negative. As the charges are proportional to the product of static charge and potential it will be found that if the neutral point be grounded that the negative and positive charges are always equal. As the phases of the three transformers change the triangle rotates, but the charges remain fixed in relation to the neutral line, with the result that the two charges actually follow each other around the delta. This is not the case when a point on the delta becomes partially grounded. Then the centre of rotation is displaced toward this point, and the positive and negative charges are no longer equal. The result is that an alternating charging current must be supplied through the partially grounded point. If one leg of the transmission line becomes solidly grounded the triangle rotates about one corner, and in this case all the windings become alternately positive and negative in relation to the ground, and it will be found that the charge will be four and one-half times as great as each of the charges on the ungrounded system. This condition may cause trouble by breaking down the insulation of the generator. The difference of potential depends upon the relative capacities, and in the case mentioned, with one generator feeding a large bank of transformers, the potential induced between its windings and the frame was about 30,000 volts.—*Abstracted from the Electric Journal (Pittsburg), November.*

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

Special Announcement.

When the ELECTRICAL REVIEW, in the issue of September 30, 1905, began the publication of its department, "Methods of Getting New Business," there was very little matter of this nature offered in the technical and industrial press. But one other journal, *Light*, from whose columns we make an abstract in this issue, devoted some space to suggestions and remarks concerning the advertising policies of gas light companies. Since that time, however, there has been a considerable volume of matter published concerning the selling organizations of central station companies. Under the stimulus of the Cooperative Electrical Development Association and the several companies which have been designing and using central station advertising in divers forms, the new-business department has become a most important factor in central station development. It is said that the prosperity of electrical manufacturers at the present time is unprecedented, and that the indications are that this condition of affairs will continue for some time. Back of the prosperity of the electrical manufacturer, however, the central station manager is feeling this wave of prosperity, and wherever the germ of advertising and properly managed publicity has been planted, good results have accrued. In all likelihood, as serious attention will be given for some years to the development of new-business departments as will be given to the engineering and mechanical features of the central stations.

In order, then, to continue this work of chronicling the development of methods of getting new business, the ELECTRICAL REVIEW will shortly begin the publication of a series of articles which, for direct benefit to central station operators, managers of sales organizations and solicitors, will be far more valuable than any matter on the subject which has been published heretofore. These articles will form an integral part of the ELECTRICAL REVIEW, but will be complete in themselves and will be prepared by advertising experts of the highest order. These articles will appear every week, and will form a coherent and continuous study of this important element of central station practice. A few of the subjects to be taken up are as follows: "The Value of a Display Room," "Ginger Talks to Solicitors," "Persistency as a Central Station Asset," "How Direct-by-Mail Advertising Helps the Solicitor," "Some Hints on Writing Follow-Up Letters," "The Cost of a Grouchy Telephone Clerk," "The Power-Load and How to Raise It," "The Money-Back Idea as Applied to Central Stations," "Growing with One's Business," "The Public is from Missouri," "Meeting the People Half-Way," "The Square Deal Policy," "How to Analyze a Consumer's Needs, and Ways and Means of Meeting His Requirements," "Good Taste in Advertising—Typographical Display as an Essential in Attracting Attention," "The Value of Illustrations in Central Station Advertising," "Glittering Generalities Not Enough—Get Down to Brass Tacks," "Plans for Securing the Wiring of Old Buildings," "Discussion of the Local Needs of Towns of Varying Sizes—Actual Observations of Successful Publicity Campaigns Now in Use—The Methods Pursued—The Results Achieved," "Some of the Discouragements—The Ordinary Man Fails Where the Thoroughbred Pulls Through," "A Few Don'ts for Managers of New-Business Departments," "The Relation of the Whole Organization to the New-Business Department," "The Value of the Monthly Bulletin in Fostering the Good-Will of the Public," "All Money Spent for Advertising Is Not Well Spent—How to Discover the Leaks," "Little-Cultivated Fields of Opportunity Which Would Well Repay an Aggressive Campaign for New Business," "The Selection and Training of Solicitors," "Discussion of Various Specific Forms of Advertising—Newspaper, Programme, Street-Car, Etc., Etc.," "The Utilization of Electricity and Electrical Attractions for Advertising Electricity," "Big Assets from Small Opportunities—The Multiplication of Small Contracts as Peak Levelers," "Taking Advantage of Local and Seasonable Happenings—Trivial Incidents Turned to Current-Selling Advantage."

In the issue of *Light* for October a letter from Clare N. Stannard, secretary of the Denver Gas and Electric Company, is published, giving the details of the methods pursued in educating the selling force of that company and stimulating in it a desire to increase the sales of the company's products. Meetings are held every Tuesday evening, and an effort is made to have a speaker who either by reason of his prominence in the profession or because of the value to the workers of the arguments presented, will make the evening well worth while to those in attendance. One of the methods employed in instructing the organization is to have one member of the "commercial council" take the part of the solicitor and another take the part of the merchant. This opposing party raises more than the ordinary number of objections to the use of the utility and the advantage of the apparatus, his arguments being met by the solicitor, and every wile at the command of the salesman is exerted to close the sale. The salesmen are also instructed and drilled in the bookkeeping of the company and become familiar with the methods of charging and the reasons for the application of different rates. Extracts from the gas and electric journals are presented at these meetings, and these are analyzed and discussed. The men are also taken on visits to the plants where the products are being manufactured, and at these times an expert familiar with the mechanical operation explains the details of procedure.

There has recently been inaugurated a school of gas and electric practice, at which lectures are given by experts from all the various departments of the company. This class is attended by the engineers of the company and by the members of the commercial department, and it is felt that valuable opportunities are given to the men to accumulate a fund of practical gas and electric knowledge.

Digitized by Google

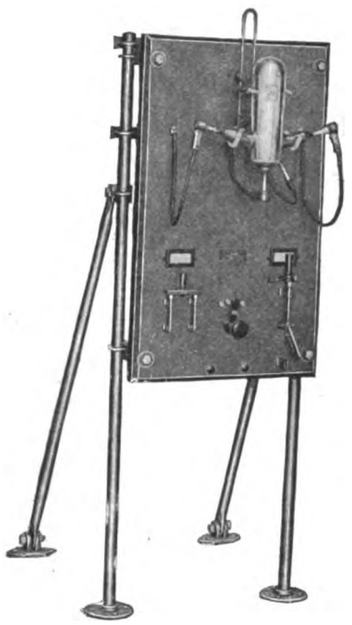
INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Mercury Arc Rectifier Panel for Charging Ignition Batteries.

The mercury arc rectifier, as a substitute for the motor-generator set for charging vehicles, has already become familiar to the owners of electric automobiles. A smaller size of this form of apparatus for changing the alternating current of the ordinary city lighting circuits to direct current for charging ignition batteries will be of particular interest to owners of gasolene machines.

Storage cells are admittedly superior to any form of primary battery, either wet



MERCURY ARC RECTIFIER PANEL FOR CHARGING IGNITION BATTERIES.

or dry, for ignition work, but are not as widely used as they could be, owing to the inconvenient and expensive methods of charging. For storage batteries a direct current is required, and on city lighting circuits this is not generally available, alternating current being used very largely for electric lighting. Even where direct current is available the voltage is higher than that necessary in charging two to six cells of an ignition battery, and it is necessary to introduce a greater or less length of wasteful resistance in series with batteries while they are charging.

The mercury arc rectifier, developed by the General Electric Company, Schenectady, N. Y., to meet these conditions, consists of a mercury arc rectifier tube having a sufficient capacity to charge five cells of the ordinary ignition type. This tube is mounted compactly with switches and rheostats upon a slate panel sixteen inches wide and twenty-eight inches high. Referring to the illustration, in the lower right-hand corner of the panel, can be seen the starting switch, at the opposite side the load switch, while between the two is a small rheostat arranged in series with the load, so as to adjust the voltage between the limits necessary for charging from two to five cells of battery.

Such a mercury arc rectifier outfit will charge a five-cell ignition battery in eight hours. At ordinary rates of electric current this means an expenditure of about twenty-five cents a week for keeping the batteries in first-class order. The outfit comes all set up on the panel, with the exception of the tube which can easily be hung in its supporting frame and connected.

The rectifier method of charging is well adapted for private as well as public garages, because of its convenience, simplicity and economy. In the public garage it will pay for itself in six months, while the convenience and reliability with which the owner can charge his ignition batteries make this method equally well suited to the private garage.

Westinghouse Gets Orders for Large Electrical Pumping Stations to Supply Mexico City with Water—Five Stations to be Installed.

The largest electric motors ever built for use in the Republic of Mexico are now being constructed at the works of the Westinghouse Electric and Manufacturing Company, at Pittsburg, Pa., for use in connection with Morris centrifugal pumps to pump water from Xochimilco to Mexico City.

It is a gigantic proposition and will give Mexico one of the most modern water systems in use in any city to-day. This is but one of the many recent improvements indicating that Mexico is easily holding its own with other cities of its size.

The contract for these pumping stations is being handled through the Mexican Light and Power Company, who will supply the electrical power from their Necaxa power plant. The five stations will be provided with electric motors direct-coupled to their respective pumps and have a total normal capacity of 3,060 horse-power, capable of a maximum of 5,222 horse-power providing for overload capacity.

Only the most modern and substantial apparatus will be provided throughout the entire installation and every precaution has been taken to prevent any possibility of interference in service due to any cause whatever, a spare electrical unit with its pump being provided in each pumping station. The water will be pumped to reservoirs near to and above the city level.

In the first pumping station, "Condesa," will be placed three large Westinghouse synchronous motors of 1,200 horse-power each, making 720 revolutions per minute, pumping 850 litres of water per second. Two motor-generator sets will supply the direct current for exciting the fields of the three motors and all necessary switchboard and lightning-arrester equipment is also being furnished. To reduce the voltage from the Mexican Light and Power Company's circuits at 18,000 volts to that required by the motors, 3,000 volts, the Westinghouse Company is supplying nine 400-kilowatt, oil-insulated transformers, three to each motor, capable of twenty-five per cent overload.

Station No. 2, "La Noria," will have two sixty-horse-power motors pumping 300 litres of water per second.

Station No. 3, "Nativitas," will have two 160-horse-power motors pumping 600 litres of water per second.

Station No. 4, "Santa Cruz," will have two 120-horse-power motors pumping 700 litres of water per second.

Station No. 5, "San Luis," will have two 356-horse-power motors, pumping 800 litres of water per second.

With all of the above will be supplied transformers, switchboard, lightning protection, etc., etc. The motors in every case will be 3,000 volts. The pumps as made by the Morris machine works, of New York, will be of the single-impeller centrifugal type.

The layout of the stations is most complete, the pumps with their motors being set in special masonry tanks below the

Digitized by Google

water level so that the pumps are always primed. The stations are roomy and provide ample space for the high voltage wires and transformers.

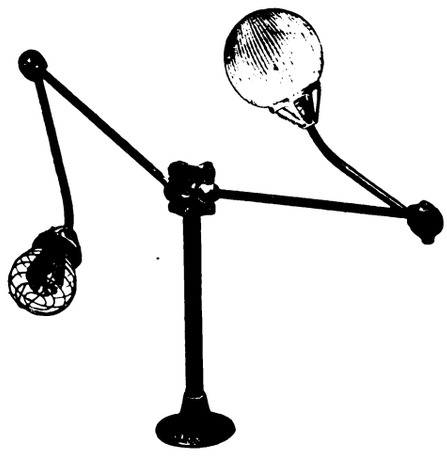
A traveling crane traverses each station, overhead, above all the apparatus, to assist in assembling and handling the heavy machinery.

A New Line of Adjustable Lamp Brackets.

The accompanying illustrations show several styles in which Wallwork's patent universal electric lamp brackets are now manufactured.

ADJUSTABLE LAMP BRACKET.

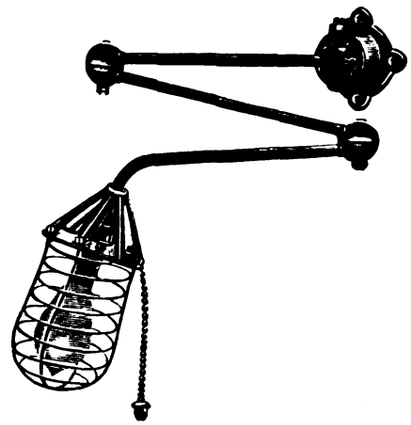
These brackets are made wholly of black enamelled iron with universal ball and socket and elbow joints. The bases, joints and globe or protection holders are of malleable cast iron, and the tubing of



ADJUSTABLE LAMP BRACKET.

standard one-half, three-eighths and one-quarter-inch gas pipe.

All brackets are provided with Hubbell standard Edison chain pull sockets. The various patterns are manufactured of standard length sections, but arms will be furnished in any required length on special order. The elbow joints are formed of cup-shaped castings, the edges of which are tongued and grooved with sufficient space inside to prevent chafing of the wire insulation.



ADJUSTABLE LAMP BRACKET.

At the present time these brackets are made in ten styles, including wall, ceiling and work-bench lights, double and single desk brackets and special patterns to be attached to lathes, planers and other shop tools.

Wallwork's patent universal lamp brackets are manufactured in the United States by the Wells Light Manufacturing Company, 44-46 Washington street, New York city.

Interborough-Metropolitan Makes Good Showing.

The report of the Interborough-Metropolitan Company for the summer quarter ended September 30 shows an increase of $640,800 in gross earnings from operation, and a decrease of $17,316 in operating expenses as compared with the earnings and expenses of the combined companies for the corresponding quarter of 1905. At that time the companies were separately operated.

The deficit for the quarter, after including the payment of all charges and the five per cent dividend on the preferred stock, was $317,638, against a deficit of $783,023 in 1905. This decrease of $465,385 in the deficit is attributable in part to the exclusion of the special franchise tax, the amount of which is in litigation.

It is predicted that the opening of the tunnel to Brooklyn will be followed by a large surplus applicable to common stock dividends, and that the current quarter's earnings will show a surplus.

The statement of the New York City Railway Company for the same quarter shows an increase of $53,876 in gross earnings, and a decrease of $182,166 in operating expenses. The income from all sources was sufficient to pay the quarterly dividend on the seven per cent guaranteed Metropolitan stock and leave a net income of $17,874.

A New Flush Receptacle.

The accompanying illustrations show the new Hubbell No. 5501 flush receptacle, manufactured by Harvey Hubbell, Incorporated, Bridgeport, Ct. Fig. 1 is a sectional view. The lid or cover rests upon the plate, while the cap or plug sets in a recess, leaving a surface upon which there is comparatively no projection and one which is practically flush. Fig. 2 shows a view of the receptacle when dis-

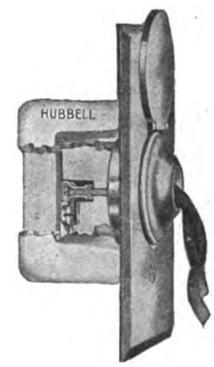


FIG. 1.—FLUSH RECEPTACLE, WITH PLUG.

connected, the cover being closed. The surface of the plate is absolutely flush and dustproof.

This combination of a practically flush surface when in use, and a perfectly flush surface as well as a dustproof surface when not in use, constitutes the principal

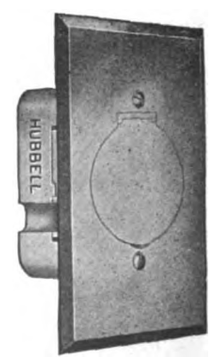


FIG. 2.—FLUSH RECEPTACLE.

feature of this receptacle. Another important feature is its interchangeability with twenty-one different styles of plugs and receptacles made by Harvey Hubbell. Each of these is for a different purpose and one cap fits them all.

Digitized by Google

A Large Order for Wright Demand Indicators.

The Boston Edison Company has placed another order with the Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., for 500 Wright demand indicators, making a total of approximately 20,000 of these instruments used in the territory served by the Edison Company.

The Chicago Edison Company has approximately 30,000 Wright demand indicators in use in connection with the demand system of charging for current in vogue in that city.

The Wright demand indicator determines the actual maximum current which passed through it since it was last set. Connected in series with a watt-hour meter it offers a logical and scientifically correct method of charging for electricity. It is also useful in checking up the load on transformers and thereby suiting them to the requirements of their respective circuits.

A Unique Lighting Proposition for Milwaukee, Wis.

The Cincinnati (Ohio) *Star* states that in order to prove his claim that municipal operation of public utilities is more expensive than private ownership, John I. Beggs, president of the Milwaukee Electric Railway and Light Company, has made an offer to the Milwaukee common council to furnish electric light for whatever prices the city of Detroit, Mich., pays. Mr. Beggs considers the Detroit municipal light plant the best operated public lighting works in the United States. He maintains that under municipal conditions no other city can operate more cheaply than Detroit; but he also claims that a private corporation can not only equal the Detroit prices, but can do so at a profit, because private corporations can operate plants more cheaply than can municipalities.

Mr. Beggs takes the position that it will be impossible for a city plant to get work done as cheaply and thoroughly as a private corporation. He argues that, regardless of efforts to prevent politics from creeping in, a city plant can not be conducted without a certain amount of inferior, and consequently more expensive, labor getting into the plant.

Milwaukee's lighting contract with the street railway company expired last December, and since that time it has not been renewed, but the company has continued to light the streets at the old figure. For a number of years there has been agitation in Milwaukee for a municipal plant, and during all the contest Detroit has been held up as a model in this respect. In 1890, when the street railway first installed electric lights, it charged $150 per lamp per year. Later it reduced the price to $99 per lamp for an underground circuit and $81 per lamp for overhead circuits. Mr. Beggs offers to take a five-year contract at $65 a light, or will accept a ten-year contract at $60 per lamp, plus the difference in the price of coal between Milwaukee and Detroit.

Merger of Wireless Telegraph Companies.

Abraham White, president of the American De Forest Wireless Telegraph Company, has announced the incorporation, under the laws of the State of Maine, of the United Wireless Telegraph Company with a capital stock of $20,000,000, to take over the interests of the American Marconi and De Forest systems. The following are given as members of the board of directors: Abraham White, president of the American De Forest Company; H. H. Buchanan, of A. O. Brown & Company, bankers; H. H. McClure, director, Marconi Wireless Company; Don Giovani del Principi del Drago, of Rome; George Irving Whitney, Pittsburg, Pa.; C. C. Galbraith, general manager, Atlantic Wireless Company; S. S. Bogart, former general superintendent, Western Union Telegraph Company; Charles A. Lieb, mechanical engineer, General Electric Company; Greenleaf Whittier Pickard, former engineer, American Bell Telephone Company; John S. Seymour, Francis K. Butler, Phillip Farnsworth, Arthur English and George C. Knabe, all of New York city. Mr. White is president of the new company; Mr. Buchanan, vice-president; Mr. Knabe treasurer, and Mr. English, secretary.

Evening Technical Courses at Columbia University.

The board of extension teaching of Columbia University, New York city, has announced a series of nine evening technical courses which will be given at the university during the winter, beginning November 26 and lasting twenty weeks. The courses are under the immediate direction of Professor Walter Rautenstrauch, of the faculty of applied science, and are to be given by professors and instructors of the university and other persons especially qualified. Moderate fees are charged and most of the courses are for two evenings a week. The courses include engineering physics, elementary mathematics, draughting, strength of materials, machine design, structural design, electrical engineering, steam engineering and special engineering problems. The courses will be given in the buildings of the Teachers' College, Columbia University, at West One Hundred and Twentieth Street and Broadway. A complete catalogue of these courses may be secured by addressing the Evening Technical Courses, Extension Teaching, Columbia University. Personal information may be secured Tuesday and Thursday evenings, between 7.30 and 9 o'clock, from Benjamin R. Andrews, room 111, Teachers' College.

Milan Honors for the "Long Arm" System.

The international jury of the Milan Exposition has announced the award of a Diploma d'Onore to the "Long Arm" system of electrically operated bulkhead doors. The award, it is said, takes higher rank than the gold medal granted by the jury in some cases. The "Long Arm" System Company, of Cleveland, Ohio, had an elaborate installation of its water-tight doors at the Exposition, and wide attention was attracted by the exhibit.

Some time ago the "Long Arm" system passed the severe tests put upon it by the United States Navy Department, and the electrical doors and hatches of this system are now in use upon many of the new American warships. From a central emergency station above deck all the principal bulkhead doors can be closed in a few minutes. The great advantage gained is that the electrical control makes closure possible under all circumstances, even in the event of a hull puncture below the water line, or when the conditions would make it impracticable to close bulkhead doors by hand against inrushing water.

Rejuvenated Sons of Jove.

There will be a special joviation and rejuvenation of the Rejuvenated Sons of Jove on Friday evening, December 7, at 7 o'clock, at the Revere House, Boston, Mass.

Illuminating Engineering Society.

The annual meeting of the Illuminating Engineering Society will be held on January 14, 1907. At this meeting there will be an election of officers to succeed those whose terms expire on that date.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

INDEPENDENT TELEPHONES FOR OMAHA—The Independent Telephone Company, capital $2,000,000, has been incorporated in Omaha, Neb. The incorporators are: T. E. Parmele, T. H. Pollack, Stockton Heath, W. C. Bullard and F. W. Judson.

NEW RAILWAY COMPANY—The Springfield, Wilmington & Cincinnati Railway Company has been incorporated for $3,000,000 by Horace Andrews, George Parmalee, Fred Gargenhire, William C. Morton and others. It will connect Springfield and Cincinnati, Ohio.

NASHVILLE RAILWAY AND LIGHT COMPANY—The stockholders of the Nashville Railway and Light Company has unanimously approved the proposition authorizing a new bond issue of $15,000,000. The stockholders have also voted to sell $1,000,000 treasury stock, half of which is common and half preferred.

NEW MEXICAN POWER COMPANY—The Michoacan Power Company, capitalized for $1,000,000 to operate in the Mexican mining districts, has been incorporated in Colorado by capitalists of that state. The incorporators are: William Waterton, L. E. Curtis and O. B. Willcox. The two latter, with Henry Hine, C. A. Coffin and J. S. Bartlett, comprise the directorate for the first year.

WIRELESS TELEGRAPH BOARD—A board has been detailed to conduct tests in wireless telegraphy in the navy, composed of Captain J. D. Adams, in command of the Washington; Lieutenant-Commander S. S. Robinson, navigating officer of the Tennessee; Lieutenant-Commander C. F. Hughes, of the Washington, and Lieutenant-Commander L. A. Kaiser, engineer officer of the Washington.

TUNNEL COMPANIES INCREASE CAPITAL—Articles have been filed with the secretary of state at Trenton, N. J., increasing the capital stock of the Hoboken & Manhattan Railroad Company from $500,000 to $15,000,000, and the capital stock of the Hudson & Manhattan Railway Company from $100,000 to $17,100,000. These companies have been formed to construct the New Jersey end of the tunnels under the Hudson river by the McAdoo syndicate.

AMERICANS TO BUILD RUSSIAN STREET RAILWAY—Murray A. Verner, of Pittsburg, Pa., has been granted a seventy-five-year concession to construct a street railway system in the city of Vilna, Russia. Vilna is one of the large and commercially important centres of the Czar's empire. It has a population of between 250,000 and 300,000. It will require an investment of about $3,815,000 to build the trolley system, which is to be undertaken, Mr. Verner states, by an American syndicate.

HUDSON TUNNEL COMPANY CHANGE—The Hudson Tunnel Company has given up its plan of building a power-house for the tunnel from Cortlandt street, New York city, to Jersey City, N. J., and is removing the 15,000 tons of steel and iron girders unloaded there last summer for use in the proposed power-house. It has been said the company intended to spend $2,000,000 on the power-house. Work on the foundations was stopped by a strike soon after it began, and has not been resumed.

NEW COMPANY TO OPERATE IN PORTUGAL—Articles of incorporation of the America-Portugal Company have been filed in New Jersey. The company will engage in the construction of railways, tramways, wagon roads, telephone and telegraph lines in Portugal. The capital is $2,500,000, divided into 25,000 shares of the par value of $100. The incorporators are: Julie Maria da Silva Costa de Cabede e Vascencelles Santos, of Lisbon, Portugal; Benjamin W. J. Fox, of Brooklyn, N. Y., and Frederick A. Jackson, of Hackensack, N. J.

POWER COMPANY INCORPORATED IN COLORADO—Articles of incorporation have been filed by L. E. Curtis, Henry Hine and O. B. Wilcox, of Colorado Springs, Col., for the incorporation of the Central Colorado Power Company, with a capital stock of $22,500,000, divided into 225,000 shares at $100 each, 75,000 of which are preferred stock. The object is to utilize the water power of the state, chiefly on the Rio Grande river, for electric power purposes. Myron T. Herrick, ex-governor of Ohio, is president of the company.

SOUTHERN NEW ENGLAND TELEPHONE COMPANY—The directors of the Southern New England Telephone Company have voted to offer to stockholders of record November 15, 1906, new stock to the extent of forty per cent of their holdings on that date. This offering is based on the recent vote at the special stockholders' meeting which authorized an increase in the company's stock from $6,000,000 to $8,000,000. At present the company has $5,500,000 stock outstanding and an increase of forty per cent will involve the issuance of $2,200,000 new stock, which will be offered at par.

NEW BUFFALO (N. Y.) TRACTION COMPANY—The Buffalo, Dunkirk & Western Railroad and the Lake Erie electric traction companies have been merged under the name of the Buffalo & Lake Erie Traction Company, with $3,900,000 authorized capital stock in shares of $100 each. This stock will be exchanged dollar for dollar for the $3,500,000 stock of the Buffalo, Dunkirk & Western Railroad, and the $400,000 stock of the Lake Erie Traction Company. The last-named company was incorporated at Albany on October 29 as a consolidation of the Lake Erie Traction Company and the South Shore Suburban Railway. The new company is organized according to the plan of Parker, Hatch & Sheehan, of New York city, for the establishment of a through electric line from Buffalo, N. Y., *via* Dunkirk, N. Y., to Erie, Pa. Louis B. Grant is president and Peter C. Schutrum, vice-president.

NEW MANUFACTURING COMPANIES.

JERSEY CITY, N. J.—The Strang Gas-Electric Car Company has been incorporated with a capital of $4,000,000. The incorporators are: Charles N. King, George H. Russell and Elmer H. Geran.

COLUMBUS, OHIO—The Telephone Specialty Company, of Cleveland, with a capital of $10,000, has been incorporated by Alexander MacArthur, John Campbell, Albert G. McClintock, Arthur C. Baird and Edmund A. Witte.

NEW HAVEN, CT.—The Thermo-Electric Lighting Company, of New Haven, has filed a certificate of incorporation. The authorized capital stock is $10,000, and business will begin with $5,000. The incorporators are: J. D. A. Kinney, Jr., Ernest C. Simpson, George W. Lewis and George A. Maycock, all of New Haven. The corporation proposes to make and deal in all kinds of electric signs and apparatus and hardware specialties.

NEW PUBLICATION.

WITH THE LUCKY THIRTEEN—The Pope Manufacturing Company has published a handsomely illustrated booklet compiled by Leroy Fairman, describing the experiences of the "lucky thirteen" contestants who were tied at the finish of the tour for the Glidden trophy. This trophy was contested for in a trip from Buffalo, N. Y., to Bretton Woods, N. H., from July 12 to July 28, 1906. The illustrations are devoted almost exclusively to views of the Pope-Toledo machines.

DATES AHEAD.

American Society of Mechanical Engineers. New York city, December 4-7.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.

Jamestown Ter-Centennial Exposition. Norfolk, Va., April 26 to November 30, 1907.

Northwestern Electrical Association. Milwaukee, Wis., January 16, 1907.

Digitized by Google

PERSONAL MENTION.

MR. C. W. AYERS, who has had charge of the Corn Belt Telephone Company's exchange at Waterloo, Iowa, has been transferred to Waverly, Iowa.

MR. A. S. HAYNES, who has been manager of the Rockland (Mass.) exchange of the New England Telephone and Telegraph Company for several months, has resigned to enter the office of the general superintendent of the company at Boston, Mass.

MR. C. A. WESTON, for several years chief operator of the New England Telephone and Telegraph Company's exchange at Fitchburg, Mass., has been appointed manager of the company's system at Rochester, N. H. He is succeeded by Carl A. Bolton, assistant chief operator at Worcester, Mass.

MR. ALLEN E. RANSOM has associated himself with Mr. E. W. Cummings, consulting and constructing engineer, at Seattle, Wash., as electrical engineer for the firm. Mr. Ransom has resigned his position as electrical engineer of the Lewiston-Clarkson Company. His headquarters will be in the Dexter-Horton Bank Building, Seattle.

MR. ELMER D. BARRY, who has been in charge of construction work for the Edison Electric Illuminating Company, of Boston, at Natick, Mass., has resigned to accept a position with the General Electric Company, Lynn, Mass. He is succeeded by William O'Brien, who has had charge of the South Framingham (Mass.) district, and who will now assume the direction of both districts.

MR. W. E. S. DYER, formerly manager of the Reeves Engine Company, Philadelphia, Pa., has been appointed manager of the Philadelphia office of the A. D. Granger Company, in the Commonwealth Building. With his new connection Mr. Dyer will handle not only the vertical automatic engines built by the Bates Machine Company, of Joliet, Ill., but the Skinner automatic engines and a full line of fire and water-tube boilers made by the A. D. Granger Company. Mr. Warren A. Peters will remain at the Philadelphia office with Mr. Dyer.

AMONG OTHERS IN TOWN last week were: H. B. Vanzwoll, secretary Sunbeam Incandescent Lamp Company, Chicago, Ill.; N. L. Norris, president Banner Electric Company, Youngstown, Ohio; H. H. Albert, Standard Electrical Manufacturing Company, Niles, Ohio; E. H. Haughton, manager Bryan-Marsh Company, Chicago, Ill.; L. P. Sawyer, manager Buckeye Electric Company, Cleveland, Ohio; William Coale, vice-president Sterling Electrical Manufacturing Company, Warren, Ohio; F. S. Terry, first vice-president National Electric Lamp Company, Cleveland, Ohio; B. G. Tremaine, National Electric Lamp Company, Cleveland, Ohio.

OBITUARY NOTE.

MR. JOHN L. OBERG, of the firm of Oberg & Blumberg, electrical contractors, New York city, died at his home in Ridgefield Park, N. J., on Thursday, November 8, 1906, in the thirty-ninth year of his age. Mr. Oberg was born in Sweden on July 1, 1868, and came to this country in 1886. He has been prominently identified with the electrical construction industry for the past twenty years, being a member of the New York Electrical Contractors' Association, state and national associations. In 1886 he entered the employ of the Thomson-Houston Electric Company, at Lynn, Mass., and served in various capacities until 1891, when he was in charge of the outside construction department. He then entered the employ of the Tucker Electrical Construction Company, and met with an unfortunate accident in December, 1893, whereby he lost his right arm. From 1894 to 1898 he was in the employ of the Alexander-Chamberlain Electric Company as superintendent of construction. On January 31, 1898, the firm of Oberg & Blumberg was organized, since then they have executed large electrical contracts over the entire country. Mr. Oberg was prominent in Republican politics in Bergen county, N. J., where he served several years as chairman of the village trustees. He was a member of the Hackensack Lodge of Elks, also the Ridgefield Park Boat Club. Funeral services were conducted at the Union Church, Ridgefield Park, N. J., on Sunday, November 11, at 3 P. M., by the Rev. Dr. McNeil and the Hackensack Lodge of Elks, and was attended by representatives of the Electrical Contractors' Association and numerous friends and relatives. Mr. Oberg leaves a widow and daughter four years of age.

ELECTRICAL SECURITIES.

A general and rapid recovery in security prices was the feature of the stock market last week. This movement was marked by expanding speculative activity, although public participation was not very extensive. The money situation has been and will for some time to come be the dominant speculative influence. Despite the continued high rate for money, however, bullish speculation and sentiment have been considerably stimulated, and it is expected that several of the prominent railroads will shortly have under way large stock issues which will find a very favorable market. The government report shows that the export trade for October was the largest on record.

ELECTRICAL SECURITIES FOR THE WEEK ENDING NOVEMBER 17.

New York:	*Closing.*
Allis-Chalmers common	17⅓
Allis-Chalmers preferred	46¼
Brooklyn Rapid Transit	79
Consolidated Gas	138
General Electric	175½
Interborough-Metropolitan common	37½
Interborough-Metropolitan preferred	71¾
Kings County Electric	150
Mackay Companies (Postal Telegraph and Cables) common	71¾
Mackay Companies (Postal Telegraph and Cables) preferred	69
Manhattan Elevated	142
Metropolitan Street Railway	106
New York & New Jersey Telephone	124
Western Union	85¼
Westinghouse Manufacturing Company	154

The directors of the New York City Railway Company, whose terms have expired, have been reelected for the ensuing year.

For the purpose of further extending the business of the Kings County Electric Light and Power Company, the directors have voted to issue the remaining $1,800,000 of the increase of capital stock authorized by the stockholders at special meeting held July 10, 1905. This stock will be issued at par, proportionately, to stockholders of record at the closing of the transfer books, 3 P. M., December 31, 1906. Each such stockholder will be entitled to subscribe for new stock to the amount of nine-forty-firsts of his holdings, or nine shares of new stock for each forty-one shares. The right to subscribe for the new stock will expire at 3 P. M., February 1, 1907. Directors of the Kings County Electric Light and Power Company have declared the regular quarterly dividend of 2 per cent on the capital stock, payable December 1, 1906. Books closed November 21 and will reopen December 1.

Boston:	*Closing.*
American Telephone and Telegraph	137½
Edison Electric Illuminating	233
Massachusetts Electric	69
New England Telephone	129
Western Telephone and Telegraph preferred	80

Philadelphia:	*Closing.*
Electric Company of America	11⅞
Electric Storage Battery common	70⅝
Electric Storage Battery preferred	70⅝
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	23¼
United Gas Improvement	97

Directors of the Philadelphia Electric Company have declared the regular semi-annual dividend of 2½ per cent (25 cents per share) on the paid-in value of the stock, payable December 15 to stock of record November 23. Books reopen December 3.

Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	142
Metropolitan Elevated preferred	66½
National Carbon common	86
National Carbon preferred	116
Union Traction common	—
Union Traction preferred	—

Digitized by Google

TELEPHONE AND TELEGRAPH.

SHELBURNE FALLS, MASS.—The Heath Telephone Company has completed an extension to Leyden.

HOULTON, ME.—The Independent Telephone Company has started work on a new exchange at Fort Fairfield.

JAMESTOWN, N. D.—The Northwestern Telephone Company has let the contract for a new building at Jamestown.

AUBURN, MICH.—The Michigan State Telephone Company has installed the switchboard for its new exchange at Auburn.

TOPEKA, KAN.—The Missouri & Kansas Telephone Company has installed a new switchboard equipped to handle 10,000 subscribers.

PORTSMOUTH, N. H.—The New England Telephone and Telegraph Company has purchased the Newmarket & Durham Telephone Company.

SPOKANE, WASH.—The Rocky Mountain Bell Telephone Company is extending two direct lines from Spokane to Coeur d'Alene, Ida., and another to Sandpoint, Ida., also numerous small toll lines.

ENOSBURG FALLS, VT.—The Northern Telephone Company is now occupying its new home, which has been in progress of construction the past summer, and which is now practically completed.

BARRE, MASS.—The New England Telephone and Telegraph Company has a large force of workmen in Barre. New lines are being put in, new cables run into the central office and new cable boxes placed.

SPOKANE, WASH.—Manager Van Dyke, of the Rocky Mountain Bell Telephone Company, announces that another wire will be strung between Spokane and Wallace, Ida., seventy miles, and that it will be in operation inside of thirty days.

ST. ALBANS, VT.—The Rutland board of aldermen has granted the Home Telephone Company, of Albany, N. Y., a franchise to operate a plant in the city of Rutland. The Home company will petition the legislature for the right to incorporate.

MAUCH CHUNK, PA.—An effort is being made to establish a rural telephone line in Franklin township, this county. Those interested are John E. Hahn, D. H. Lesher, W. B. Adams, E. W. Dreisbach, Thomas LeRose and Harry Rickert.

PULASKI, N. Y.—The Syracuse Independent Telephone Company has completed its line between that city and Pulaski, and it has been placed in commission. This gives the Black River Independent Telephone Company, which has an exchange in this village, a direct wire to Syracuse.

OKLAHOMA, OKLA.—The Pioneer Telephone Company has decided to add the sixth and seventh stories to its modern steel structure on North Broadway. The contract for the additional two stories has been let, and all the materials ordered. The original estimate of the building was $125,000, and the new contract calls for an additional $40,000.

SPOKANE, WASH.—The forthcoming directory at Walla Walla, Wash., will show 2,500 patrons for the Pacific States Telephone and Telegraph Company, the increase in the last eight months being a little more than twenty per cent. Manager McGillibray announces that all rural lines out of Walla Walla have made connection with the Pacific States lines.

CONNELLSVILLE, N. Y.—The increase in the business of the Bell Telephone Company during the past few years has made radical changes necessary in this section. Uniontown is to be the centre of the Bell company's system throughout several counties in western Pennsylvania and West Virginia, and in the future much business that has passed through the Pittsburg office of the company will be transacted in Uniontown.

SPOKANE, WASH.—The Farmers' United Telephone and Telegraph Company, financed by Walter and Albert Higgs and Anton Kramer, of St. Andrews, Wash., has asked the commissioners of Douglas county for a franchise to build a line from Coulee City, 100 miles north and northwest, to enter the towns of St. Andrews, Jean, Mansfield, Bridgeport and Heahy. If the farmers' lines join the company will have a complete service by independent telephones reaching all over Douglas county.

ANAHEIM, CAL.—The Home Telephone Company is building a tall-pole line from Anaheim to Olive and will string a cable between the two points. Connecting lines will be built from Olive to the Fullerton oil fields, Yorba and to El Modena, all to be connected with the Anaheim exchange, as will be the lines to Garden Grove, Buena Park, Orangethorpe and Brookshurt. The line to the last-named place and the main line from Anaheim to Fullerton have been completed. There will be an exchange office in Fullerton for that city and the surrounding territory.

BOSTON, MASS.—Control of the People's Telephone Company, of Haverhill, Mass., has passed into the hands of the New England Telephone and Telegraph Company. A number of changes have been announced by the New England Telephone Company in its rates for service, the principal one being the abolition of the free telephones that have been given for residences for several years past in connection with business telephones. The change in rates will not take effect until December 1, although all new business since October 1 has been taken under the new schedule of rates.

SPOKANE, WASH.—M. A. Phelps, president and treasurer of the Interstate Telephone Company, announces that the $400,000 added to the capital stock of $100,000 will be used in building operations in Spokane, the completion of the exchange at Coeur d'Alene, Ida., the building of the extension to Wallace, Ida., and the completion of the toll line into Spokane. One hundred thousand dollars of the increase was subscribed at the meeting on the evening of November 2, when the stockholders expressed themselves in favor of pushing plans for the invasion of territory in Oregon and Idaho, as well as eastern Washington.

SPOKANE, WASH.—The Empire Construction Company began work on the Home Telephone Company's lines November 5 and it is given out that work will be pushed. The company has 3,000 poles in the yards ready for installation in the outskirts of the city. The wires in the business districts will be put underground. Contracts for the excavation of the home building in Howard street, to cost $60,000, have been awarded, and it is expected that work on the foundation will begin early in December, the purpose being to have the structure completed in May, 1907. The main building will be 71 by 100 feet, three stories and a full basement, of reenforced concrete with terra-cotta trimmings. Albert Held is the architect.

WASHINGTON, D. C.—Preparations are being made by the army signal corps for laying the extension of the Alaska telegraphic cable southward from the Juneau-Sitka loop to Wrangell and Ketchikan. It is expected that, barring accidents, the cable will be in operation before the end of the year. The laying of this extension line will bring into instant communication with one another and with the United States, all Alaska points as far westward as Seward, on Resurrection Bay. The tolls for commercial messages sent over the cable and land lines will probably remain as they are for the present at least. There have been several efforts to secure a material reduction of rates, and the tolls have been cut down on two occasions, but there is little likelihood that the secretary of war will favor a further reduction in the near future. The present tolls approximate the charges for similar services on many of the commercial cable lines of the world, although they are a little higher, probably, all conditions considered, than the rates on the cables between the United States and England.

WINNIPEG, MANITOBA—The Bell Telephone Company has entered into a contract for the delivery of 83,000 poles, which represents 2,500 miles of construction in the northwest. The telephone business will be developed to the southeast of Winnipeg and there will be a line north from Stonewall to Teulon and one to Winnipeg Beach. It is intended to "double up" the circuits between the city and Brandon and Souris and Deloraine. The rural telephone service of the province will also be doubled in extent. There are some 2,000 farmers connected at present, and next year it is expected that an additional 2,000 will have telephone connections. The company will, moreover, build north and west of Shoal Lake, but the distance has not yet been decided. There will be a line from Souris through by Pipestone, which will eventually lead to a new route up through Saskatchewan to Regina, and probably another route through Hartley and Melita and through Estevan thus giving a third route to Regina. This will provide a new circuit to Moose Jaw. The connecting link supplied is from Melita to Estevan. In all likelihood the company's lines will be extended northward from Regina towards the Prince Albert and Battleford districts.

Digitized by Google

ELECTRIC RAILWAYS.

STROUDSBURG, PA.—The Delaware Water Gap council has granted a right of way through the streets to the Stroudsburg & Water Gap Trolley Company.

HOUSTON, TEX.—Fred A. Jones, of Houston, who is the chief engineer of the Dallas-Sherman Interurban Company, states that it is the determination of the company to have the line in operation about February, 1908.

DALLAS, TEX.—Engineers are at work in the field near Waxahachie, and it is understood a line is being located for an electric railway to be built from Dallas to Waxahachie, thence to Ennis and perhaps further south.

MONTREAL, CANADA—The Montreal Street Railway, by securing the controlling interest in the Montreal Terminal Railway, now controls every traction company that has the right to operate on the island of Montreal.

JONESBORO, ARK.—Robert McGill and Ruddy Copeland have sold the entire issue of Jonesboro & Nettleton Electric Railway Company bonds to W. Williams & Company, Nashville, Tenn., who will finance and construct the road.

ATLANTA, GA.—The franchise for the Atlanta & Carolina Construction Company to use certain streets in the city for trolley-car lines to run from Atlanta to West Point and from Atlanta to Conyers, has been granted by the city council.

HAGERSTOWN, MD.—The Hagerstown Electric Railway Company's ten-mile extension from Hagerstown to Shady Grove, Pa., has been completed. The road at Shady Grove connects with the electric railway running from Greencastle to Waynesboro and Penmar.

SCIO, ORE.—From private sources it is learned that an electric railway will be built in the near future, connecting Scio with Salem. From Scio the line will extend up Thomas creek and Crabtree, tapping one of the finest belts of timber in the Cascade mountains.

GOSHEN, IND.—Another traction line, known as the Plymouth, Goshen & White Pigeon Electric Railway, and connecting with the cities named, is projected for Northern Indiana. The road will be forty-seven miles long, and will aid in making Goshen the second largest interurban centre in Indiana. Local capital is interested.

POTTSTOWN, PA.—For the purpose of making the running time between Reading and Philadelphia as short as possible the Schuylkill Valley Traction Company will cut out many of the sharp curves on its Oley Valley line and those near Ringing Rocks Park. The trestle at the power-house near the latter point will be replaced by a double concrete arch.

SPOKANE, WASH.—Work on the Spokane & Inland Electric Railway Company's line between Spokane and Colfax, Wash., is being rushed and it is expected the service to the last-named city will be opened some time the coming month. Much of the bridge work has been completed, and it is given out that the road will be extended to Lewiston, Ida.

SAULT STE. MARIE, MICH.—Street cars will be running between Sault Ste. Marie and the suburb of Algonquin, December 1, it is announced by the Trans-St. Mary's Traction Company. On condition that trolley connection be made with the tannery location, the common council recently extended the franchise of the company so that it has a life of twenty years.

DAKOTA CITY, NEB.—Joseph A. Foye, of Sioux City, who recently purchased the Sioux City, Homer & Southern Railway Company's effects at sheriff's sale, has been granted a thirty-year franchise by the county officials for the running of an interurban line from South Sioux City to Homer *via* Dakota City. Mr. Foye has changed the name of the company to the Sioux City, Crystal Lake & Homer Railway.

SPRINGFIELD, OHIO—A. E. Locke, of Boston, has purchased the Springfield & Western interurban line, the last of the Appleyard properties, at the receiver's sale at the upset price of $25,000 for Kelsey Schoepf, head of the Indiana, Columbus & Eastern Traction Company. It is a part of the syndicate system and runs between Medway and New Carlisle. Limited service will be given from Springfield to Columbus.

ALBION, N. Y.—The contract for the erection of five substations for the Buffalo, Lockport & Rochester electric railroad has been let for stations at Brockport, South Greece, Albion, Medina and Gasport. All must be completed before January 1. Power will be supplied by the Niagara Falls Electrical Transmission Company, which bought the Albion Power Company. The building and equipment of each station will cost $14,500.

TOLEDO, OHIO—A new electric line with the terminals at Toledo and Defiance, and intersecting Maumee, Waterville, Whitehouse, Neapolis, Colton, Liberty, Napoleon, Okalona, Jewel and several other places, is soon to be launched. The preliminary surveys are now being made by Riggs & Sherman and the names of the promoters will be announced as soon as the company secures its charter. The company is said to be independent of any other existing interurban company.

ZANESVILLE, OHIO—At the annual meeting of the stockholders of the Southeastern Ohio Railway, Light and Power Company the annual election of directors was held which resulted as follows: C. B. Hart, F. B. Hoofman and Alfred Caldwell, of Wheeling; Fred J. Fox and William Lipphardt, of Martin's Ferry, and E. R. Meyer and H. C. Meyer, of Zanesville. The board of directors organized by electing William Lipphardt, president; F. B. Hoofman, vice-president, and W. H. Neikirw, secretary.

BALTIMORE, MD.—The contract for the electrical equipment of the Washington, Baltimore & Annapolis Railway Company has been awarded to the General Electric Company. The amount is for $500,000. The award covers the needed machinery in the power-houses and electric motors for the cars. All this is expected to be ready by April. In the meantime contracts for the power-houses and for the car bodies will be let, so that everything will be in readiness for the opening of the road July 1 next.

BOSTON, MASS.—The Old Colony Street Railway Company has petitioned the railroad commissioners for their approval of an increase in the stock by an amount not to exceed $200,000, for the purpose of providing means for payment of indebtedness incurred in making permanent investments and improvements. The Boston & Northern Street Railway Company has petitioned the railroad commissioners for their approval of an issue of $300,000 new stock for the purpose of providing means to pay for additional rolling stock and equipment.

SPOKANE, WASH.—The Spokane Interurban Railway Company, with a capital of $150,000, has been incorporated in the state of Washington by C. P. Lund, C. W. Ewart, L. R. Hamblin, W. S. Gilbert and H. L. Bleecker, of Spokane, and will at once build a line between Hayford and Cheney, six miles. It will use the Washington Water Power Company's Medical Lake line from Spokane to Hayford, ten miles. The company has secured the necessary franchises and right of way. Mr. Bleecker is secretary of the Washington Water Power Company.

MANSFIELD, OHIO—Two separate companies that have been engaged in preparatory work for the building of an electric line between Mansfield and Mount Vernon have been consolidated with the following officers: president, S. N. Ford, Mansfield; first vice-president, Thomas W. Latham, Mount Vernon; second vice-president, Frank L. Beam, Mount Vernon; treasurer, C. H. Voegele, Mansfield; secretary, Reid Carpenter, Mansfield. These officers' with Rush Taggart, of New York, A. B. Beverstock, of Lexington, and R. Y. Struble, of Fredericktown, constitute the board of directors.

CLEVELAND, OHIO—Preliminary plans have been made for connecting the Lake Shore Electric and the Columbus, Delaware & Marion. A link will have to be built between Bucyrus and Tiffin. Just which of the two interests will do the work has not been determined. At present the Webb interests, behind the Columbus, Delaware & Marion, are building an extension of their lines through to Bucyrus. At this point a connection will be made with the Ohio Central, controlled by the Mandelbaum-Pomeroy interests. Incidentally in connection with the link now being built by the Southwestern from Seville to Mansfield, this will form a new line from Cleveland to Columbus. The link which will connect the Webb and the Everett-Moore lines will give a through line from Toledo to Columbus.

Digitized by Google

ELECTRIC LIGHTING.

LAKEWOOD, OHIO—The council has voted to issue $50,000 to improve the electric light plant.

COLTON, CAL.—O. L. Emery has been awarded the contract for the city electric light plant building.

ABERDEEN, WASH.—The Gray's Harbor Electric Light Company has secured the contract from the city for street lights for a term of ten years at $6.66 a lamp each month.

BROWNSVILLE, TEX.—The $20,000 cash necessary to secure a charter for the electric light and waterworks to be installed here has been obtained. Work will commence as soon as the material arrives.

KALAMA, WASH.—The Prebel & Stine Logging Company, of Portland and Vancouver, has completed arrangements for the installation of an electric light and power plant at its camp near Kalama.

SARATOGA, WYO.—The electric light plant of the Saratoga Power and Light Company was destroyed by fire November 1. The damage aggregates $6,000, with $4,000 insurance. The plant will be rebuilt at once.

AUBURN, N. Y.—The Citizens' Light and Power Company is considering the establishment of a new power plant in Auburn. The proposed station will have a capacity of 15,000 horse-power. The cost, exclusive of the site, will approximate $100,000.

TEXARKANA, ARK.—The Texarkana Light and Traction Company has been purchased by the Texarkana Gas and Electric Company. The new owners announce that they will at once greatly improve the light and car service, and will extend the street-railway lines.

WELDON, N. C.—The stockholders of the Roanoke Rapids Power Company have elected a board of directors as follows: William Habliston, T. C. Williams, Jr., Charles Cohen, Richmond; Winthrop Charter, Henry Lewis Morris, New York; T. L. Emry, Roanoke Rapids.

ARGENTA, ARK.—The Argenta Light and Power Company, composed of J. M. Griffin, E. A. Ramsey and Vernon Layne, has been granted an exclusive franchise for furnishing the city with a minimum of sixty arc lights at $10 per month for each light, the life of the franchise being thirty-five years.

WILKESBARRE, PA.—Arrangements are being made for improving the dam across the Susquehanna river at Nanticoke, preparatory to the erection of a large power plant at that place. Several consignments of tools have arrived from Philadelphia and a tool house is being erected at the west side of the dam.

SAULT STE. MARIE, MICH.—Contracts for improvements to the local power plant, to entail an expenditure of $500,000, are to be let. The money will be forthcoming from the sale of receivers' certificates. The improvements will increase the capacity of the plant by several thousand horse-power and make it the largest in the world.

NEW YORK, N. Y.—The New York Edison Company will erect a five-story fireproof power-house on a plot, forty feet by ninety-nine feet eleven inches, on the north side of Sixty-fourth street, east of Third avenue. Plans are being prepared by the company's architect, who is designing a structure similar to the other power-houses in the metropolitan district.

CHESTER, PA.—The Suburban Electric Company, of which former State Treasurer William L. Mathues is president, has purchased the old Lewis mill in Matthews Hollow, along the Darby creek, in Lansdowne. The building will be transformed into a power plant, which will supply sufficient current to operate the company's lines in Lansdowne, Yeadon, Morton, Rutledge, Swarthmore and Darby.

GERMAN VALLEY, N. J.—It is reported here that a stock company will soon be formed to supply electric light to German Valley, Middle Valley and Chester. It is said that a plant will be built on the property recently bought by John C. Kennedy from the executors of the late John Van Der Vort Stryker, of German Valley, and that the power will be obtained by harnessing the mountain stream that runs on the south side of the farm.

NAPOLEONVILLE, LA.—The electric light committee has accepted the bid of Henry Widmer, of New Orleans, for the erection of an up-to-date electric light plant for $7,264. While this was not the lowest bid, other bidders' specifications did not meet the requirements of the consulting engineer. The contract calls for the plant to be in operation in about seventy-five days after signing.

LISBON, OHIO—The council at Lisbon has entered into a contract with the Lisbon Electric Light Company for another period of five years for the furnishing of street lights. The first forty lights are to be furnished at the rate of $70 a year each, and the remaining five at $62.50 each. These are the same rates as heretofore. Half price will be charged for city hall lights, which formerly were free.

WATERLOO, N. Y.—The work of surveying a route through this section for a transmission line to convey electric current from Niagara Falls to Geneva, Waterloo, Seneca Falls, Auburn, Syracuse and intermediate towns is progressing rapidly and rights of way are being secured without trouble. When this line is in operation it is expected to result in the villages securing electric lights and power at a considerable reduction from the present prices.

BALTIMORE, MD.—The $600,000 plant of the Wilmington Light, Power and Telephone Company, which is practically a duplicate, except as to size, of the plant of the Baltimore Electric Power Company, has been formally opened. The new plant is located on the Brandywine creek, ground having been broken on April 5 last. The capacity is 2,000 kilowatts. The construction was under the supervision of James B. Scott, of Baltimore. The company also controls an automatic telephone system, which connects with the Maryland Telephone Company.

AMITYVILLE, N. Y.—At the annual meeting of the Amityville Electric Light and Waterworks companies directors were chosen as follows: electric light company—County Clerk Solomon Ketcham, John E. Ireland, Samuel Pierson Hildreth, Dr. E. Forrest Preston, Captain Elmer W. Davis, Amityville; George W. Cooper and Timothy M. Griffing, Riverhead. Waterworks company—same directors as the electric light company, and Joshua P. Jervis and Charles O. Ireland. The directors organized by again electing Captain Davis president, S. P. Hildreth vice-president, and Solomon Ketcham secretary and treasurer. Both corporations declared dividends of six per cent.

PORTLAND, ORE.—Articles of incorporation have been filed at Salem by the Garden Falls City Manufacturing, Power and Light Company. This is the first step in the founding of a new industrial town in close proximity to Portland. Portland capitalists have been engaged for some weeks in the promotion of this enterprise. This has involved the purchase of a tract of 845 acres, lying in a strip along the Columbia and on the main line of the Oregon Railroad and Navigation Company, about midway between Multnomah and Bridal Veil Falls. As the name of the corporation indicates, valuable power rights have been acquired, and the specific purpose is to establish a manufacturing village, the making of woolen cloth to be the chief industry. The place will be known as Garden Falls City. On the company's property there are two water-power rights, capable of developing an aggregate of 1,400 horse-power.

BERGEN, N. Y.—At a special meeting of the village board a franchise was granted to the Genesee County Electric Light, Power and Gas Company, of Batavia, to construct, maintain, use and operate a plant for the purpose of transmitting and distributing Niagara Falls electrical energy and power, together with powers essential or convenient thereto in the village of Bergen, and defining the powers, privileges and restrictions of the company. It is provided in the franchise that the company shall execute to the village and file a penalty bond for $2,000 and guarantee the delivery of Niagara Falls power into the village within one year from the acceptance of the franchise, unless such delivery shall be unavoidably delayed by litigation. The franchise is granted on condition that the company shall enter into a contract to light the streets at the limit allowed by the statute, $700 to $750, and furnish power for the waterworks plant for $500 a year. The electric transmission line of the company will tap the cable of the Niagara, Lockport & Ontario Power Company at Oakfield and be extended to Bergen by way of Batavia.

Digitized by Google

INDUSTRIAL ITEMS.

THE DAYTON ELECTRICAL MANUFACTURING COMPANY, Dayton, Ohio, has ready for distribution a new series of literature descriptive of the "Apple" ignition system.

THE PHŒNIX ELECTRIC COMPANY, Mansfield, Ohio, has established a branch office at 83 West Jackson Boulevard, Chicago, Ill. John Nangle is manager of this office.

THE STEEL CITY ELECTRIC COMPANY, Pittsburg, Pa., has appointed W. J. Bramhall as its New York representative, the New York office to be located at 136 Liberty street.

THE TRUXAL-PAINTER MANUFACTURING COMPANY, Chattanooga, Tenn., has developed a motor-driven hoist for lifting brick, mortar and concrete in wheelbarrows. Full information concerning this apparatus will be furnished upon request.

THE AJAX LINE MATERIAL COMPANY, Chicago, Ill., has increased its capital stock from $12,500 to $20,000, the increase being demanded by the growth of its line, which now includes toggle bolts, mast arms, arc lamp insulators, pulleys and bracket fixtures.

THE DE VEAU TELEPHONE MANUFACTURING COMPANY, New York, has obtained a site and will equip and occupy a new factory in Brooklyn, N. Y. This company is said to be the first manufacturer of "independent" telephone apparatus established in this country.

THE DE LA VERGNE MACHINE COMPANY, foot of East 138th street., New York city, has issued a folder describing the Klein water-cooling tower which it builds. These towers, it is stated, will cool the water to from five to fifteen degrees below the temperature of the atmosphere.

THE ATLANTIC INSULATED WIRE AND CABLE COMPANY, Stamford, Ct., suffered the total destruction of its factory by fire on the morning of November 15. The loss was $400,000, fully covered by insurance. A contract for new buildings was let while the ruins were still smoking, and the company expects to fully resume business in sixty days.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., held the annual convention of its salesmen at the Bellevue-Stratford Hotel, Philadelphia, on October 24, 25 and 26. The convention was attended by the managers of the sales offices of the company throughout the United States, the district engineers and other officers of the company.

THE UNION SWITCH AND SIGNAL COMPANY, Pittsburg, Pa., announces that it has abandoned the manufacture and sale of the torpedo used in the machine on plate 369 of its catalogue, and has transferred the business to the Versailles Railway Signal Company, of Pittsburg. This company makes a specialty of manufacturing track torpedoes of all kinds for railroad service. The Union Switch and Signal Company will continue to manufacture and sell the torpedo machine shown on page 369, as heretofore.

THE CHICAGO PNEUMATIC TOOL COMPANY, Chicago, Ill., reports that October, in point of shipments, was the banner month in the history of the company. The increase amounted to twenty-five per cent over the corresponding month last year. Orders booked were forty-five per cent greater than in October, 1905. For the ten months ended October 31 the orders were twenty-nine per cent greater than during the same period last year. President Duntley has sailed for Europe, and will visit France, England and Scotland in the interest of the company. He expects to remain abroad five or six weeks.

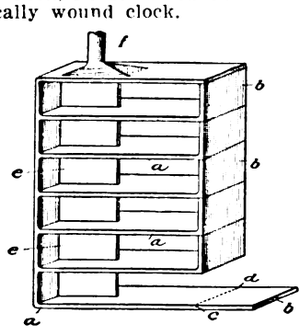
THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, Chicago, Ill., announces that it has made arrangements with G. A. Knoche to represent it as its agent in the southwestern states. Mr. Knoche was with the Wesco Supply Company for a number of years in the capacity of purchasing agent. His headquarters are at 539 Frisco Building, St. Louis, Mo., where he conducts his business under the name of the Mutual Sales Company. His intimate knowledge of the requirements of the electrical trade will be of value to the Chicago Fuse Wire and Manufacturing Company. Among the well-known products of this company are the "Union" enclosed fuses and blocks, which are approved by the Underwriters' National Electric Association, and also by the Factory Mutual Laboratory, of Boston; "Union" switch outlet boxes, conduit boxes and covers, fuse wire and fuse links.

Record of Electrical Patents.

Week of November 13.

835,493. CUT-OUT. Rollin A. Baldwin, New Haven, Ct., assignor to the Baldwin & Rowland Switch and Signal Company. Filed September 8, 1905. The circuit is closed through the armature of an iron-clad magnet.

835,516. ELECTRIC CLOCK. Peter G. Giroud, New York, N. Y., assignor to American Electrical Novelty and Manufacturing Company, New York, N. Y. Filed October 25, 1905. A spring-driven, electrically wound clock.



835,642. ELECTRIC ACCUMULATOR.

835,529. PORTABLE ELECTRIC LIGHT. Conrad Hubert, New York, N. Y. Filed May 19, 1905. A pocket battery light.

835,605. TRAIN-ANNUNCIATOR. Edward A. Everett, Detroit, Mich., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed May 8, 1906. An annunciator of the drop type.

835,608. CAP FOR SIGNAL LAMPS. Francis L. Gilman, Montclair, N. J., assignor to Western Electric Company, Chicago, Ill. Filed December 18, 1905. A split cap containing a lens.

835,642. ELECTRIC ACCUMULATOR. Paul Schmitt and Charles Fabre, Paris, France. Filed November 6, 1902. The support for the active material is formed from sheet lead.

835,647. TELEGRAPH INSTRUMENT. Daniel O. Stinson, Falkville, Ala. Filed August 26, 1905. A relay with vertical armature.

835,661. ELECTROLYTIC PROCESS OF MAKING BASES OF THE ALKALI EARTH METALS. André Brochet and George Ranson, Paris, France. Filed February 14, 1901. The anode liquor is composed of a solution of a sulphide of an alkaline earth, and the cathode liquor of a solution of chloride of an alkaline earth.

835,685. INSULATING MATERIAL AND METHOD OF MANUFACTURING SAME. George Kelly, Hinsdale, Ill. Filed April 24, 1906. A fabric is coated with zinc oxide containing a binder which is vulcanized.

835,704. SELECTIVE SIGNAL FOR TELEPHONE SYSTEMS. Michael H. Degnan, Nashua, N. H. Filed February 20, 1906. A tilting box containing a zig-zag channel within which moves a roller.

835,728. CONTACT SPRING FOR TROLLEY HARPS. John Hensley, Huntington, Ind. Filed March 22, 1906. V-shaped contact springs are interposed between wheel and arms.

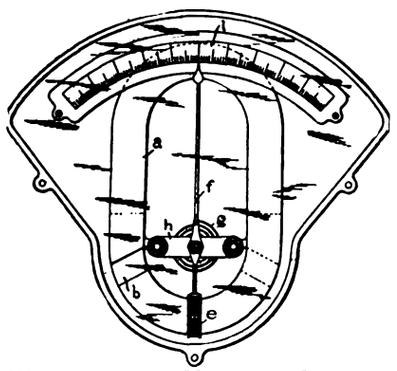
835,731. TROLLEY FOR ELECTRIC RAILWAYS. Ezra F. Landis, La Salle, N. Y. Filed September 11, 1905. The wheel is provided with an annular chamber within which are retainers.

835,750. AUTOMATIC TRANSMITTER FOR TELEGRAPHIC SYSTEMS. John Gell, Highgate, London, England. Filed November 28, 1904. Renewed October 19, 1906. A star feed-wheel device for feeding punched telegraphic tape.

Digitized by Google

835,751. AUTOMATIC TRANSMITTER FOR TELEGRAPHIC SYSTEMS. John Gell, London, England. Filed September 29, 1905. An instrument for automatic telegraphy, utilizing a pair of main and auxiliary contacts.

835,755. ELECTRICAL MEASURING INSTRUMENT. Frank Holden, Rugby, England, assignor to General Electric Company. Filed January 2, 1904. The actuating coil moves between the opposed curved poles of the permanent magnets.



835,755. ELECTRICAL MEASURING INSTRUMENT.

835,763. ELECTRIC CURRENT REGULATOR. Oscar H. Pieper and Alphonse F. Pieper, Rochester, N. Y. Filed February 7, 1906. A regulating rheostat.

835,772. TELEGRAPH REPEATER. Paul E. Bliss, Leesburg, Fla. Filed April 18, 1906. The parts are in duplicate.

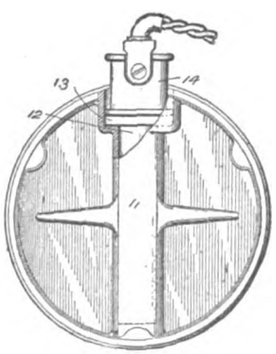
835,801. TELEPHONE WIRE SECURING MEANS. Harvey W. Ragsdale, Morgantown, Ind. Filed June 19, 1905. The wire is held on two arms and kinked by a lever placed between them.

835,802. TELEPHONE EXCHANGE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Filed December 16, 1904. A method of arranging a simple battery system.

835,807. WARP STOP-MOTION FOR LOOMS. John T. Bolton, Fall River, Mass., assignor of one-half to George Grime, Fall River, Mass. Filed February 8, 1905. An electrically operated safety device.

835,816. ELECTRIC CANDLE LAMP. Constant K. Decherd, Meriden, Ct., assignor to International Silver Company, Meriden, Ct. Filed April 16, 1906. A design of incandescent lamp socket.

835,841. ELECTRIC HEATER. Frederick M. Vogel, Lynn, Mass., assignor to General Electric Company. Filed March 31, 1906. A heater composed of a receptacle having high thermal conductivity so proportioned that the temperature remains substantially 100 degrees centigrade.



835,841. ELECTRIC HEATER.

835,848. ELECTRIC SIGN LETTER. Charles A. Chase, Chicago, Ill. Filed April 13, 1905. The lamp connections are carried through the hollow sign supports.

835,860. MICROTELEPHONE. Arvid A. Lind, Malmö, Sweden, assignor to Elektromilitära Aktiebolaget, Stockholm, Sweden. Filed February 28, 1905. The granular resistance is held between two diaphragms.

835,865. HEAD TELEPHONE SET. Joseph Pieringer, Jersey City, N. J., assignor to Western Electric Company, Chicago, Ill. Filed December 1, 1905. A head-set carrying receiver and transmitter.

835,868. CENTRAL ENERGY SYSTEM FOR TELEPHONE EXCHANGES. John G. Roberts, Evanston, Ill., assignor to Western Electric Company, Chicago, Ill. Filed April 2, 1903. Makes use of two doubly wound relays with means of controlling the currents through the two windings.

835,870. ALTERNATING-CURRENT POLE-CHANGER CIRCUIT. Edwin H. Smythe, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. Filed February 1, 1906. A pole-changing device for party-line telephones.

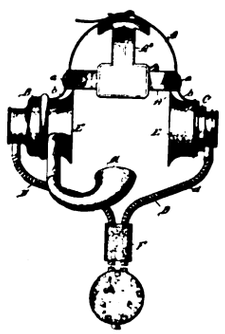
835,878. AUTOMATIC TELEPHONE EXCHANGE FOR DOUBLE-WIRE TELEPHONE SYSTEMS. Gotthilf A. Betulander, Stockholm, Sweden. Filed April 5, 1904. Connections are made through the step-by-step movement of a slide.

835,909. SECTION INSULATOR FOR TROLLEY ROADS. Charles M. Means, Punxsutawney, Pa., assignor to H. W. Johns-Manville Company. Filed April 9, 1906. The metal bed-pieces carry metal bells to which the strain insulator is attached.

835,918. MILKING-MACHINE WITH ELECTROMAGNETIC CLOSING DEVICE. Axel Sabroe, Aastrup, Germany. Filed February 1, 1906. The circuit is completed through the fluid, and when broken by its stoppage the valve is automatically closed.

835,938. ELECTRIC INCANDESCENT LAMP. Francis M. F. Cazin, Hoboken, N. J. Filed February 2, 1899. Renewed April 15, 1902. The filament is made of a permanent metal covered with one or more layers of other metal having less affinity for oxygen.

835,946. ELECTRIC GAS-LIGHTER. Giorgio Giorgi, Florence, Italy. Filed September 16, 1905. An electromagnetic gas valve.



835,865. HEAD TELEPHONE SET.

835,951. SIGNALING ON RAILWAYS. Charles M. Jacobs and Robert J. Insell, Reading, England. Filed July 2, 1906. The operation of the signals is controlled by the passage of the cars.

835,960. APPARATUS USED IN ELECTROPLATING. Albert J. Leaver, London, England. Filed June 11, 1906. A propeller for circulating electroplating liquids.

835,982. DEVICE FOR REGULATING THE ELECTRIC SPARK OF GASOLENE ENGINES. Herbert O. Phillips, Warwick, R. I. Filed December 19, 1905. A cam-actuated igniter.

836,019. MULTIVOLTAGE SPEED CONTROLLER. Alexander D. Du Bois, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. Filed January 13, 1906. The proper amount of field resistance for the different voltages is automatically inserted by the starting controller.

836,036. AUTOMATIC MOTOR STARTER. William F. Hendry, New York, N. Y, assignor to Western Electric Company, Chicago, Ill. Filed October 16, 1905. Unit switches operated successively by different current strengths.

836,062. CIRCUIT CLOSER FOR TROLLEY SIGNALS. Alexander Bevan, Providence, R. I., assignor to the Record Electric Railway Signal Company, Providence, R. I. Filed February 6, 1906. The circuit controlling the signal is closed by the passage of the cars.

836,070. OSCILLATION RESPONSIVE DEVICE. Lee de Forest, New York, N. Y. Original application filed January 18, 1906, Serial No. 296,615. Divided and this application filed May 19, 1906. Two electrodes are enclosed in an exhausted vessel, means provided for heating one of them.

836,071. OSCILLATION RESPONSIVE DEVICE. Lee de Forest, New York, N. Y. Original application filed January 18, 1906, Serial No. 296,615. Divided and this application filed May 19, 1906. A partially exhausted vessel in which are two electrodes, the gas medium being rendered sensitive to electric oscillation by means of a source of electrical energy.

836,072. AEROPHONE. Lee de Forest, New York, N. Y. Original application filed December 11, 1905, Serial No. 291,222. Divided and this application filed December 22, 1905. A device for continuously transmitting trains of electromagnetic waves.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 22. NEW YORK, SATURDAY, DECEMBER 1, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON
NEW ENGLAND OFFICE, ... 95 MILK STREET

LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE
TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single copy, 10 cents. Back numbers, beyond one month, each	.25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
- Predetermining Alternator Characteristics ... 877
- High-Efficiency Electric Lamps ... 877
- Electricity in Medicine ... 879
- Possible Prediction of Earthquakes ... 879

Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw (Concluded) ... 880
Tantalite in Australia ... 883
The "Electrician," Electrical Trades Directory and Handbook ... 883
Recent Storage Battery Improvements, by Sherard Cowper-Coles ... 884
Electric Power in the Transvaal ... 888
Armature Reaction in Polyphase Alternators, by L. A. Herdt ... 889
Athletic Sports for Operators, by J. E. Peavey ... 893
Electrical Equipment of the Erie Railroad Shops at Hornell (Hornellsville), N. Y. ... 894
The Chicago Electrical Trades Exposition ... 898
Non-Resident Lectures at the University of Minnesota ... 898
Magnetograph Records of Earthquakes, with Special Reference to the San Francisco Earthquake ... 901
BOOK REVIEWS ... 901
Electrical Trades Association of Chicago ... 901
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE ... 902
METHODS OF GETTING NEW BUSINESS—"Organization and Conduct of a New-Business Department Suitable for Central Stations in Cities of 50,000 Population and Under," by James L. Wiltse ... 904
INDUSTRIAL SECTION:
- A New Splice Protector ... 906
- The Apple Ignition System for 1907 ... 906
- Diesel Engines for Interurban Railway Service, by Norman McCarty ... 907
- Blue-Print Washing Machine ... 908
- Fireproof Insulated Magnet Wire, by W. H. Easton ... 908
- Two Thousand Six Hundred Dollars in Prizes for an Electrical Solicitor's Handbook ... 909
- Automatic Electric Motor-Driven Pumping Plant ... 909
- To Harness Victoria Falls ... 909

CURRENT ELECTRICAL NEWS ... 910
RECORD OF ELECTRICAL PATENTS ... 915

Copyright, 1906, by Electrical Review Publishing Co.

PREDETERMINING ALTERNATOR CHARACTERISTICS.

In spite of the assertion made by electrical engineers, particularly designing engineers, that they are able to predict most accurately the performance of the machines built according to their designs, there is one machine which has given a great deal of trouble and has baffled many. The alternating-current generator, while in its construction one of the simplest electrical machines, has not yielded readily to analytical and graphical analyses. The machine can not be called erratic, because one such machine always behaves in the same way, and, having built one, it is always easy to say how another, built exactly like it, will behave. But if the design be changed either in size or in type the performance of the older machine does not give a ready means of predetermining how the new one will behave. This problem has been attacked by many, some with a good degree of success, although the methods of procedure differ considerably. While it may not be possible now to say beforehand just exactly what will be the result, there is no difficulty in predicting it with sufficient accuracy for all practical purposes.

Although, from the viewpoint of the designing engineer, matters are in a fairly satisfactory state, new methods of attacking the problem are of interest and of value, if they are simpler or give better results. On another page of this issue a solution is offered by Mr. L. A. Herdt, which, while not entirely new, since it was proposed by him several years ago, is nevertheless worthy of careful study. In the author's hands it has given results agreeing remarkably well with those obtained from direct tests.

HIGH-EFFICIENCY ELECTRIC LAMPS.

Two exceptionally interesting papers were read at the meeting of the American Institute of Electrical Engineers which took place in New York city on Friday evening, November 23. One of these deals particularly with the arc type of light and was presented by Dr. C. P. Steinmetz in his usual clear and convincing manner. The other, not less interesting to users as well as to the lighting companies and lamp manufacturers, was by Dr. Clayton H. Sharp, and gave much more information than has hitherto been available respecting one of the newer types of metallic-filament incandescent lamp—the tungsten lamp, which seems at the present time to be the most efficient of all the newer lamps. A report of this meeting, with the discussion of the papers, will be found on another page of this issue.

Dr. Steinmetz's paper is valuable from the thorough way

Digitized by Google

in which the subject is treated; in fact, as indicated by the title, it is an erudite study of the transformation of electric power into light, and is particularly valuable at this time when so much interest and energy are being shown in the improvement of electric lamps. That there is ample room for such improvement is well known; indeed, were it not true that these lamps compare so favorably with other types of illuminants of practical value to man, we should be ashamed of an efficiency of transformation of less than one per cent from heat energy into luminous radiations. Any improvement is therefore much to be desired, provided that it does not involve disadvantages which more than counterbalance it; and our present knowledge shows that it is possible to improve the efficiency as compared with our present commercial types of lamp two or three times, or perhaps more. Such improvements, if put into practice, would certainly profoundly affect the electric lighting industry. Just how can not be surely predicted. A sudden change to the new lamps would first decrease the station output. This would be immediately followed by a large increase in the use of electric lights which would probably in a short time carry the station load much beyond what it had been before the change; and a more general use of electric lamps would also affect the station load-factor, probably improving it, since, as a general rule, the larger the number of consumers the less variable the load. These revolutionary improvements in electric lighting would still leave the lamps in an unenviable position as compared with other electrical machinery, but there seems to be no hope of securing for the lamps an efficiency which, for motors or transformers, would be considered respectable, by working along any of the lines which are now being followed.

This matter of luminous efficiency is an exceedingly complicated one, for what we desire is a physiological effect, while what we measure is a physical one. Thus, to secure the best performance it is necessary not only to produce a considerable proportion of the radiations within the visible range, but, of this proportion, a good deal must lie in that part of the spectrum to which the eye is most sensitive—that is to say, the green and yellow. In other words, a lamp may be highly efficient, comparatively speaking, when subjected to physical tests, because of the proportion of its radiations lying within the visible spectrum; yet, since the greater part of this may be in the red or in the violet, the result may be less satisfactory physiologically than that produced by a lamp which, while giving off a lower percentage of its radiations as compared with the former lamp within the visible spectrum, still gives off a good proportion of green and yellow. Stated in other words, a given amount of radiant energy is less effective in the form of red rays than in the form of yellow. Moreover, as in everything else, high efficiency is not the only desirable feature. The color of the light is just as important, and the convenience of the lamp and its lack of undesirable features are points of sufficient weight to turn the balance one way or the other. As long as sunlight is taken as the standard the most desirable light is one containing rays from the red and blue ends of the spectrum, as well as the yellow, even though their presence lower the efficiency of the lamp when measured physiologically.

The latter part of Dr. Steinmetz's paper dealt particularly with lamps of the arc type. It is shown that there are two ways of securing light—by radiation from incandescent electrodes when the arc itself is non-luminous, or by radiation from a luminous arc. There are two ways of rendering the arc luminous. One is that employed in the so-called flame arcs, in which the incandescent material is supplied by vapors set free from the positive electrode by heat, and the other that in which the luminous vapor is produced directly by the electric current, since it forms a true arc and provides the conducting path. This is the type of arc given by the magnetite lamp, and it is thought by Dr. Steinmetz to be the case in which there is the most direct production of light from electricity; in fact, the efficiency of this type of arc is, to a considerable extent, independent of the electrode temperature. At the present time the only suitable materials for this arc are the metals of the iron group, and, as used, they are in the form of oxides so as to avoid the deleterious effects of oxidation at high temperatures. The best results are obtained by using a mixture of iron and titanium oxides, the former supplying, to a large extent, the conducting vapor; while the latter increases the efficiency of the arc as a light-producer.

While Dr. Sharp's paper deals in a general way with all the newer types of high-efficiency lamps, the most interesting part is that relating to the tungsten lamp. This is one of the latest types brought forward, and, at the same time, from the results presented in the paper, it would seem to offer much promise of success. Tungsten is too refractory to be worked as other metals, and its conversion into filament form is brought about in another way, which does not differ so greatly from the method of producing carbon filaments. A paste of the powdered metal is expressed through dies into filament form, and is then dried and the binding material removed by heating or chemical treatment. There are several ways of securing the metal in the necessary finely divided state, but present information is not sufficient to enable a comparison to be drawn. Dr. Sharp does, however, compare the tungsten filament with the tantalum, considerably to the advantage of the former. Tantalum, unfortunately, for some unknown reason, becomes striated. The effect is more pronounced in alternating currents of high frequency, rendering the lamp, as at present manufactured, unsuitable for such systems. This defect has not been found in the tungsten lamp. And the latter gives a higher efficiency as measured in watts per candle-power, and a longer life.

The tungsten lamp shares the disadvantage of the other metallic-filament lamps that, due to the high conductivity, it is only made in large units and for low voltages—that is to say, for not less than twenty-five candle-power, nor more than 110 volts. The former feature is a disadvantage from the point of view of the illuminating engineer, and the latter from that of the central station. It possesses, however, the ability of repairing itself after the filament is broken. This repair, it seems, is not as satisfactory as is that of the tantalum lamp, because,

Digitized by Google

due to the infusibility of the metal, the weld is not so perfect, but it is sufficient to enable the lamp to go on burning. Dr. Sharp raises the question whether, in obtaining figures showing the useful life of these lamps, this first break should be considered the stopping point, or whether the lamp should be allowed to mend itself and the test continue. This is a point to be considered when a comparison is being made with carbon lamps, but when determining the useful life for ordinary purposes it certainly should be taken into consideration. What one really wants to determine is the point at which it no longer pays to use the lamp, and since the first cost will be greater than that of the carbon lamps, it should be run a longer time; in fact, it would seem logical to allow the candle-power to fall to a point lower than that now accepted as the smashing point for carbon lamps, if it be found that the new lamps will last so long. The breaking of a filament and its rewelding do not lower the candle-power and efficiency—rather the reverse. Another point to be considered in this connection is the change in the distribution of the light due to the blackening of the bulb of the new lamps; but since the loss is chiefly in a horizontal direction, the proportion of light which is thrown down and thus used without reflectors is not so much affected. From the central station point of view the most significant feature of the tungsten lamp is its efficiency, which is about three times that of the carbon lamp, even in its present state. It is not probable, however, that there will be any sudden change from the old to the new, and if no unexpected developments take place there will be a transition period from the old to the new which will enable all to accommodate themselves to the new conditions.

ELECTRICITY IN MEDICINE.

Probably every science suffers from those human leeches who seize upon every advance and discovery to aid them in bleeding the credulous public, and when a science is closely identified with industries which are working mightily to uplift the world, the opportunity for such charlatans seems to be greatly multiplied. Electrical science and arts seem to have suffered more than their fair share from such persons, although electrical energy is so widely used in so many ways as a means to an end that the opportunities for such impositions have probably been unusually great. And when, in addition, the really surprising discoveries that are associated with electricity, in the public mind, at least, are recalled, it is seen that the chances offered for deceiving the ignorant have been exceptional.

That many have availed themselves of this opportunity can not be denied, and it is therefore comforting to hear such sensible remarks upon the use of electricity for treating human ailments as were made by Dr. John V. Shoemaker in a recent paper before the Pennsylvania State Medical College, at Bedford Springs, Pa. A brief abstract of this paper appeared in the ELECTRICAL REVIEW for November 24, but the remarks referred to will bear repetition: "Electricity in most cases is to be regarded only as an adjunct to other treatment. While giving the special electric application we should also give appropriate remedies to act upon the glands of excretion and secretion. . . . Massage, exercise in the fresh air and proper diet and regulation of habits of the individual—all these are accessory agents and should be conjoined with the electrical treatment if we wish to obtain the best results. Such, indeed, is the intelligent medical use of this agent in the hands of the qualified physician. Without such therapeutic accessories electricity, like massage, is very restricted in its usefulness and tends toward charlatanism."

One hears so much speculation, by those with little knowledge, about electricity and its relation to life that it is pleasing to find it put in its proper place for medical purposes. Here, as in all other uses, it is a means to an end, an agent for bringing about certain results; and to be successful it must be used in its proper place and in harmony with other agencies.

POSSIBLE PREDICTION OF EARTHQUAKES.

When the disastrous earthquake occurred last summer at Valparaiso, a paragraph went the rounds of the daily newspapers which stated that a warning had been issued to the city the day before. No explanation of this paragraph has been given, and in the absence of volcanic action preliminary to the quake, a good deal of interest was aroused by the reported prediction. It was probably merely a mistake, very likely due to some statement given out by the local observatory.

In the September issue of *Terrestrial Magnetism and Atmospheric Electricity* there is an interesting paper by Dr. L. A. Bauer, on "Magnetograph Records of Earthquakes, with Special Reference to the San Francisco Earthquake." This study was suggested by the behavior of certain magnetic observatories located throughout the world, but principally in this country. It was found, by comparing these records, that the magnetograph was frequently disturbed by earthquakes, but in a somewhat erratic way. Records were secured at unexpected points, while there was nothing to show that a disturbance had taken place at other observatories where a record might be expected. This has suggested the idea to Dr. Bauer that there is a slight possibility of some magnetic disturbances brought about by the earthquake, and if this were found to be true it might also be found that the magnetic disturbances would occur before that due to the trembling of the earth, because the magnetic waves would travel more rapidly than the ground waves. In other words, a disturbance of the magnetograph might serve to predict, by a short time, a coming earthquake wave.

A comparative examination of the available records does not agree with this idea, although the magnetograph records seem to involve some disturbance not recorded by the seismograph, so that there is still a possibility that some magnetic effect is produced and that the record of the magnetograph is not simply due to the motion of its supports. The subject is worthy of further study. Even though the prospect of being able to predict an earthquake far enough ahead to make the prediction of practical value is slight, still it has not been proved impossible; and, moreover, the scientific side of the question is of very great interest.

Digitized by Google

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW.

(Concluded.)

XII—The Practical Application of the Gas-Test Results.

1. Calculation of the Total Heat Losses Due to the Volume and Specific Heat of the Exit Gases—In order to be able to calculate the heat lost daily with the waste gases from any boiler plant it is necessary to obtain figures showing the mean temperature, and the mean CO_2 and CO contents[2] of these gases for the twelve or twenty-four hours. These returns may be based either upon the average of a stated number of snap-tests, or upon the results obtained with one of the automatic recording instruments.

As already pointed out in Article xi, the automatic gas-testing apparatus only records percentages of CO_2, and where any apparatus of this kind is installed it is still necessary to make occasional tests of the gases with the modified Orsat apparatus, in order to be certain that no carbonic oxide is present in the waste gases. This precaution is all the more necessary since the tendency where automatic apparatus has been installed is to work the furnaces with too little rather than with too great an excess of air, in order to obtain carbonic acid gas averages above ten per cent. A simple calculation will show that it is better to have ten per cent CO_2 and no CO in the exit gases than fourteen per cent CO_2 and two per cent CO. This is a fact which is not sufficiently recognized by boiler engineers who have installed automatic apparatus, and trust to the records of this alone in controlling the working of their boiler plant. The modified form of Orsat apparatus described in Article x ought, therefore, to be installed in any works using over fifty tons of fuel per week. Tests of the waste gases should be made with this apparatus daily, both as a check upon the automatic recording apparatus, and as a guide to the economic working of the whole plant.

Air contains, in round numbers, twenty-one per cent by volume of oxygen and seventy-nine per cent of nitrogen. When this oxygen is employed for burning solid carbon, it yields the same volume of carbon dioxide gas. If, therefore, the whole of the oxygen of the air could be used up in burning fuel on the grates of steam-boiler furnaces, and if this fuel contained nothing beyond carbon and ash, a maximum percentage of twenty-one per cent CO_2 by volume in the waste gases would be attainable.

Two facts render this maximum impossible of attainment. In the first place all solid and liquid fuels contain hydrogen, and the oxygen likewise contained in fuel is not sufficient to combine with this hydrogen and to yield with it aqueous vapor. Therefore some portion of the oxygen of the air is required to burn the excess hydrogen contained in the fuel.

Further, under actual conditions of work, it is impossible to burn solid fuel properly with only the theoretical amount of oxygen. An excess varying from fifty per cent to 100 per cent above this theoretical amount is required to obtain perfect combustion of the fuel.

The hydrogen present varies considerably in different classes of solid fuel: in bituminous fuels it ranges, as a rule, from three to six per cent. By calculating the weight of oxygen required to burn the hydrogen present in the fuel, and by deducting from this the oxygen contained in the fuel, one obtains the oxygen required from the air. Deducting the equivalent volume of this from 20.8, we have the percentage by volume of oxygen available for combustion of the carbon. This figure for most bituminous fuels is about 19.2 per cent, and this therefore represents the maximum percentage of CO_2 which could be obtained by perfect combustion with the theoretical amount of air. Now, supposing we have an average test for the day of the waste gases of ten per cent CO_2, and an average temperature of 465 degrees Fahrenheit at the base of the chimney; how are these figures to be used to calculate the 2,304 British thermal units given in Article iv as the thermal loss under these conditions of work?

The calculation is as follows:

Ten per cent CO_2 equals an air consumption of $\frac{19.2}{10}$ or 1.92 times that theoretically necessary. As twelve pounds of air are theoretically required for the combustion of one pound of fuel, this excess of air represents 12×1.92, or twenty-three pounds of air consumed per pound of fuel, yielding twenty-four pounds of waste gases.

The specific heat of these gases may be taken as 0.240. The loss of heat with the waste gases, per pound of fuel burnt, is therefore $24 \times 0.24 \times 400^1 = 2{,}304$ British thermal units.

The calculation for any other percentage of CO_2 in the exit gases is similarly made, the maximum percentage of CO_2 (19.2) being used as a means for finding the excess of air represented by any given percentage of CO_2.

2. Calculation of the Heat Losses Due to Imperfect Combustion—The gases due to the imperfect combustion of fuel are carbon-monoxide, free hydrogen and certain hydrocarbons of the methane and ethylene series. Since the heat produced by the combustion of fuel is dependent upon the complete oxidation of the carbon and hydrogen to carbon dioxide gas and aqueous vapor, respectively, it is evident that incomplete oxidation must be accompanied by loss of heat, and that the amount of this loss will depend upon the volume of the unburned hydrogen, hydrocarbons and carbonic oxide gases. The following methods can be applied for calculating these losses from the results of the approximate analysis of the waste gases by the improved Orsat apparatus described in Article x; the percentage of carbon in the fuel and percentage by volume of hydrogen, carbonic oxide and carbon dioxide in the waste gases being the test figures required for the calculation.

(*a*)—*Losses Due to Carbonic Oxide*—Fuel contained eighty per cent carbon, waste gases contained two per cent carbonic oxide with eight per cent of carbon dioxide. Since carbonic oxide yields on combustion its own volume of carbon dioxide, the total volume of carbon dioxide, if the oxidation of the carbon had been complete, would have been 2 + 8, or 10 per cent. Therefore, two-tenths or one-fifth of the carbon had escaped complete oxidation. This is equivalent to $0.80 \times \frac{1}{5}$ or 0.16 pound of carbon.

Now, it has been proved by experiment that when one pound of carbon is burned to carbonic oxide it produces 4,415 British thermal units of heat, while when it is burned to carbon dioxide it produces 14,646 British thermal units (the difference between the heat produced by the union with the first atom of oxygen and that with the second atom of oxygen is believed to represent the work done in converting the solid carbon into the gaseous form.) The heat loss arising from incomplete combustion of the carbon is therefore 14,646—4,415, or 10,231 British thermal units, and the heat loss in British thermal units for the particular case under discussion is $10{,}231 \times 0.16 = 1{,}637$ British thermal units for every pound of fuel burnt. Supposing that the fuel in this case had a thermal value of 14,320 British

[1] All rights of reproduction and translation are reserved. Copyright, 1906, by John B. C. Kershaw.

[2] CO_2 is the chemical symbol for carbon dioxide and CO that for carbon-monoxide.

[1] It is assumed that the air temperature is 65 degrees Fahrenheit and that the net loss of heat in the exit gases is 465 − 65 = 400 degrees Fahrenheit.

Digitized by Google

thermal units, the heat lost by imperfect combustion of the carbon and production of two per cent of carbonic oxide in the waste gases would amount to 11.40 per cent of the total heat value of the fuel. These figures prove the great importance of testing for carbonic oxide, and the inadequacy of any system of control which ignores its possible presence in the exit gases.

The general formula for calculating the losses due to carbonic oxide is:

$$X = \frac{\text{per cent CO}}{\text{per cent CO}_2 + \text{per cent CO}} \times \frac{\text{percentage of carbon in fuel}}{100} \times 10{,}231$$

in which X represents the British thermal units lost per pound of fuel burnt.

(*b*)—*Losses Due to Hydrogen*—The older theory of combustion assumed that oxygen had a preferential attraction for hydrogen in presence of carbon, and that all the hydrogen would be burned to aqueous vapor before any of the carbon was oxidized to carbonic oxide or carbon dioxide.

The recent researches of Bone and others upon the chemistry of the combustion process have shown that this theory is incorrect, and that hydrogen can still exist in the free state in the combustible gases after the oxidation of the carbon has commenced. On the other hand, Sodeau has proved that by the use of improved methods, notable amounts of free hydrogen can be found in the exit gases from boiler plants worked with an insufficient air supply, and in the article referred to below[1] he gives the following analyses of the exit gases from a 1,000-horse-power water-tube boiler of the Express type, fired with Welsh coal.

CO_2	9.0	11.0	9.9	9.2
CO	2.15	2.8	1.65	1.3
H	0.65	0.55	0.47	0.4

These tests prove conclusively that free hydrogen may exist in the exit gases from boiler furnaces in the presence of considerable percentages of carbon dioxide, and that the older view that the hydrogen must be first completely burnt to aqueous vapor before the combustion of the carbon occurred, is incorrect. It is therefore always advisable to test for the presence of hydrogen in the exit gases from boilers worked under close supervision as regards air excess, since with the escape of one per cent of unconsumed hydrogen, considerable heat losses may arise.

The method of calculation is less simple than in the case of carbonic oxide, since in the absence of any test for the aqueous vapor, one is unable to state the loss as a proportion of the total hydrogen present in the fuel. It is therefore necessary first to calculate from the volume percentages of the gas analysis the weight of the various gases by aid of the specific gravity figures given in Article iv. Taking the first example given above by Sodeau, we have the following figures:

	Percentage by Volume.		Factor.		Equivalent by Weight.
Carbon dioxide	9.0	×	1 529	=	13.76
Carbon monoxide	2.15	×	.967	=	2.07
Hydrogen	0.65	×	.069	=	0.045
Oxygen	8.00	×	1.105	=	8.84
Nitrogen	80.20	×	.971	=	77.87
	100.00				102.585

The figure 0.045 in 102.585 of waste gases is equivalent to 0.0439 per cent hydrogen by weight.

By application of the method described in Section i of this article we find that a percentage by volume in these gases of nine per cent CO_2 and 2.15 per cent CO corresponds to an air supply of 20.52 pounds of air, and to a production of 21.52 pounds of waste gases per pound of fuel burnt. The weight of hydrogen which is escaping combustion per pound of fuel burned in the above case is therefore $\frac{0.0439 \times 21.5}{100}$ or 0.009438 pound. Now, one pound of hydrogen gas, when burned completely to H_2O, produces 62,100 British thermal units of heat, and the loss of heat in the particular case named above is therefore 0.009458 × 62,100 or 586 British thermal units, equivalent to four per cent of the total heat value of the fuel. Although the percentage of free hydrogen in the waste gases by volume may be small, it is thus seen to be of considerable importance in its effect upon the heat losses, and its presence ought always to be made the subject of special tests.

(*c*)—*Heat Losses Due to Unburned Hydrocarbon Gases*—Since the hydrocarbon gases, methane, ethylene, etc., will have been burned to carbon dioxide and aqueous vapor, respectively, in the combustion pipette described in Article x, and have been returned in the test as carbon monoxide and free hydrogen, it is unnecessary to make any separate calculations for the heat losses due to the presence of these gases. The error in the final result is negligible, for both elements exist in combination in the gaseous state in the hydrocarbon gases, and the thermal energy required to render them free is probably small. The thermal values given for the combustion of free hydrogen and of the gaseous atom of carbon in carbon monoxide are therefore applicable, and the calculations given under *a* and *b* include the losses due to the possible percentage of these hydrocarbon gases.

3. Circulation of the Heat Losses Due to Air Leakage. (*a*)—*At the Dampers*—Tests of the CO_2 present in snap samples of the exit gases drawn simultaneously from the sampling hole just within the damper (on the furnace side of it) and from the nearest sampling hole on the chimney side of it, at a distance of at least two yards, are made. If the tests differ by less than half of one per cent the air leakage may be regarded as slight.

In some cases, however, it will be found that a difference of two or more per cent exists between the tests of the two samples. The excess of air and heat loss represented by this difference is then calculated by the method given under Section i of this article. It is advisable when making use of this method to check the air leakage at the dampers, to make the test when the boiler fires are burned red, and to see that no interference with the fires occurs during the sampling operation. Both sampling tubes should be inserted an equal distance into the flues, and it is, of course, necessary to take the second sample of gas from the flue at a point where the exit gases from other boilers have not had a chance to mix with it and to change its composition.

Air leakage at dampers and through the flues of incompletely dampered-off boilers is a prolific cause of bad draught in most boiler plants, and attention to this defect is urgently needed. Since the cold air drawn into the flues in this way does not pass through the furnace of the boiler it may be argued that the heat loss is negligible. In most modern boiler plants, however, economizers or feed-water heaters are employed for extracting some portion of the heat from the waste gases; and the dilution with cold air drawn in through the dampers of the boilers diminishes greatly the efficiency of this accessory plant. The use of gas testing for discovering and checking this leakage is therefore of considerable importance.

(*b*)—*Through the Brickwork of the Boiler Setting, Economizer and Flue Walls*—The method of making the test is described under *a*. Simultaneous snap samples are drawn from different sections of the flue, and are tested for the percentage of CO_2. The gradual reduction in the percentage of CO_2 as the sampling approaches the chimney is the measure of the air leakage. The calculation of the air excess and of the heat loss

[1] *Chemical News*, February 5, 1904.

Digitized by Google

is carried out as already described in detail under Section 1 of this article. In nearly every case where special attention has been devoted to this subject, considerable air leakage through the brickwork of boilers and flues has been found; and the casting in of the rough setting of these in glazed bricks or in sheet iron has been found to result in considerable economy. It must be pointed out here that leakage through the brickwork setting of a boiler or through the economizer walls is a direct source of heat loss, since the cold air which leaks into the flues in this way is raised to the boiler or economizer temperature by heat abstraction from the boiler plates and economizer tubes. The ordinary direction of heat transfer is therefore reversed, with direct loss to the efficiency of the boiler or economizer plant.

4. Calculation of the Initial Furnace Temperature—The test results of the exit gases can be made use of to calculate the temperature attained in the combustion area of the boiler furnace. The method is based upon the calorific value of the fuel and the weight of the products of combustion per pound of fuel burnt. The former figure is obtained by one of the methods of direct test described in Article iii; the latter is calculated from the results of the approximate analysis of the waste gases, as described in Section i of this article.

Taking the case there given in which the gases contained ten per cent CO_2 and no carbonic oxide or unburned hydrogen, this was found to correspond to an air excess of 1.92 times the volume demanded by theory, or to twenty-four pounds of waste gases per pound of fuel. The specific heat of these gases was, however, 0.24; therefore 5.76 British thermal units would be required to raise the temperature of these twenty-four pounds of waste gases through one degree Fahrenheit. Taking the heat value of the fuel in this case at 14,200 British thermal units, it is evident that the furnace temperature must have been $\frac{14,200}{5.76}$ or 2,465 degrees Fahrenheit.

Should the combustion of the fuel be incomplete, and carbonic oxide, hydrocarbon gases or free hydrogen be present in the exit gases, it is necessary to deduct from the thermal value of the fuel the thermal units corresponding to the amount of these gases per pound of fuel burnt. These are calculated by the method given under Section 2 of this article. The balance of heat units produced by the combustion of one pound of the fuel is then divided by the factor 5.76, as in the previous example.

Since the rate of heat transfer from the hot gases on the one side of the boiler plate to the water on the other side of the plate is dependent upon the difference in temperature between the two, and increases directly as the temperature, it is evident that a high initial furnace temperature is requisite for the most economical working of boilers. The method of calculation described above is the simplest and quickest method of ascertaining and controlling this factor in good boiler working.

5. Calculation of the Heat Losses Due to Aqueous Vapor—As pointed out in Article x, the amount of aqueous vapor in the waste gases from steam boiler plants is rarely determined, and the heat losses due to this constituent of the final exit gases are therefore largely unknown. The following calculations, however, prove their importance and the necessity for keeping the moisture in the coal as low as possible, as well as the advantage of using fuels containing a low percentage of hydrogen. The superior steam-raising efficiency of South Wales steam coal is no doubt due to its low percentage of hydrogen.

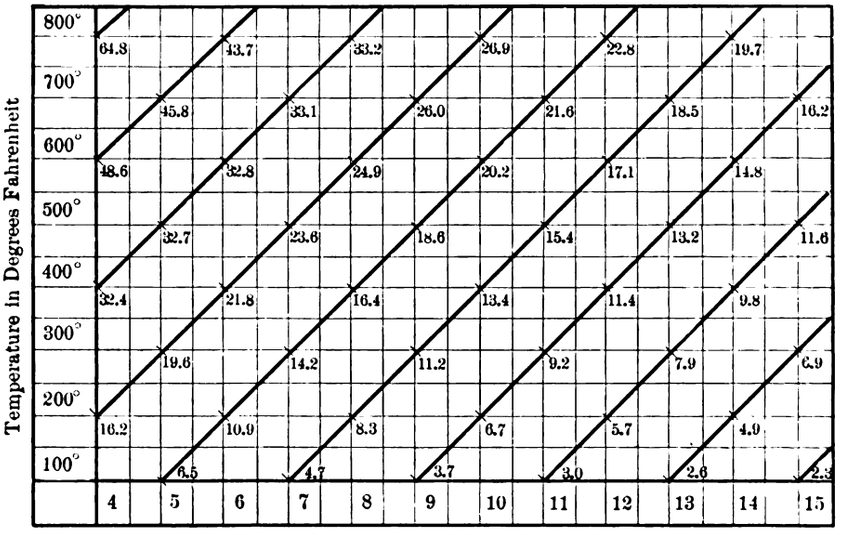


FIG. 49.—PERCENTAGE OF FUEL LOST FOR VARIOUS TEMPERATURES AND CO_2 TESTS OF EXIT GASES.

Taking the coal the analysis of which was given in Article i, we find that there was 3.05 per cent moisture and 4.65 per cent hydrogen present in the fuel as delivered.

Since hydrogen yields nine times its own weight of aqueous vapor on combustion, every 100 pounds of this coal would produce 3.05 + (4.65 × 9) or 44.90 pounds of aqueous vapor in the furnace gases, and one pound of the coal would correspondingly produce 0.449 pounds of aqueous vapor. This aqueous vapor had, however, all to be raised from the temperature of the external air to the temperature of the exit gases. In addition to the loss of heat due to the high specific heat of aqueous vapor, there was that due to the fact that all of the water passing off as aqueous vapor from the furnace of the boiler had first to be raised to 212 degrees Fahrenheit and then vaporized. Now 966 British thermal units of heat disappear in the vaporization of one pound of water, and this value is known as the latent heat of steam. The calculation for the heat lost with the moisture present in these gases is therefore made as follows, the temperature of the exit gases being taken as 665 degrees Fahrenheit, and the external air temperature at sixty-five degrees Fahrenheit:

1. Heat required to raise the moisture from sixty-five degrees Fahrenheit to 212 degrees Fahrenheit: .449 × (212 — 65) = 66 British thermal units.

2. Heat required to convert this moisture into steam at 212 degrees Fahrenheit: .449 × 966 = 433 British thermal units.

3. Heat required to raise this steam from 212 degrees Fahrenheit to 665 degrees Fahrenheit:[1] .449 × (665 — 212) × .540 = 109 British thermal units.

The total heat loss due to the presence of this aqueous vapor in the exit gases is therefore: 66 + 433 + 109 = 608 British thermal units.

With the fuel under consideration, this loss was equivalent to $\frac{608}{12,600}$ or to 4.8 per cent of the total heat value of

[1] The specific heat of steam increases with the temperature and at 665 degrees Fahrenheit is about 600 degrees.

Digitized by Google

the fuel. The chief loss is due to the latent heat of the steam, and this heat can not be recovered from the waste gases, unless they be cooled below 212 degrees Fahrenheit before passing up the chimney. Since the efficiency of chimney draught is dependent upon a temperature difference of at least 400 degrees Fahrenheit between the vapor within the shaft and the air outside it, it will be seen that until fan draught is more general, the loss of this heat is largely unavoidable. It can, however, be minimized by the use of dry fuel and the prevention of all unnecessary steam escapes into the furnaces of the boilers. The fuel tests given at the end of Article iv show that great differences exist between the moisture tests for various classes of coal, and that in washed slacks of bituminous character the moisture may rise to a very high figure.

It is therefore questionable whether the freedom from ash obtained by washing is not purchased at too high a cost; and it would be well to stipulate in buying such washed slacks or "peas" that the moisture shall not exceed five per cent in the fuel as delivered.

6. Calculation of the Heat Balance—The method of ascertaining the evaporative efficiency of the boilers by means of a "heat balance" was described in Article iv. It is unnecessary to repeat here the details of this method of calculating the efficiency of the steam-raising plant. The second entry in the heat balance given in Article iv may, however, be expanded to include all the heat losses discussed in Sections 2, 4 and 5 of this article.

The heat balance is then set out as follows:

Heat value of fuel in calorimeter.	British Thermal Units.
1.—Losses by radiation, etc.	—
2.—Losses by waste gases:	
(*a*) due to excess air	—
(*b*) due to unburned carbonic oxide	—
(*c*) due to unburned hydrogen and hydrocarbons	—
(*d*) due to moisture	—
3.—Losses by unburned carbon in cinders and ash	—
4.—Losses by heat carried in cinders and ash	—
5.—Balance, heat converted into steam	—

The difference between the total of the items 1-4 and the heat value of the fuel as ascertained by the calorimeter then gives the total units of heat converted into steam, and from this the evaporative efficiency of the boiler or boilers is obtained by expressing the result as a percentage of the total heat available. It is important that the heat value of the undried fuel be used in these calculations, and not the heat value of the dry fuel as usually returned by the chemist. The former can be calculated when the latter is known.

Fig. 49 shows in graphic form the percentage of fuel wasted by heat losses in the exit gases at various temperatures and percentages of CO_2. It is based upon a table given in the appendix of the book named below.[1]

Tantalite in Australia.

A very important feature of the Wodgina tin field, in Western Australia, according to the last annual report of the Department of Mines, is the tantalite lode. The lode traverses the whole length of two of the leases applied for, namely, Nos. 86 and 87. Upon the most southerly of the two not much work has been done, operations having been confined to dry-blowing the surface along the outcrop and in the vicinity of the pegmatite vein. The principal activity is centered upon the ground embraced within the limits of No. 86. The pegmatite vein (the lode) has been opened up for a length of forty-five feet, but only to a depth of three or four feet, and exposes coarse fragments and crystals of tantalite; one fragment weighed a little over four hundredweight (448 pounds). To the west of the open cut its width is forty-one feet, while 264 feet farther its width is thirty-four feet. A shaft is being sunk in the open cut. The lode is in "greenstone country" and not in sedimentary rocks, as is the case with the tin lodes yet opened up.

It is estimated that about eighteen tons of the mineral have been taken from the surface of the lease (in 1905). This detrital tantalite results from the disintegration of the rich shoot in the vein adjoining.

About 300 feet to the west of the main tantalite lode is a smaller pegmatite vein, containing tantalite. Dry-blowers have been at work near the southern end and have obtained (in 1905) about one hundredweight (112 pounds) of the fine grained mineral.

What may be called the tantalite group of lodes has been followed with more or less interruption for about a mile to the north of the tantalite lease No. 86; it eventually merges into the granite underlying the plains. A fair quantity of detrital tantalite has been obtained from this locality and there is every reason to believe that the area over which the mineral occurs will be extended.

As much as $4.37 per pound for eighty per cent ore was paid early in 1905 in London. Prices rapidly fell, however, owing to the large production and limited demand, to about one-sixth that price.

Tantalum was first detected in Western Australia in Greenbushes stibiotantalite (tantalate of antimony) in 1896. Subsequently, in 1900, tantalite (tantalate of iron) was detected in alluvial material from Greenbushes; manganotantalite (tantalate of manganese) in 1904 in material from Wodgina (Pilbara gold-field); manganocolumbite (niobate and tantalate of manganese) and calciotantalite (tantalate of lime and iron) in 1905 from Wodgina and Green's Well (Pilbara gold-field).

At Greenbushes tantalite has been found *in situ* as a constituent of a highly micaceous greisen, but is most frequent in water-worn pieces from the size of fine shot up to thirteen pounds in weight, associated with stream tin ore. An analysis of a detrital specimen yielded 80.61 per cent of Ta_2O_5 and 2.5 per cent of Nb_2O_5.

Associated with the tantalite, but in much smaller and less frequent pieces, is the unique mineral stibiotantalite. It is found forming thin veins in tantalite, of which it is almost certainly an alteration product due to the passage of antimonial solutions through cracks in the parent mineral, and also occurs in water-worn fragments from the size of a pin's head up to about two inches in diameter. Most of these consist of pure yellow stibiotantalite, but some consist of an ill-defined black core of tantalite surrounded by yellow stibiotantalite. It is always more or less well crystallized and exhibits one very distinct cleavage. Assays of various samples showed from 50.57 to 51.05 per cent Ta_2O_5, and 4.49 to 12.58 per cent Nb_2O_5.

At Wodgina and Green's Well manganotantalite and manganocolumbite occur in detrital fragments from small grains up to thirty-seven pounds in weight associated with more or less tin ore, as well as *in situ* in veins of albite-granite. Specimens are frequently well crystallized.—*Mining World.*

The "Electrician" Electrical Trades Directory and Handbook.

The *Electrician*, Salisbury Court, Fleet street, London, E. C., announces the preparation of the twenty-fifth edition of the "Big Blue Book," which will be ready January, 1907. This will contain the usual list of British, colonial and foreign engineers and manufacturers, technical and commercial tables and other useful data, together with an illustrated biographical section. This is one of the most useful electrical directories published and will be corrected up to January, 1907.

[1] "Smoke Prevention and Fuel Economy" by Booth and Kershaw, Constable, 1904.

Digitized by Google

RECENT STORAGE BATTERY IMPROVEMENTS.[1]

BY SHERARD COWPER-COLES.

(Concluded.)

SOLID CELLS.

In the year 1890, Hatch, of Boston, Mass., used grooved earthenware separators and filled his negative and positive active material into either side of the separators themselves. The current was drawn off by conductors of plain sheet lead, which were placed between the separators. The whole was placed together, so that absolutely no space at all was allowed for the electrolyte. It was the failure to recognize the necessity for the diffusion of the electrolyte, or at any rate, means for supplying the active matter with sufficient electrolyte close at hand to do its work, which was fatal to the Hatch cell. So long as only a very small current was required from the cell, it was fairly efficient, but if any real work were attempted, if it were put on at, say, a two-hour rate, the voltage immediately dropped to an unworkable figure. It is, however, a remarkable fact that if Hatch, instead of filling up the whole of the space with active matter, had merely coated the porcelain slabs with a film of active matter, he would, as will be shown later on, have fulfilled all the conditions which are called for today in the solid network type of cell.

It was, perhaps, an instinctive feeling that they were on the right track that caused so many, in spite of discouraging results, to follow in Hatch's footsteps. Usher, Washburn in 1892, Roe and Sutro in 1893, and Menges in 1895, made some trifling improvements, but did not remove the chief defect of the cell. In England, recently, these cells were being made under the Hatch patents by Messrs. Sutherland and Marcuson (who have transferred their rights to Messrs. Peto and Radford), and under the Hathaway patents by the Taipo Accumulator Company. Several years ago the Hatch cells were being made in America by the International Storage Battery Company in Boston, Mass., and have been revived again by the Hatch Accumulator Company, of Boston. The positives are now enclosed in a porous stiff pottery envelope, which is claimed to prevent the disintegration of the active matter. The entire surface of the new Hatch metallic electrodes is covered by active matter, which no doubt prevents the corrosion of the metallic cores.

Messrs. Peto and Radford are now manufacturing the Umpire type of plate in London, partly under the Hatch patents and partly under patents taken out by Messrs. Sutherland, Marcuson and Niblett. Owing to internal resistance of the porous plates, which are used as separators, the battery is chiefly suitable for the discharge of comparatively small currents. The makers claim that the best working figure is at the ten-hour rate, but that it is possible to discharge at seven, five and three-hour rates with proportionate drop in the voltage, and that this drop is only due to internal resistance, and not due to the electrolytic condition of the cells.

NETWORK CELLS.

From the preceding remarks it will be gathered that there is a decided movement in the direction of making storage cells solid, and doing away with the reserve acid-space between the plates. This, of course, will always result in failure so long as the additional space is not provided for the electrolyte, and that at the right place. To bring the greatest percentage of active matter in contact with its share of electrolyte, it is necessary that the surface should be very large, as in a Planté positive plate, the Tudor being a good example.

The same success, however, has not attended the Planté negative. Unfortunately, the Planté negative must, of necessity, be made by reversing a Planté positive. When positive active matter (the highest oxide) is reversed into spongy lead, much oxygen has to be removed, and a very highly molecular, porous, and therefore mechanically weak, active matter results, with consequent drop in capacity. This, of course, does not apply to the positive, because it derives a fresh supply of active matter from its metallic support. It has been attempted to work toward the same end in pasted plates by making them thinner, which necessitates increasing their number. This, of course, shortens the life of the electrode, as the thin plates, with open space each side, are mechanically very weak.

The very next year after Hatch produced his cell, Morrison, of Chicago, in 1891 attempted to meet these conditions by modifying the pasted plate type. The Universal Electric Storage Battery Company, of Chicago, is still making his cell, which has a remarkable construction, and appears to be giving very excellent results, the general design of the electrodes being in the direction of a solid network. Each electrode is built up of a number of thin pasted plates, placed horizontally, after the manner of the lamelles of the Planté plate. The cost of preparing and putting together the many little shelves of each electrode must be considerable, each small grid having to be first cast and pasted. All the thin pasted grids are then assembled, between each being placed a kind of sandwich composed of two pieces of prepared paper, and one piece of prepared grooved wood; a strip of lead is then burnt on to the ends of the shelves, and a big lug on the top. Each plate may be said to consist of a number of trays of active material exposed on both upper and lower sides to the action of the electrolyte, which can circulate through the openings of the grooved wood. There is electrolyte between each shelf, the electrodes being put very close together. The surface of active matter exposed in the electrolyte is thus very large in proportion to the sides of the electrode. A Morrison cell, rated at 450 ampere-hours, was tested in Chicago. The ampere-hour efficiency was found to be at a twenty-hour charge and discharge 90.8 per cent, at a five-and-one-half-hour charge and a two-and-three-quarter-hour discharge seventy-four per cent, and the watt-hour efficiencies at the same rates were 83.66 per cent and seventy-four per cent, respectively. The cell was said to have been severely abused for some time, after which it was found to be practically unchanged.

The same idea of an electrode built up of a number of small electrodes placed horizontally has been carried out in a modified manner by E. A. Sperry, and his cells are being made by the National Battery Company, of New York. The small grids filled with active materials are attached to the main frame of the electrode at the upper side only, space being thus provided for expansion to take place on the other three sides. The positives, however, are not pasted, as in the Morrison cell, but each positive electrode is made up of similar but Planté-formed units.

The Bijur battery made by the General Storage Battery Company, New York, is very similar to the Sperry design. The electrodes of the Morrison, the Sperry and the Bijur type, built up of small units so as to form a network, are suggestive of possible improvements in the Planté plate. As now made, however, they are mechanically very weak, and the separate units have still the old fault of liability to warp out of shape and destroy themselves.

A good example of improvement in the direction of the Sperry is a light-traction positive plate, made by the Fulmen Accumulator Company, of Paris. It consists in the first place of a bar of antimony-lead in the centre serving to support lamelles

[1] Paper read at the Royal United Service Institution, London England, before the Society of Engineers, November 5.

Digitized by Google

of soft lead, which stand out on each side in sets like wings. This arrangement of the lamelles causes each to be under the same conditions and insures the uniformity of the formation. They are burned to the supporting bar at one end only, so that they are free to expand individually in all directions without causing warping or distortion, which is a frequent cause of trouble in the ordinary Planté plate.

The Climax (made by Pritchetts and Gold) is also a good type of Planté plate. The lamelles of this plate are not cast, but are rolled up by rows of little wheels acting simultaneously on either side of the plate, resulting in a very much larger surface than it is possible to obtain by casting; rolled metal is also more homogeneous than cast.

SOLID NETWORK CELLS.

Perhaps the first serious attempt to produce a solid network cell with some provision for the electrolyte was by Niblett. His cell, in its original form, was, to all intents and purposes, of the Planté type. Each electrode consisted of a highly cellular mass of material, which filled the cell completely, and was claimed to be so constructed that it was capable of absorbing sufficient electrolyte within itself, and obviating the necessity for providing extra acid space as in the ordinary plate cell. The electrodes were merely separated by a thin, porous, inert partition. The cellular construction was arrived at in a very simple manner. Each electrode consisted of a number of small irregularly shaped pieces of lead, which were filled into the cell and then formed Planté style. These irregular pieces were made in an ingenious manner by dropping red-hot lead into water. The cell was not introduced without much opposition, although it by no means stands alone as an example of the solid network type in England and other countries.

Engineers generally, and especially most of those connected with storage-battery work, still look very unfavorably upon attempts to put the electrolyte within the electrode. The specifications of engineers usually stipulate the following conditions: Electrodes to be suspended, positives Planté, negatives of the Sellon type, acid space so much, space below plates so much, separation glass tubes, discharge down to so many volts (no matter at what rate of discharge), and so on. The introduction of the Niblett and similar cells has entirely revolutionized the mechanical construction of accumulators, enabling them to be constructed without plates, glass-tube separators, acid space, etc.

An illustration of the difficulty engineers find in regarding storage-battery matters in other than conventional and stereotyped form was given recently. An electrode of the network type was sent to a prominent manufacturer for him to test its capacity, efficiency, etc. The cubical contents of the network electrode included, of course, the acid-space within itself, but the manufacturer's engineer, who made the test, actually compared the electrode with an ordinary pasted plate (which, of course, does not include acid-space) for capacity, etc., in ratio to their cubical contents, without taking this important fact into consideration. The chief defect in the original construction of the Niblett battery was that there was no guarantee that electrodes do not consist for the most part of isolated pockets having no connection with each other, and so trap the gas and give no chance for adequate circulation of the electrolyte.

Niblett claimed that the cellular construction of the electrodes gave them the peculiar property of automatically regulating their own internal resistance, for if the cell be charged at too high a rate, or when it would be on the point of becoming fully charged, the gas would tend to drive the electrolyte from the pores of the elements, and itself to remain imprisoned therein, thereby largely increasing the internal resistance. At the same time he claimed that as the discharge proceeded the occluded gas reentered into chemical combination, and allowed the liquid to refill the pores and expose more active surface. Nothing is said about the occluded gas lowering the potential, and another serious defect in this earlier Niblett cell was the high internal resistance caused principally by the use of a porous pot, which renders it useless for central station work. The manufacturers claim, however, to have overcome this difficulty in their latest type by using a porous pot of very low resistance. In this later type the negative is a true network consisting of granules of active matter, or of a mixture of active matter and diatomaceous earth, thus avoiding the isolated pockets. In the positive, the principal improvement is the use of a conducting rod having a very large surface for contact with the active material, which further lowers the resistance.

SOLID NON-CONDUCTING NETWORK CELL.

The foregoing shows roughly the position of affairs when the first non-conducting network cell, with film only of active matter, was produced. This may be broadly described as containing electrodes composed of a hard, porous, non-conducting substance in the form of a network of three dimensions covered or painted with a very thin film of active material. This in effect produces a complete network of active material, and inside of this again a complete network of electrolyte. To help to make this clear it may be described in other words as a non-conducting mass pierced in more than one direction with intercommunicating passages, the walls of which are covered with a thin film of active material. The thickness of the film of active material and the capacity of the passages for electrolyte are said to be so proportioned that each particle of active matter has in contact with it its proper quota of electrolyte.

At the same time that the experiments of Fennell and Perry were being made, which led to the non-conducting network cell, Niblett was going over practically the same ground, and a great many of these remarks apply as well to his granule cells. The first solid network cell closely resembles the Niblett solid cell in appearance. There is this difference, however, between the two: Fennell and Perry appear to insist on a complete network of non-conducting substance, independent of the active matter, but itself supporting a film of active matter. Niblett, on the other hand, makes his granules entirely of active matter, or of a compound of active and inactive matter, or of a mixture of active-matter network with metallic network. There is, however, in either case no need of the extra acid space between the plates, and the electrodes can be set up close together, having only a thin insulator of any suitable material between them. The electrodes fill the entire cell, and so warping is impossible, even if it were not already so by reason of the subordinate part from a mechanical point of view that the active matter now plays. As a material for the non-conducting network support, the best results have been obtained with pumice stone. Niblett, on the other hand, prefers diatomaceous earth for mixing with his active matter.

From its very nature and organic origin, diatomaceous earth is obviously one of the finest inert absorbents known, and is used as such for making nitroglycerine. It is, however, very soft, as is testified by its use, as fullers' earth. It is an essential condition that the non-conducting substance should be hard, rough, porous, insoluble and non-conducting. This description would apply almost exclusively to pumice. The ideal, however, appears to be on a basis of a homogeneous, non-conducting network. This could not very well be pumice, because, although of the same chemical constituents as diatomaceous earth, it has an inorganic origin, and is too brittle to stand drilling, sawing

Digitized by Google

or working into a network. It became necessary, therefore, to imitate the qualities of pumice in some plastic material like clay, which could be afterwards baked hard. A network is thus built up entirely of one piece, and of the most desirable

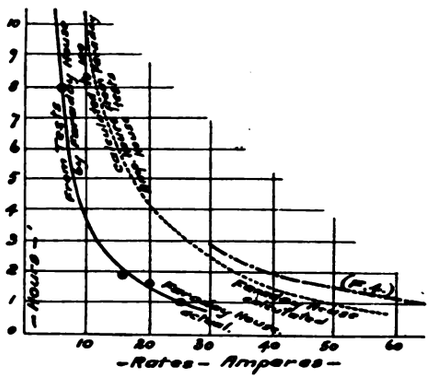


FIG. 9.—TESTS OF PANTHODE CELL.

material, which is then coated with a film of active matter, this film lining the intercommunicating passages throughout. The results given in this paper, however, were obtained from cells in which small, rough pieces of pumice were filled into the spaces reserved for them, thus forming a network of three dimensions. When the intercommunicating spaces between the pieces of pumice are lined with a film of active matter, the result is a network of inactive material supporting the network of active material, and in this again a network of electrolyte—all fitting, as it were, like one glove within another. In this cell and in the Niblett type, great attention must be paid to the method of conducting the current away. The difficulty is greater in the Niblett, however, because the conductivity depends not only on the contact with the conductor, but on the contact of the granules one with another, while in the Panthode the active matter is continuous. In the Electrical Ignition Company's type of Niblett cell the positive in the porous pot has a rod

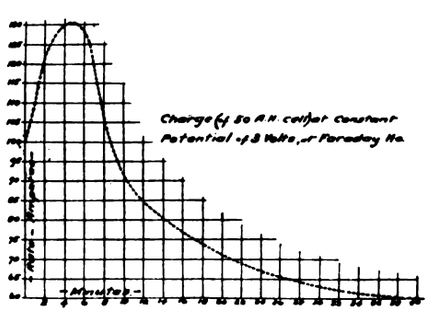


FIG. 10.—TEST OF PANTHODE CELL.

in the centre for a conductor, while the negative is served by a strip of sheet lead. In Fennell and Perry's Panthode cell similar means are adopted. The Panthode appears to involve an entirely new principle in accumulator construction, which is capable of wide application.

FARADAY HOUSE TESTS.

The first independent tests were made (see Fig. 9) by the Faraday House Testing and Training Institution in August, 1903, and the report was not received until October 23. The cell, meanwhile, received constant and severe treatment. This was, of course, before the non-conducting networks were made in one piece, and therefore the network was by no means an ideal one. A thin, perforated sheet-lead conductor ran through the centre of the electrode. The non-conducting network consisted of small rough pieces (or granules) of pumice piled on each other. When in position in the electrode, the film of future active matter (of the Lithanode type) was precipitated on the surface of the pumice and of the conductor. In doing this, great care had to be taken not to accidentally fill up any of the spaces or intercommunicating passages between the pieces of pumice. The containing box was made of celluloid, and its dimensions were four and one-quarter by four and one-quarter by ten and one-quarter inches high outside. A

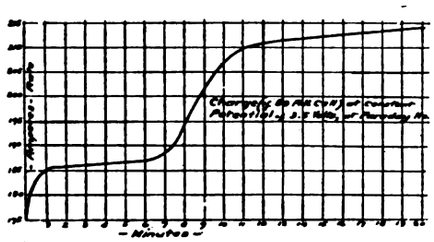


FIG. 11.—TEST OF PANTHODE CELL.

discharge of six amperes was first made, and also another last of all at the same rate in order to ascertain whether the intervening severe treatment had injured the cell.

	Ampere hour Output.	Watt-hour Output.
First discharge.....	48	86
Last discharge..... ..	48	89

The capacity was unchanged, but the watt-hour output was improved in spite of the rough treatment.

The tests included charges at constant potentials of three volts and 3.5 volts, when current rose to 214 amperes, and the cell was completely charged in twenty minutes (see Figs. 10 and 11). Fig. 9 shows all discharges taken by Faraday House.

THE AUTHOR'S TESTS.

After the above treatment the cell was sent to the author's laboratory, and after a number of tests it was found that the capacity had risen to fifty-two ampere-hours, or four ampere-hours higher than it was in the first test. About a year ago several more electrodes were sent for testing. They were each ten by nine and one-half by three-quarters inches—of the same size as some Planté positives, and pasted negatives of well-known make which were to be tested with them. They

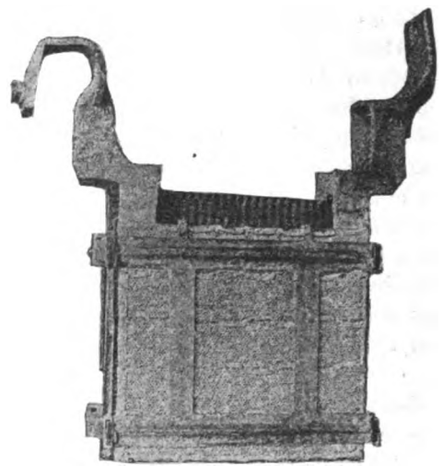


FIG. 12.—SIDE VIEW OF PANTHODE CELL.

contained sufficient room for electrolyte within themselves. A five-plate cell was made up which consisted of three Panthode negatives and two Planté positives of well-known make. A five-plate cell was obtained from the same maker for the purpose of comparison. After a few tests the sizes were found to be inconveniently large for the tests, and the cells were

FIG. 13.—END VIEW OF PANTHODE CELL.

therefore dismantled and remade as follows:

PARTICULARS OF THE FOUR CELLS TESTED, EACH CONTAINING ONE POSITIVE AND TWO NEGATIVES.

	Positive.	Negative.
F_1	Planté.	Pasted plate.
F_2	Planté.	Panthode.
F_3	Planté.	Panthode.
F_4	Panthode.	Panthode.

The Panthode negatives in F_2 were covered with perforated lead, and those in F_3 and F_4 were uncovered. Figs. 12

Digitized by Google

and 13 are side view and end view, respectively, of cell F_4.

The tests undertaken were for the purpose of determining the comparative value of the Panthode solid network electrodes, and other makes with regard to volume resistance, output, efficiency and durability. For the purpose of comparison, calculations were made to bring every cell to a common basis of ten amperes for ten hours. There is one point that should be mentioned before giving any details of the tests. Cell F_4 was the only one containing a network positive. This plate was assembled in a half-formed condition to save time, as indeed is now becoming the common practice. It has frequently been done with the Panthode electrodes, and has hitherto made no difference to their due and proper formation by actual use. At the end of the tests, however, when the cells were dismantled it was found that the positive was still not completely formed.

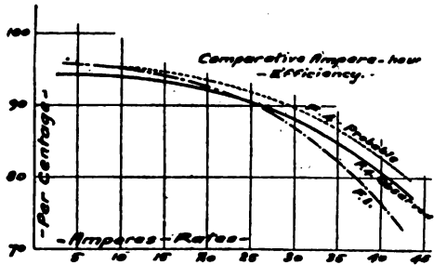


FIG. 14.—COMPARATIVE AMPERE-HOUR EFFICIENCY.

There is little doubt that this was due to an accident which occurred almost at the outset of the work. The cell was to be left on charge all night from 6 P. M. By some mistake the charging dynamo was stopped, so that for fifteen hours the already discharged cell was practically shorted through the silent dynamo. This would not have harmed a fully formed electrode, but in the half-formed state it had the effect of retarding further formation. Under normal conditions a network electrode can be formed very rapidly, because so large a surface can be simultaneously acted upon. A negative network was completely formed in three hours, but, of course, the positive takes longer. The only correction necessary to make is in the efficiency curve. The efficiency is essentially comparative, and required no conversion to the ten-hour rate. In Figs. 14 and 15 the full lines show the observed efficiencies of F_4 and the dotted lines the probable efficiencies. A large number of discharges were taken from all four cells to determine the relative ampere-hour capacities, and the results are shown on Figs. 16, 17 and 18, which give the capacities at various rates for F_1 and F_4. The result is what might be expected. At high rates the advantage is all with the network type of electrode. At very low rates the long, attenuated pores in the ordinary pasted plate for escape of gas and excess of electrolyte to active matter are perhaps sufficient. This, however, becomes a more and more important factor as density of current increases. Although these curves were made from many discharges, it will only be necessary to show several discharge curves for the characteristic of this type of cell to be at once seen.

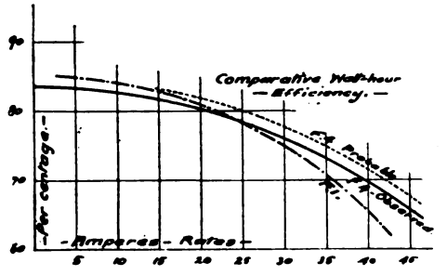


FIG. 15.—COMPARATIVE WATT-HOUR EFFICIENCY.

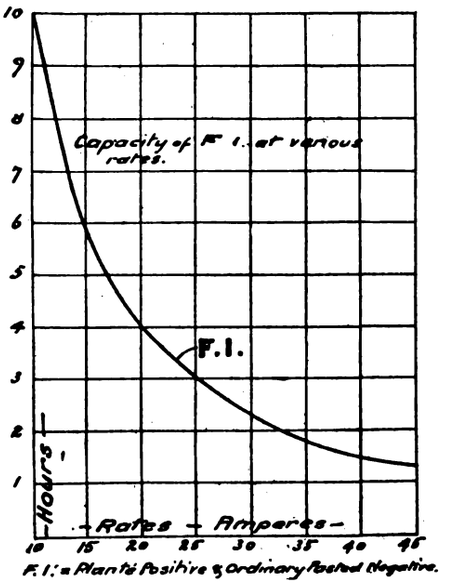


FIG. 16.—AMPERE-HOUR CAPACITY TEST.

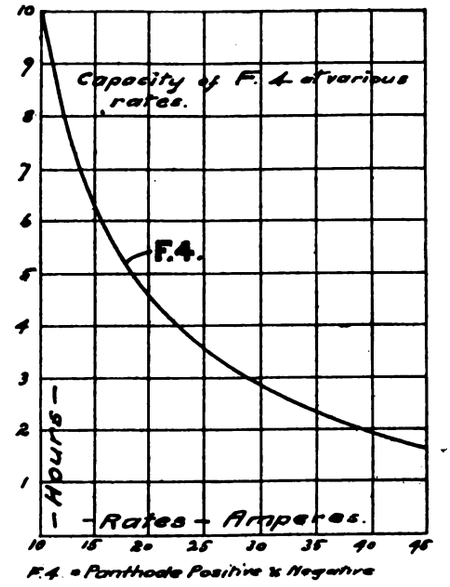


FIG. 17.—AMPERE-HOUR CAPACITY TEST.

It will be observed that in every case the usual sudden drop in the curve is practically absent. It is modified to such an extent that a working current can be obtained from the cell up to the last gasp. This characteristic has also been observed in the Niblett cells. It is a valuable quality in the case of any work which the battery may be called upon to do, but especially so when used to propel electromobiles. From its construction it is also obvious that a network electrode can be more safely discharged to zero, because a dangerously high or dangerously low density of electrolyte is less likely to be produced. The ratio of output to volume of electrode may be roughly considered to be identical with the actual outputs. The network electrodes used in the tests (containing acid space within themselves) filled about the same space as the electrodes in the ordinary cells, plus the acid space between the plates. For instance, an ordinary electrode and glass tube separators may be considered as removed, and the network electrode and thin corrugated, perforated ebonite or asbestos cloth put in its place.

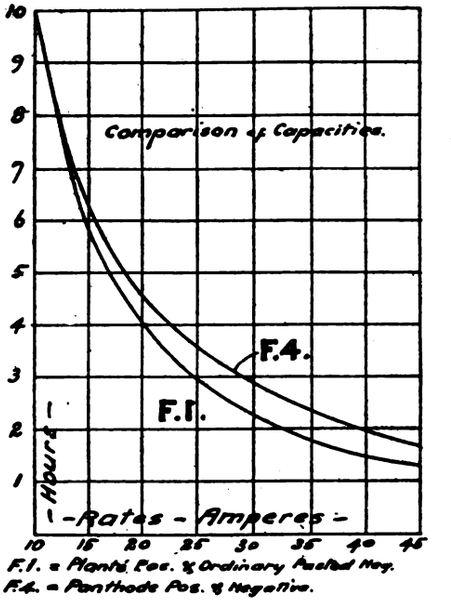


FIG. 18.—COMPARISON OF AMPERE-HOUR CAPACITIES.

Another characteristic of these network electrodes, which came out in the capacity tests, is their remarkable indifference to high rates of charge. This was much more in evidence in the efficiency tests.

Digitized by Google

In order to make the conditions as near as possible to actual practice all the results, whether obtained for the express purpose of determining efficiency or not, were included as material for plotting the comparative efficiency curves. The efficiency cycles were all comparatively short, and were started in a dis-

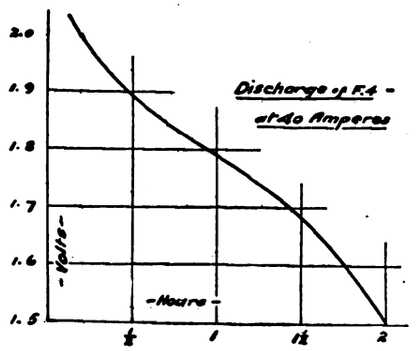


FIG. 19.—DISCHARGE OF F_4 AT FORTY AMPERES.

charged condition—discharged down to the proposed standard cut-off point curve. Take, for instance, a one-hour cycle at a forty-ampere rate; the work would be in the following order:

1. Put cell in discharged condition by discharging at forty amperes down to 1.5 volts.

2. Charge for one hour at forty amperes.

3. Discharge at forty amperes until potential difference equals 1.5 volts.

For a two-hour cycle at the normal rate it would be as follows:

1. Put cell in discharged condition by discharging at seven amperes down to 1.85 volts.

2. Charge for two hours at seven amperes.

3. Discharge at seven amperes down to 1.85 volts.

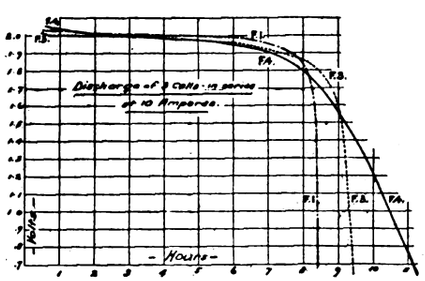


FIG. 20.—DISCHARGE OF THREE CELLS IN SERIES, AT TEN AMPERES.

It has often been attempted to use the open-circuit voltage to mark the start and finish of an efficiency cycle. It has been found, however, that the open-circuit voltage is unreliable as an indication of the electrochemical condition of a cell, and even by the method used, 100 per cent efficiency was sometimes obtained, thus showing how extremely difficult it is under any circumstances to determine the actual electrochemical condition of the cell. The best way is the one the author has adopted, that of taking a number of consecutive charges and discharges at a constant rate, noting every watt that goes in and that comes out. In this diagram of comparative efficiency at all rates, it will be seen that in efficiency, as in output, the network electrode does its best work at high rates. Fig. 19, showing discharge of F_4 at forty amperes, and Fig. 20, showing the discharge of F_1, F_3 and F_4 in series simultaneously, all bear out to a more or less marked extent the characteristic of the network electrode. The tests were intended to be only comparative, so this applies also to resistance. When the cells were in a half-charged condition, the ratio was approximately nine, eight and ten for F_1, F_3 and F_4, respectively. The resistance of F_4 would probably have been much lower if the network positive had been fully formed. F_2 was chosen to test the drop on open circuit, because the outsides of

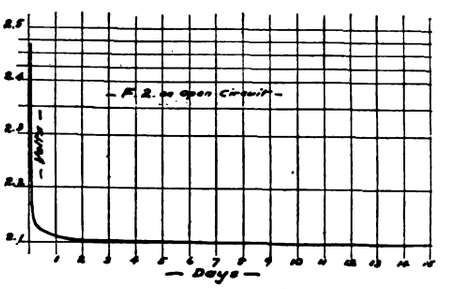


FIG. 21.—DROP ON OPEN CIRCUIT.

electrodes in that cell were covered with perforated lead, and might be expected to suffer most from local action. The result is shown in Fig. 21.

CONCLUSION.

These tests, coupled with the results already obtained, have advanced the matter much in two ways, and have led the author to the following conclusions:

1. That the networks of non-conducting substance and of active matter are each in themselves continuous and homogeneous. The contact between granule and granule (which in the older types of network cells was the cause of so much resistance) is abolished.

2. That the space for electrolyte is also continuous and intercommunicating, so that the gas can now freely escape, and, in addition, provision is made for the access to each particle of active matter of its necessary quota of electrolyte.

There is, however, still one weak point in the network cell, which the Panthode battery or the Niblett solid battery have not completely solved, *viz.*: the contact of the active matter with the conductor for the purpose of leading the current away.

The author has endeavored in particular to explain the various stages of development of network storage cells, and to point out the directions in which improvements are likely to occur, such as the proper regulation of the physical effects, other than the electrochemical effects, which are known to exist, but have not been turned to advantage.

Electric Power in the Transvaal.

It was stated recently that the scheme for the electrical transmission of power from the Victoria Falls of the Zambesi river, Africa, was being held in abeyance, and that plans were being developed to establish a steam-power generating station on the Witwatersrand, the intention being to take up the hydroelectrical development at a later period. On this subject the London *Electrical Review* quotes from a correspondent of the *Frankfurter Zeitung,* who states that there has been a gradual reduction in the data relating to the utilization of the water-power of the Victoria Falls for the production of electrical energy. The rights for developing these falls have belonged for some years to the African Concessions Company, Limited, but nothing has yet been done by the company. More accurate information seems to raise a doubt whether the falls could be depended upon to develop 15,000 horse-power during the dry season. Besides this comparatively small amount, there would be a heavy loss of power in transmitting it over 800 miles through the wilderness. For these reasons it will be necessary, in any case, to erect a steam power-station in the vicinity of the Rand as a reserve, but this would probably become too expensive to be used merely as such. It seems probable that what will be done will be to erect a new power-station, steam-driven, near the Vereeniging coal mines, on the Vaal river. A similar station already exists in the Rand Central Electric Works, on the east of the Rand, near Brakpan, and it is yet undecided whether there is sufficient demand for power to warrant the erection of a second station.

Digitized by Google

Armature Reaction in Polyphase Alternators.

By L. A. Herdt.

IN a paper presented at the nineteenth annual convention of the American Institute of Electrical Engineers in 1902 the writer advocated a method for the predetermination of alternator regulation based upon the principles laid down by Blondel[1] that, when an alternator supplies a current dephased by an angle ϕ with respect to the internal induced electomotive force, the armature reaction may be considered as the result of a direct reaction produced by the wattless component of the current (I sin ϕ), and a transverse reaction due to the watt component of the current (I cos ϕ).

The object in writing another paper on the same subject is to outline an experimental method for the determination of the regulation of alternators under load, based on the above theory.

THEORY OF ARMATURE REACTION.

In a distributed armature winding type of alternator when the field magnets are excited, the field magnetomotive force will set up in the air gap a certain induction distribution. This distribution is approximately sine form, but depends of course on the shape of the pole-pieces and the saturation of the magnetic circuit. The flux set up by the field magnetomotive force revolves with the field structure and its distribution remains practically undisturbed throughout one revolution as with a distributed armature winding, the reluctance of the magnetic circuit for any particular position of the field structure is practically the same.

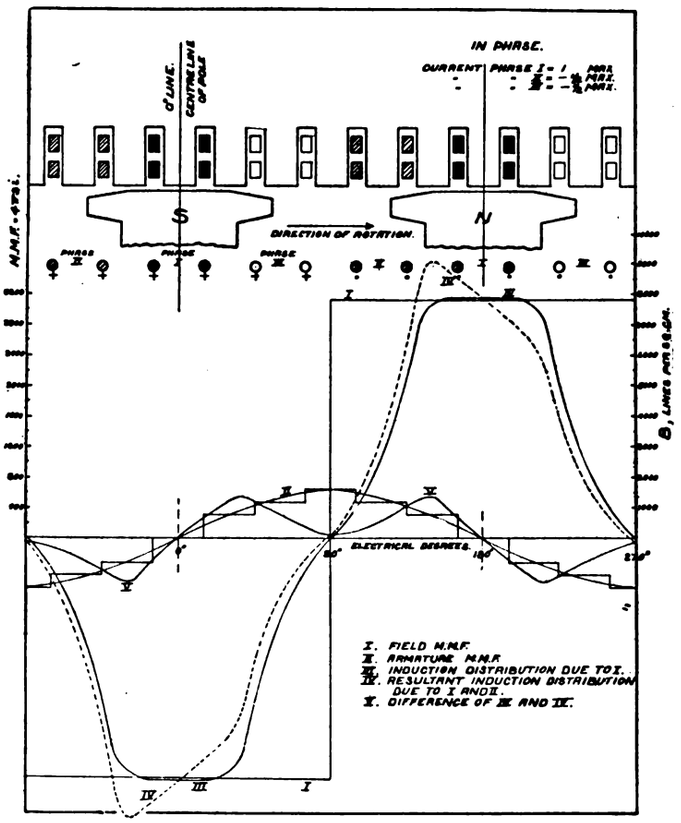

IN PHASE.
CENTRE LINE OF POLE
DIRECTION OF ROTATION.
ELECTRICAL DEGREES.
I. FIELD M.M.F.
II. ARMATURE M.M.F.
III. INDUCTION DISTRIBUTION DUE TO I.
IV. RESULTANT INDUCTION DISTRIBUTION DUE TO I AND II.
V. DIFFERENCE OF II AND IV.

FIG. 1.—ARRANGEMENT OF ARMATURE COILS OF A THREE-PHASE ALTERNATOR.

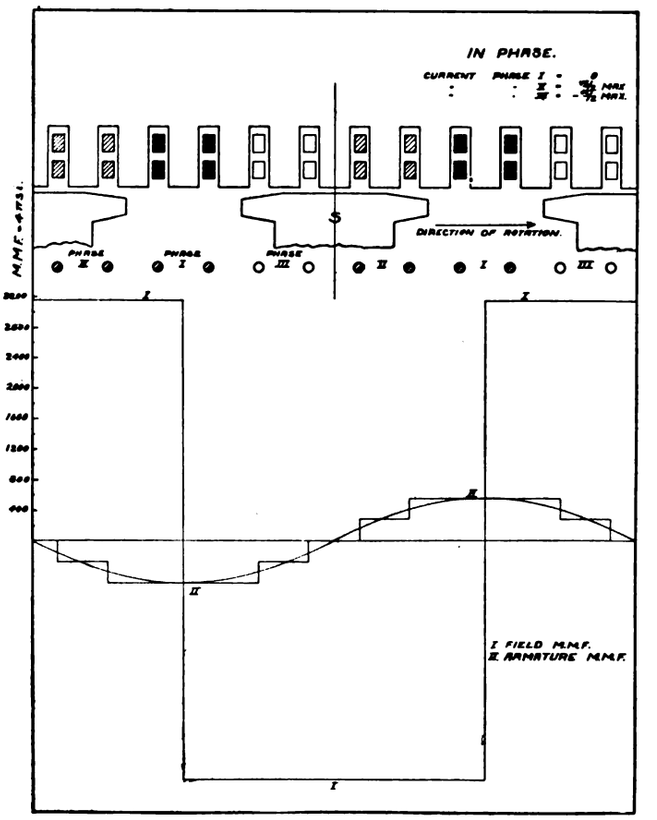


FIG. 2.—SHOWING RELATIVE CHANGES IN POSITION AT ANOTHER INSTANT.

With respect to the stationary armature windings the field flux corresponds to an alternating flux, cutting through the armature coils, increasing and decreasing according to a sine law. The field flux, and the field magnetomotive force as well, can be represented in direction and magnitude by a vector of constant length revolving at the speed of the field structure in revolving field alternators, or fixed in space in revolving armature alternators.

When the armature carries a current, the armature magnetomotive force set up by three-phase currents in the windings is also an alternating function whose form depends upon the type of winding, but in the ordinary type of alternators it does not differ very much from a sine curve. The armature magnetomotive force can therefore also be represented by a vector revolving at the speed of the field structure; the dimension of this vector depends on the strength of the armature current, and the position it occupies relatively to the field magnetomotive force vector depends on the phase angle between the induced electromotive force and the current. With inphase current the armature magnetomotive force rotates ninety degrees behind the field magnetomotive force; that is, in quadrature with it. When the current lags ninety degrees behind the induced electromotive force, the armature vector is at 180 degrees to the field magnetomotive force; that is, in line with it but opposed to it. For other phase displacements between the current and the volts the armature lags or leads the field magnetomotive force by an angle of ninety degrees plus the angle between the current and the induced electromotive force.

Under load these two distinct magnetomotive forces, namely, the field and the armature magnetomotive forces, will set up the resultant induction distribution. The regulation of the alternator evidently depends on the change between the no-load induction and the induction set up

[1] "The Empirical Theory of Alternators," A. Blondel, *L'Industrie Électrique*, 1899.

Digitized by Google

under load. The change from the no-load induction due to a certain value of the armature magnetomotive force will vary with the power-factor; that is, the induction set up by the armature magnetomotive force varies not only with the magnitude of the magnetomotive force but also with the position this magnetomotive force wave occupies relatively to the field-poles.

While in induction motors, for example, the distribution of magnetic induction in the air-gap can be taken directly from the distribution of the magnetomotive force, for the gap length is constant, this will not apply, even to an unsaturated alternator, for the induction set up by the armature magnetomotive force will invariably depend upon the relative position of the armature magnetomotive force wave and the field structure.

ARMATURE REACTION WITH INPHASE CURRENT.

In Fig. 1 is shown the arrangement of the armature coils of a three-phase alternator (two slots per pole per phase).

Curve I is the field magnetomotive force. The armature magnetomotive force produced by three-phase currents assumed of sine form in phases I, II and III for the particular instant stated in the figure and for current assumed inphase with the induced electromotive force, is shown by the right-angled curve II which can be assumed smoothed out to approximate a sine curve.

At any other instant (see Figs. 2, 3 and 4), this armature magnetomotive force changes but little and the position it occupies relatively to the pole-pieces remains unchanged, assuming, of course, that the angle between the volts and the current is not altered.

The induction set up in the air-gap at no-load by the field magnetomotive force (curve I, Fig. 1) is given by curve III. This flux is calculated by taking at every point the value of the magnetomotive force acting and the reluctance is assumed as that equivalent to the air-gap alone. (Experiments that have been carried out on this machine, and which are discussed further on, show that the flux calculated in this way comes very close to the actual distribution determined experimentally.) The flux set up by the armature magnetomotive force is shown by curve V. (The lines across the slots and those which interlink with the end connections are neglected for the present.)

Curve IV is the resultant induction distribution due to the magnetomotive forces I and II. From this figure it is shown that the armature magnetomotive force with inphase current sets up a cross flux increasing the induction in one side of the pole-pieces and diminishing the induction in the other. A change in the distribution of magnetic flux is thus set up by the armature magnetomotive force, but the resultant total induction is but slightly altered. This is specially so with alternators having chamfered pole-pieces, as with inphase current the armature magnetomotive force wave, having its maximum ordinates between the poles, can not set up any marked effect of armature reaction, the reluctance being considerable.

EFFECT OF LAGGING CURRENT UPON ARMATURE REACTION.

In Fig. 5 the same method is applied to determine the distribution of armature magnetomotive force when the current is lagging ninety electrical degrees behind the electromotive force.

The distribution of magnetomotive force is the same as that for inphase currents (see curve II, Fig. 1). The magnetomotive-force wave, however, is displaced by ninety degrees from the position it held for similar values of inphase current. This rotating magnetomotive-force wave is now at 180 degrees to the field magnetomotive force and opposes it.

The induction set up by the armature magnetomotive force with quadrature current is vastly different from that set up by inphase current, although the magnetomotive-force values are unchanged for equal currents. The reluctance of the magnetic circuit is entirely different from

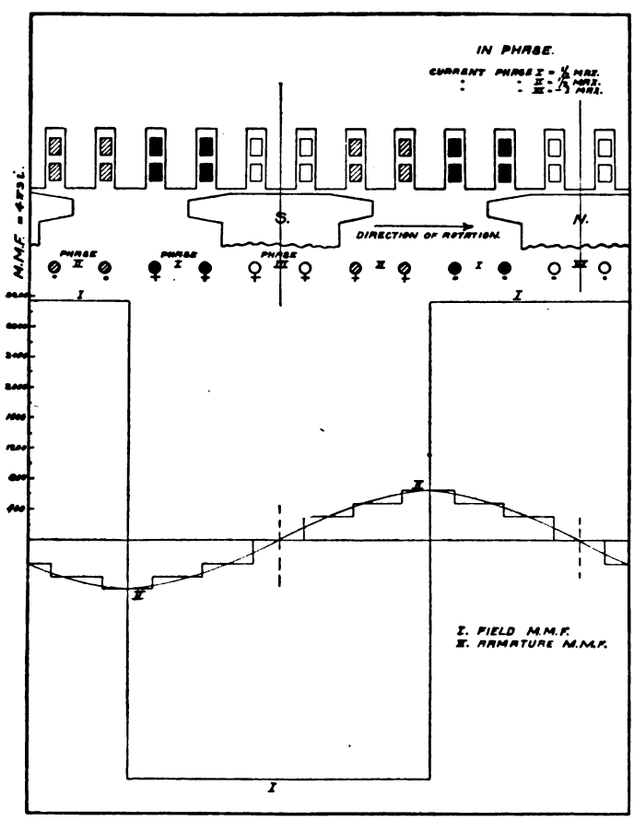


FIG. 3.—RELATIVE CHANGES AT ANOTHER INSTANT.

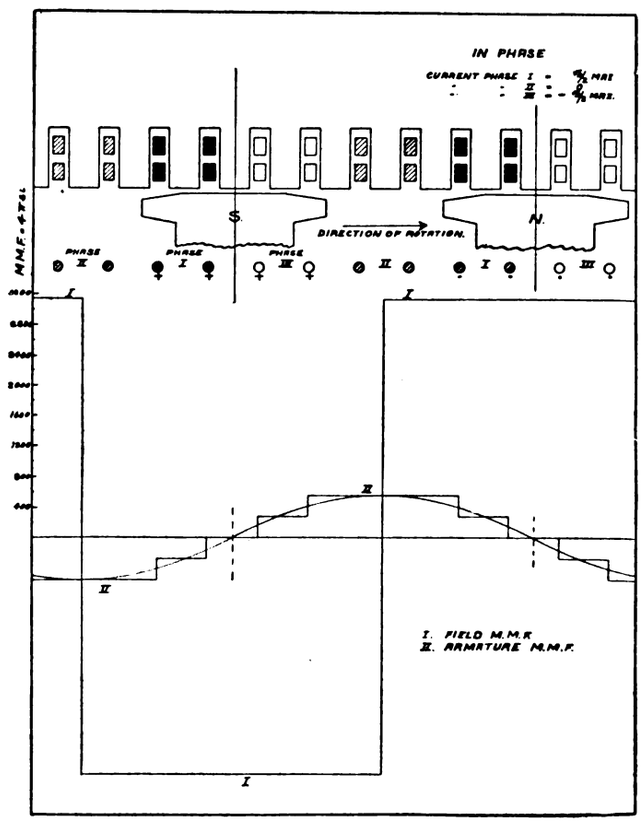


FIG. 4.—RELATIVE CHANGES AT LATER INSTANT.

Digitized by Google

that with inphase current; in this case the maximum ordinates of the armature magnetomotive-force wave act over the pole centres and the armature magnetomotive force is now directly opposed to the magnetomotive force; the reluctance of the magnetic circuit is that of the machine.

It is thus shown that the induction set up by an armature magnetomotive force with quadrature currents is greater than that set up by an equal amount of inphase current, also that the effect of the armature current in diminishing the no-load induction and varying its distribution depends on the phase relation of the electromotive force and current.

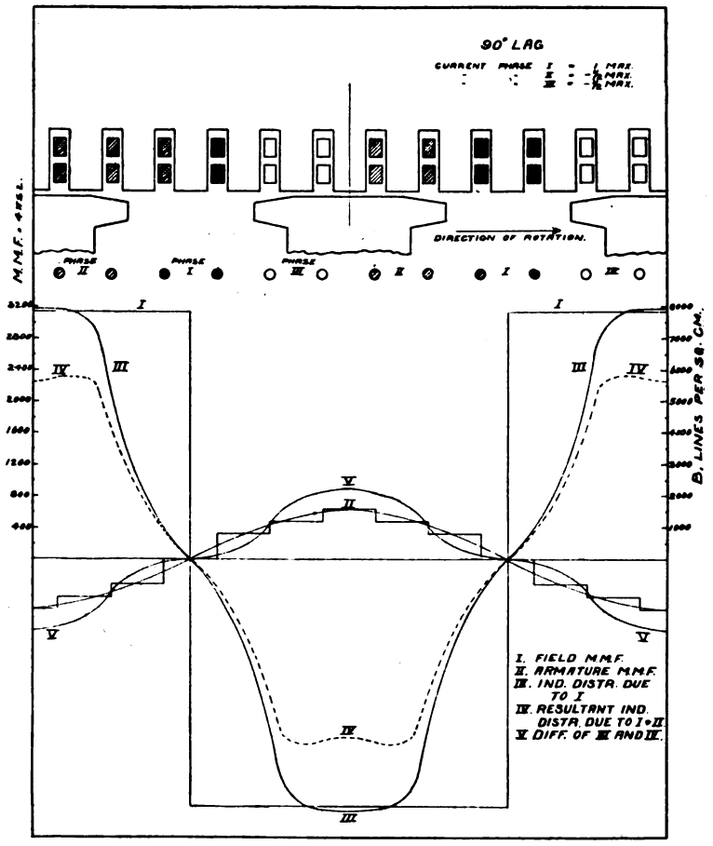

90° LAG
DIRECTION OF ROTATION.
I. FIELD M.M.F.
II. ARMATURE M.M.F.
III. IND. DISTR. DUE TO I
IV. RESULTANT IND. DISTR. DUE TO I+II
V. DIFF. OF III AND IV.
B, LINES PER SQ. CM.

FIG. 5.—DISTRIBUTION OF ARMATURE MAGNETOMOTIVE FORCE, WITH CURRENT LAGGING NINETY ELECTRICAL DEGREES BEHIND ELECTROMOTIVE FORCE.

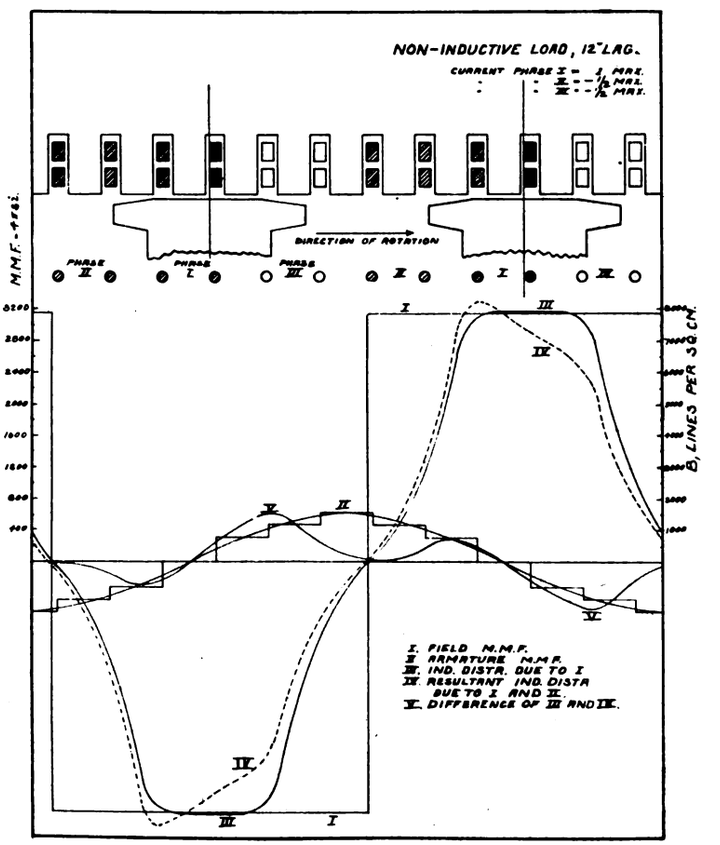

NON-INDUCTIVE LOAD, 12° LAG.
DIRECTION OF ROTATION
I. FIELD M.M.F.
II. ARMATURE M.M.F.
III. IND. DISTR. DUE TO I
IV. RESULTANT IND. DISTR. DUE TO I AND II.
V. DIFFERENCE OF III AND IV.
B, LINES PER SQ. CM.

FIG. 6.—ARMATURE MAGNETOMOTIVE FORCE FOR NON-INDUCTIVE LOAD.

ARMATURE REACTION FOR NON-INDUCTIVE LOAD AND INDUCTIVE LOAD THEORETICALLY AND EXPERIMENTALLY DETERMINED.

The effect of the armature magnetomotive force on the no-load induction distribution has also been worked out (1, for non-inductive load, Fig. 6; 2, for an inductive load of power-factor sixty-two per cent, Fig. 7).

In the first case the current lags behind the total induced electromotive force by twelve degrees, in the second case the current lags fifty-two degrees. The different effects of the armature reaction for these two particular loads, the magnetomotive forces being equal, are shown by curve V on both figures. The effect of the lagging current in diminishing the total induction is well marked.

As previously stated, these curves are all calculated curves. Experiments were carried out to obtain these curves experimentally and to compare them with the calculated curves.

In Fig. 8 is shown the no-load induction distribution for a certain value of the field magnetomotive force.

Curve I is the calculated or predetermined curve used before. Curve II is the same curve obtained experimentally. The induction distribution with non-inductive load experimentally determined and calculated is shown in Fig. 9, and for inductive load fifty-two degrees lag in Fig. 10. These curves show that the effects of armature reaction can be calculated very closely.

ARMATURE REACTION.

The above discussion shows that armature reaction, including the cross-magnetizing effect, the demagnetizing effect, and the armature leakage, can not be expressed as an equivalent reactance, irrespectively of the lag or lead of the armature current. Any method to predetermine correctly the regulation of an alternator that does not take into account these separate effects of the armature magnetomotive force must be incorrect.

When the armature current lags behind the nominal induced electromotive force by an angle between zero and ninety degrees we may regard the armature magnetomotive force as made up of two components, a quadrature component and an inphase component.

DIRECT REACTION.

The quadrature component of the magnetomotive-force wave has its maximum ordinates over the pole centres and sets up the demagnetizing effect. This can be expressed either in ampere-turns and the demagnetizing effect measured off as KNI sin ϕ, ϕ being the phase angle between the current and the volts, or as an equivalent reactance X_1 and this multiplied by I sin ϕ, the quadrature current (I sin ϕ X_1), will give the demagnetizing effect. The value of X_1 can be experimentally determined, as will be shown presently.

TRANSVERSE REACTION.

The inphase component of the magnetomotive-force wave has its maximum ordinates midway between the pole centres and sets up the cross-magnetizing effect. This is equal to a constant X_2, and this

Digitized by Google

multiplied by I cos ϕ the inphase current (I cos ϕ X_2) expresses the cross-magnetizing effect due to the inphase current.

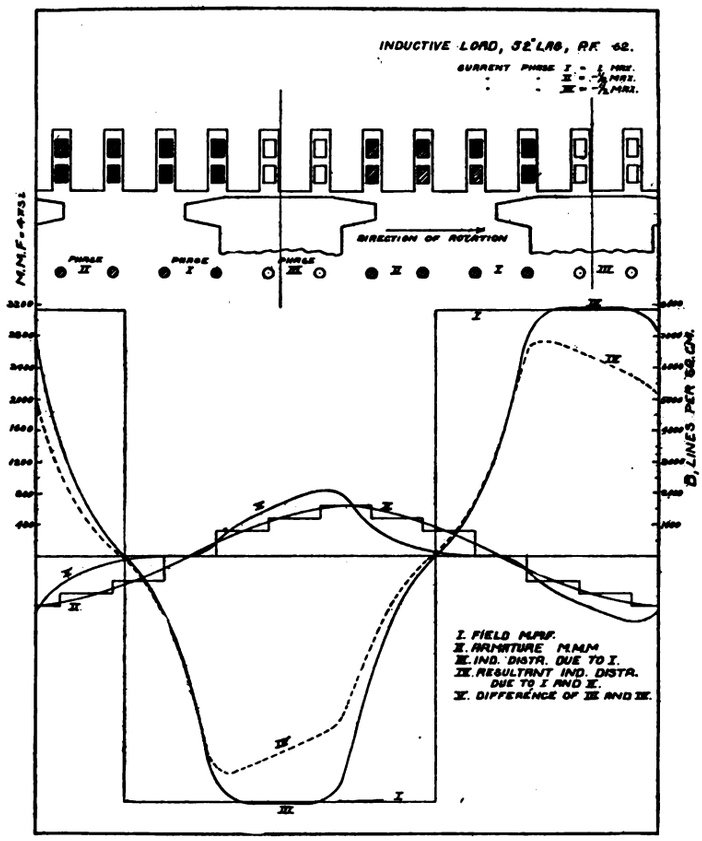

INDUCTIVE LOAD, 52° LAG, P.F. 62.
DIRECTION OF ROTATION
I. FIELD M.M.F.
II. ARMATURE M.M.F.
III. IND. DISTR. DUE TO I.
IV. RESULTANT IND. DISTR. DUE TO I AND II.
V. DIFFERENCE OF III AND IV.

FIG. 7.—ARMATURE MAGNETOMOTIVE FORCE FOR INDUCTIVE LOAD OF POWER FACTOR 0 62.

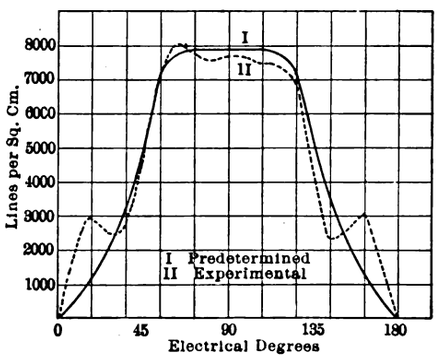


FIG. 8.—NO LOAD INDUCTION DISTRIBUTION.

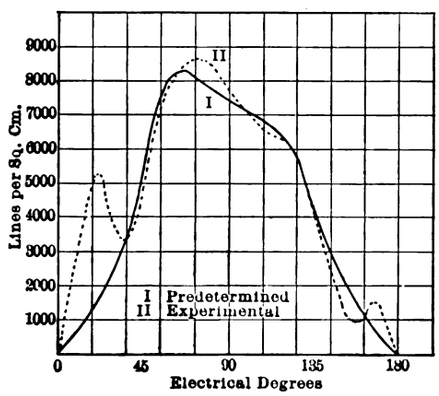


FIG. 9.—NON-INDUCTIVE LOAD, TWELVE DEGREES LAG.

The value of X_2 can also be experimentally determined.

LEAKAGE REACTANCE.

The leakage flux encircling the armature conductors is entirely independent of the lag or lead of the current, but as it varies directly with the current it can be expressed in the form of IX_3, X_3 being an equivalent reactance.

EXPERIMENTAL DETERMINATION OF X_1, X_2 AND X_3.

Demagnetizing Component of Armature Reactance (X_1)—X_1 can be determined experimentally by working the alternator on a purely reactive load so that the demagnetizing effects of varying quadrature armature currents with full field excitation are determined. It is advisable as stated to determine these effects with full field excitation and not an excitation just sufficient to circulate full-load current through the armature short-circuited as is ordinarily done. X_1 is essentially variable for different armature current intensities on account of the saturation of the iron.

Cross-Magnetizing Effect of Armature Reaction (X_2)—X_2 can not be taken at a

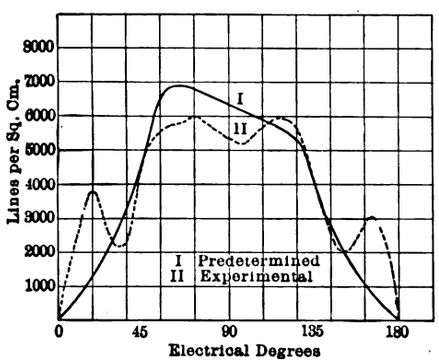


FIG. 10—INDUCTIVE LOAD, FIFTY-TWO DEGREES LAG, POWER FACTOR, 0.62.

value equal to the synchronous reactance X_1 obtained in the test with quadrature current. It is, however, proportional to X_1; that is,

Knowing X_1, the ratio of these two reluctances is all that is required. This value is determined experimentally as fol-

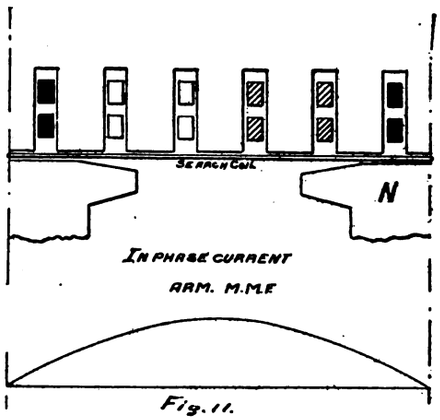


Fig. 11.

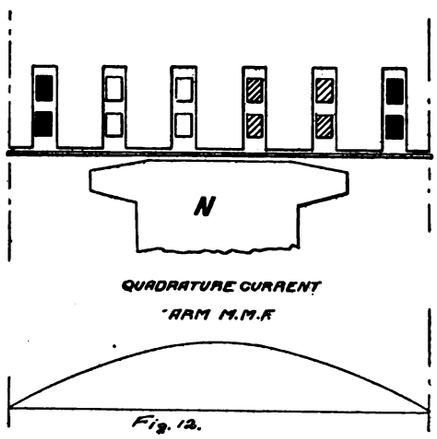


Fig. 12.

FIGS. 11 AND 12.—RELUCTANCE OF MAGNETIC CIRCUIT.

lows: A search coil of width equal to the pole pitch and encircling the armature is placed in the air-gap and connected to a galvanometer or voltmeter; the fields are excited. A direct current equal to I maximum value is passed in phase I, and half maximum values in phases II and III; the poles are placed first in position, relatively to the search coil, as shown in Fig. 11, the armature current is reversed or broken, the poles are then placed in position relatively to the search coil as shown in Fig. 12 and the armature current again broken or reversed. The ratio of the deflections of the galvanometer or voltmeter is the ratio referred to above. X_2 is thus obtained.

Armature Leakage Flux (X_3)—This flux can be determined theoretically but with difficulty. Experimentally it can be determined by measuring the reactance per phase of the alternator with the field magnets removed.

The reactance X_2 obtained in this way multiplied by the armature current I

$$\frac{X_2}{X_1} = \frac{\text{reluctance of magnetic circuit poles placed as shown in Fig. 11.}}{\text{reluctance of magnetic circuit poles placed as shown in Fig. 12.}}$$

Digitized by Google

gives the value of the electromotive force of self-induction set up (IX_2). The electromotive force acts in quadrature with the current.

ALTERNATOR DIAGRAM.

Using the values so obtained for the demagnetizing and cross-magnetizing components of synchronous reactance and for armature leakage reactance, the following diagram properly expresses the relation of electromotive forces and current in the armature of an alternator under load.

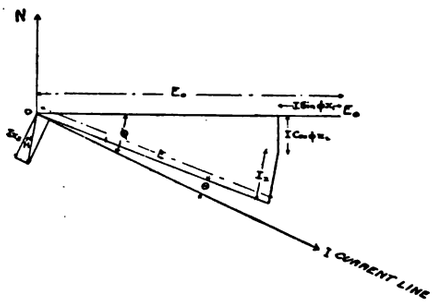


FIGURE.—RELATION OF ELECTROMOTIVE FORCES AND CURRENT IN ARMATURE OF ALTERNATOR UNDER LOAD.

The line ON represents in direction and magnitude the field flux; this field flux sets up to total induced electromotive force (E_o); that is, the no-load electromotive force.

r = resistance of armature.

X_2 = reactance due to leakage flux alone.

I_r = the electromotive force of resistance drop set off on the current line.

IX_2 = the electromotive force set off at right angles to the current.

Iz = drop due to leakage reactance and armature resistance.

$I \sin \phi X_1$ = drop of potential due to the demagnetizing effect of the quadrature armature current that is set off along E_o line and opposing it.

$I \cos \phi X_2$ = the electromotive force set up by the cross-magnetizing effect of the inphase armature current; this is set off at right angles to E_o.

Combining all these electromotive forces, the terminal voltage E is obtained.

This method applied to a number of alternators has been found to give very accurate results. The application of this method to a number of alternators will be discussed in a paper to appear shortly.

ATHLETIC SPORTS FOR OPERATORS.

BY J. E. PEAVEY.

To be successful in the pursuit of any business or profession, it is very essential that the individual should be possessed with robust health and an amiable disposition. Of all vocations, there is none that requires these qualifications so much as the telephone operator. Her position is more or less confining, and her duties do not alone demand quickness and accuracy in her work, but she must be above all things courteous, never showing a trace of irritability, detection of which in her voice or manner would in many cases make a lasting enemy to her company of some restless, impatient and inconsiderate telephone patron, whom she has daily to deal with. In fact, she should have the disposition of an angel; her voice and manner at all times and under all circumstances being as balm to the troubled waters.

TELEPHONE OPERATORS OF THE CINCINNATI BELL TELEPHONE COMPANY EXERCISING.

To establish a well-disciplined and efficient operating force, it behooves every employé to lose as little time as possible from their work. Failure to promptly report for duty regularly will demoralize the entire force and service. To provide for these qualifications and requirements, all well-regulated telephone companies select from the various applications those that are the most robust and intelligent, and, in order to stimulate an interest in their work, provide comfortable quarters, containing books and games, and in order to further provide for their health and its consequent blessings where possible, gardens and playgrounds are provided. But above all forms of amusement and entertainment athletic sports are the most popular and far-reaching in its beneficial results, chief among which is the punching-bag shown in accompanying illustration. This photograph was taken at the West exchange of the Cincinnati & Suburban Bell Telephone Company, Cincinnati, Ohio, and shows an operator in the act of using it. These punching-bags have been in service for some time, and at no time has interest in them lagged; in fact, they are overworked, maintenance being the only objectionable feature in their use. Many operators soon become expert in manipulating the bag, and all take a hearty interest in this healthful and fascinating exercise.

Digitized by Google

Electrical Equipment of the Erie Railroad Shops at Hornell (Hornellsville), N. Y.

THE operation of machine tools by electric motors has an exceedingly wide field, but no class of manufacturing establishments exemplifies the adaptability of electric drive more than railroad shops. The large work handled necessitates extensive buildings and the use of great lengths of shafting and belting if power is transmitted mechanically from a central source. Rush repair jobs are frequent and require a great deal of overtime and Sunday work, when power requirements are small, as but sufficient machinery is operated to complete the particular work at hand. Mechanical transmission of power under such conditions is wasteful in the extreme, owing to the surplus power required to overcome the friction of shafting and belting throughout the shops. Where electric drive is used—either individual or group—a flexibility is obtained that can not be secured by any other means, as it permits the use of a few machines independently, obviating the objectionable features enumerated and permitting operation with a minimum power-house' capacity, thereby effecting a considerable saving in fuel.

There are many other considerations in connection with power transmission, one of the most prominent being the layout of the plant, which is especially important in a railroad shop, as it is generally made up of a number of separate buildings aside from the main machine and erecting shop, such as boiler shop, carpenter shop, tank shop, blacksmith shop, pipe shop, etc., which are necessarily scattered, widely distributing the power requirements and necessitating the use of a number of prime movers. Where engines are used, steam is supplied either from a central boiler plant or by individual boilers forming a combination unit with the engine. The former arrangement is poor from an economical standpoint owing to the low efficiency resulting from the usual excessive condensation which takes place in long lengths of steam pipe. Either method involves the expense of skilled attendants, which amounts to a considerable sum annually. These conditions are, however, rapidly changing; electric motors are superseding steam equipments and have many times proved that they fill all requirements—reducing operating expenses, requiring a very small amount of attention, providing power that is perfectly reliable, and reducing the time of starting and stopping and changing speed to a minimum.

Other applications may be found in cranes and in transfer and turntables, where the electric motor is superior to every other motive gear, owing to its ease of control, efficiency and reliability.

It was these considerations that led the Erie Railroad Company to abandon mechanical transmission of power and adopt the electric drive at its Hornell shops, which now utilize electric power entirely and furnish an excellent example of the expediency and use of both individual and group drive.

When the present management took charge of the Erie Railroad it adopted broad and comprehensive plans for the development of the entire property, which are rapidly making it one of the most modern and efficient railway systems in the country. These plans embraced extensive alterations and additions to the many shops of the system in order to enable them to respond rapidly and efficiently to the increasing demands made upon them by the necessary additions to the rolling equipment.

New shop buildings and roundhouses have been constructed, old machines replaced by new, an efficient shop organization effected and the entire mechanical department brought up to a high standard of efficiency. This work, under the direction of E. A. Williams, general mechanical superintendent, and G. W. Wilden, mechanical superintendent, has been carried on at many different points on the system, but the most extensive single installation of modern shop equipment is at the Hornell shops, located at Hornell, N. Y. At this point new buildings have been erected, additions made to old buildings, a new power-house erected and a large number of new machine tools, with a complete system of electric drive, installed. This installation is an interesting and instructive illustration of the latest engineering practice for a railway shop, where the largest proportion of power is required at short distances from the power-house and a large proportion of variable-speed and crane load is required.

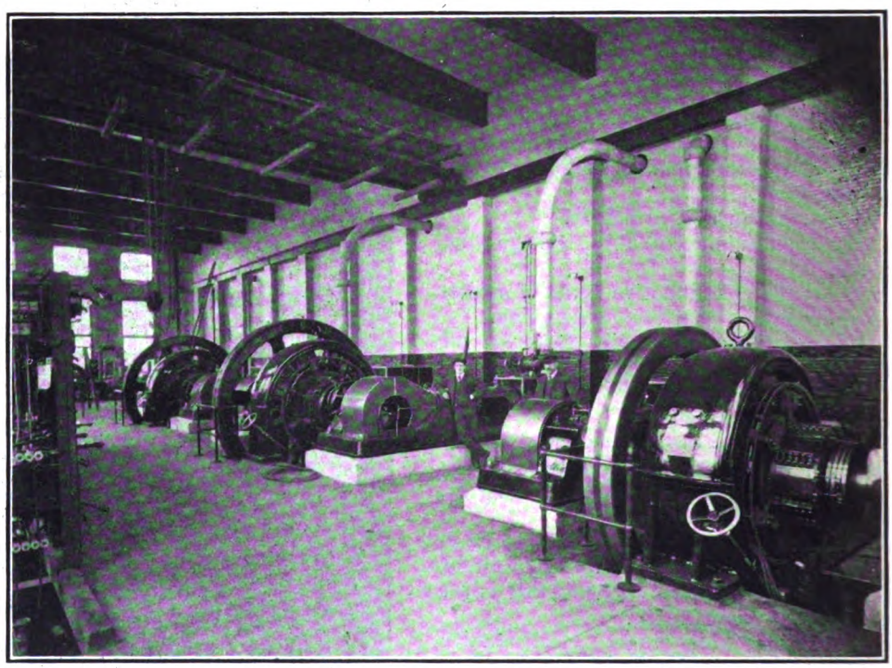


FIG. 1.—INTERIOR OF POWER-HOUSE, ERIE RAILROAD SHOPS, HORNELL, N. Y.

Before making a final decision as to the type of electrical apparatus to be installed, a careful comparison was made relative to the advantages and disadvantages of both the alternating-current and direct-current types of apparatus for the service contemplated. This analysis included not only the motors themselves, but also the various accessories, such as wiring, controllers, etc. Due considera-

Digitized by Google

tion was also given to an installation involving the use of both alternating and direct-current motors, but while it appeared probable that at some time in the future an equipment of this nature would be necessary, it was decided that present conditions do not justify the installation of both types of motors. Under the conditions existing at Hornell it is apparent that all of the motors are located well within the limits of 220 volts distribution, and in addition that there is at this time no woodworking shop in existence, therefore it was finally resolved to make the installation consist entirely of direct-current apparatus with the exception of a small generator set which is used to supply the current necessary for the present yard and depot lights. This installation is an excellent illustration of the principle that each railroad shop must be considered as a separate and independent problem, and it is impossible to lay down any hard and fast rules which can be taken as a guide, but that each particular case must be thoroughly investigated and a final decision reached in conformity with the conditions existing at that point.

As indicated above, the enlargement of the power-house at some future time has not only been contemplated but provided for. The type of apparatus to be placed in the engine room, however, will be determined upon at the time of making the addition, as the present system can readily be expanded in either of two ways. Additional power can be obtained by the installation of the necessary capacity, either in an alternating-current generator which would supply the lines direct, the present motor-generator set acting as a tie between the present units and the future one, or a direct-current generator, with the necessary transforming apparatus for alternating current, can be installed if it is found that conditions demand that this be done.

The power-house is a large brick structure of fireproof construction, with concrete roof and flooring, and has ample provision for light and ventilation. The building is large enough to provide for future extensions, foundations already being in place for doubling the boiler capacity, so that it is only necessary to erect the additional units. The interior of the power-house, showing the engines and generators, is shown in Fig. 1. The boiler plant consists of four Babcock & Wilcox units of 400 horse-power, operating at 150 pounds pressure and equipped with chain grates. All live-steam mains are provided with the Holley drip system. The coal handling and stoking is especially interesting as, from the time the coal is dumped from the cars until it is fed into the furnace, it is conveyed automatically. The coal passes from the car into a chute which empties into a crusher, and is then conveyed by an endless belt to the top of the power-house, where it passes through another chute to the second conveyer that distributes it in the bunkers over the boiler room. From there the coal passes through chutes to hoppers in front of the furnaces, where it is fed into the chain grates. The amount of coal admitted into the hoppers is controlled in the boiler room by means of levers. The conveyers, which were manufactured by the Exeter Machine Company, have a capacity of sixty tons per hour and are operated by a ten-horse-power and a thirteen-and-one-half-horse-power Westinghouse type S motor. The coal crusher is operated by a twenty-horse-power type S motor.

The generating equipment consists of three Ball & Wood cross-compound, high-speed condensing engines, two of 500-horse-power each, direct-connected to a Westinghouse 300-kilowatt, direct-current, 250-volt, three-wire generator, running at 150 revolutions per minute, and one of 400 horse-power, direct-connected to a similar generator of 200 kilowatts capacity operating at 200 revolutions per minute. The engines run condensing except in cold weather, when the exhaust steam is utilized in heating the shops. Water for condensing purposes is stored in a large well, which derives its supply from a small river near the power-house.

Besides the generating equipment and pumps there are two Ingersoll-Sargent compound air-compressors that furnish compressed air to the pneumatic hammers in the shops.

A motor-generator set supplies current for the yard and depot lights. It consists of a 115-horse-power motor, direct-connected to a seventy-five-kilowatt, two-phase, sixty-cycle, 1,040-volt, revolving-field alternator, operating at 900 revolutions per minute.

A standard switchboard, shown in Fig. 2, is provided with motor-generator panels, direct-current generator panels, feeder panels and a load panel, two blank panels providing for future extensions.

There are three motor-generator panels, two alternating-current and one direct-current or motor panel. The alternating-current generator panel is provided with one indicating wattmeter, one ammeter, one voltmeter, one type F oil-switch, a rheostat and the usual smaller instruments. The feeder panel is equipped with one power-factor meter and two type F oil-switches. Mounted upon the motor panel is a circuit-breaker, an ammeter, a field rheostat and a motor-starting switch. The three generator panels are provided with the usual apparatus for a three-wire installation. The load panel is equipped with two switchboard-type integrating wattmeters, two ammeters and two voltmeters.

The six feeder panels control six circuits as follows: circuit No. 1—new erecting shop, 120-ton crane and transfer table;

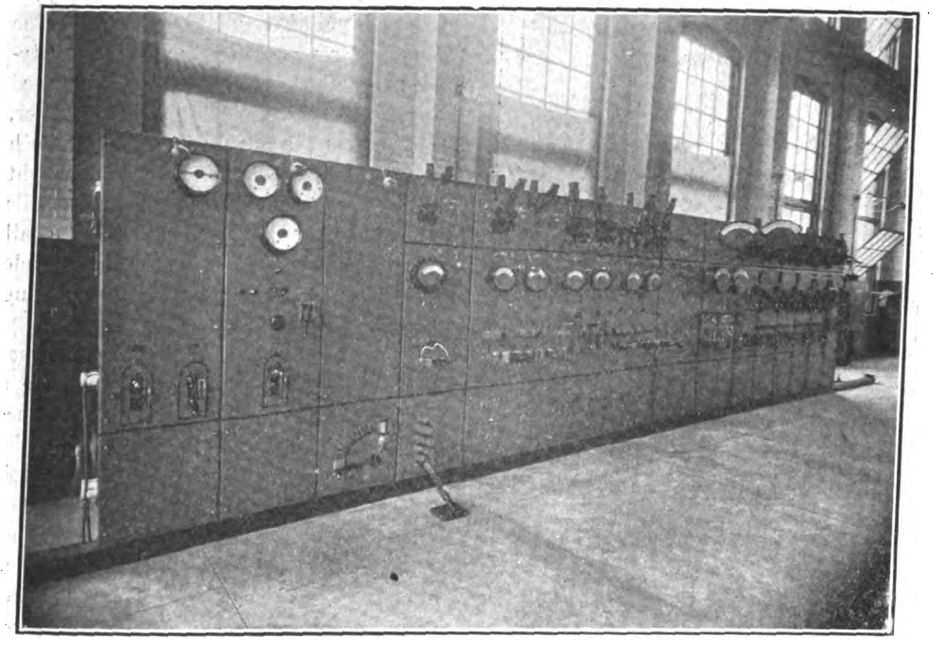


FIG. 2.—SWITCHBOARD, ERIE RAILROAD SHOPS, HORNELL, N. Y.

Digitized by Google

circuit No. 2—carpenter-shop, blacksmith-shop, new boiler-shop and tank-shop motors; circuit No. 3—roundhouse turntable, machine-shop, coal-pocket and ashpit motors; circuit No. 4—all line-shaft motors; circuit No. 5—individual-drive motors; circuit No. 6—motors in powerhouse for coal-conveying apparatus. Each feeder panel is also provided with switches for controlling the various lighting circuits.

Current is transmitted by cables through a large tunnel to the new erecting shop and thence through underground conduits to the various buildings. The three-wire system of distribution is used for lighting and power, with an electromotive force of 250 volts between outside wires and 125 volts between each outside wire and neutral. There is a decided advantage in the flexibility of the voltage, as incandescent and Cooper Hewitt lamps are operated on the 125-volt sides of the system, and constant-speed, 250-volt motors are connected to the main or outside wires while the variable-speed motors utilize shunt-field control. The switchboard and all of the motors referred to below are of Westinghouse design.

The old erecting shop utilizes both group and individual drive, the group-driven machines being divided into five sections and operated by five type S constant-speed motors, two of thirty-horse-power capacity and three of fifty-horse-power capacity. The machines in the fitting shop, which occupies one wing of the erecting shop, are also group driven by a thirty-horse-power, constant-speed, type S motor. A complete list of the machine tools operated in each section is given below:

Section 1—Fifty-horse-power, constant-speed, type S motor—Wheel press, 100 tons capacity; wheel press, 300 tons capacity; car-wheel borer, double car-axle lathe, single car-axle lathe, four-spindle drill, horizontal boring machine, twenty-four-inch engine lathe, eighty-inch driving-wheel lathe, two sixteen-inch engine lathes, eighteen-inch engine lathe, fifteen-inch engine lathe, ten-inch slotter, No. 4 plain milling machine, fifty-three-inch vertical boring mill, forty-two-inch vertical boring mill, thirty-seven-inch vertical boring mill, thirty-six-inch upright drill, twenty-eight-inch upright drill, twenty-four-inch pillar shaper, thirty-two-inch by thirty-two-inch by eight-foot planer, one-and-one-half-inch by twenty-four-inch turret lathe, ninety-inch quartering machine, duplex emery grinder, seven-spindle nut tapper, forty-inch upright drill, small flange punch.

Section 2—Thirty-horse-power, constant-speed, type S motor—Sixty-inch by sixty-inch by nineteen-foot planer, five-foot radial drill, four-foot radial drill, eighteen-inch slotter, two two-inch double bolt cutters, one-and-one-half-inch stay-bolt cutter, twelve-inch slotter, two-spindle centering machine, slab milling machine, forty-inch drilling, facing and tapping machine, duplex emery grinder, triple head slotter, forty-inch upright drill, two sixteen-inch engine lathes, one one-and-one-half-inch bolt pointer.

Section 3—Fifty-horse-power, constant-speed, type S motor—Forty-two-inch by forty-two-inch by eighteen-foot planer, ring turret lathe, forty-eight-inch upright drill, forty-two-inch engine lathe, thirty-inch engine lathe, twenty-four-inch engine lathe, crank planer, twenty-inch by twenty-inch by twenty-four-foot; two-inch by twenty-six-inch turret lathe, thirty-six-inch engine lathe, thirty-six-inch engine lathe, horizontal boring machine, horizontal boring machine, fourteen-inch engine lathe, two sixteen-inch engine lathes, forty-two-inch vertical boring machine, forty-inch upright drill, thirty-two-inch by thirty-two-inch by eight-foot planer, five-inch radial, double-head traverse shaper, No. 4 plain milling machine, twenty-six-inch engine lathe, thirty-inch engine lathe.

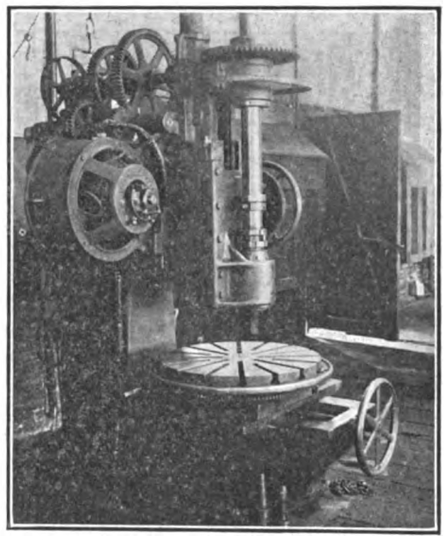


FIG. 3 —SEVEN-AND-ONE-HALF HORSE POWER MOTOR OPERATING VERTICAL MILLER, ERIE RAILROAD SHOPS, HORNELL, N. Y.

Section 4—Fifty-horse-power, constant-speed, type S motor—Sixteen-inch engine lathe, twenty-four-inch engine lathe, twenty-four-inch pillar shaper, friction drill, thirty-six-inch by thirty-six-inch by ten-foot planer, thirty-six-inch by thirty-six-inch by eight-foot planer, thirty-two-inch by thirty-two-inch by eight-foot planer, twenty-inch engine lathe, eighteen-inch engine lathe, sixteen-inch engine lathe, twenty-four-inch engine lathe, cylinder boring machine, No. 17 Landis grinding machine, forty-two-inch vertical boring machine, thirty-six-inch upright drill, twenty-eight-inch upright drill, forty-eight-inch upright drill, thirty-six-inch engine lathe, thirty-inch engine lathe, two Fox turret lathes, eighty-six-inch vertical boring machine, duplex emery grinder.

Section 5—Thirty-horse-power, constant-speed, type S motor—two-inch by twenty-six-inch turret lathe, twenty-inch American brass lathe, twenty-four-inch engine lathe, eighteen-inch slotter, key-slot milling machine, thirty-inch engine lathe (piston rods), thirty-six-inch by thirty-six-inch by ten-foot planer.

Fitting Shop—Thirty-horse-power, constant-speed, type S motor—Twenty-eight-inch upright drill, thirty-ton arbor press, thirty-six-inch by thirty-six-inch by eight-foot planer, thirty-seven-inch vertical boring machine, three eighteen-inch engine lathes, sixteen-inch engine lathe, thirty-inch engine lathe, eleven-inch bench speed lathe, twenty-four-inch pillar shaper, crank planer, twenty-inch by twenty-inch by twenty-four-foot; forty-inch upright drill, fifteen-ton arbor press, two-spindle centering machine, buffing wheel, small emery grinder, surface grinder, guide grinder, polishing tape and wheel, swing grinder, friction drill.

In addition to the group-driven machines in the erecting shop, there are a number of individually driven machines operated by both constant and variable-speed Westinghouse type S motors, as follows:

Constant-speed motor-driven machines—One twenty-horse-power motor driving a planer, one thirteen-horse-power motor direct-connected to 600-ton wheel press, one seven-and-one-half-horse-power motor for moving tail-stock of driving-wheel lathe.

Variable-speed motor-driven machines—One seven-and-one-half-horse-power motor operating vertical miller for side-rods, one twenty-horse-power and one six-horse-power motor operating ninety-inch boring mill, one twenty-horse-power motor operating driving-axle lathe, one seven-and-one-half-horse-power motor operating crank-pin lathe, one forty-horse-power motor operating ninety-inch driving-wheel lathe, one twenty-five-horse-power motor driving truck-tire lathe.

The speed of these motors is controlled by varying the field strength, and, as this may be done while the machine is in opera-

Digitized by Google

tion, it affords an easy and convenient method of speed regulation always under the immediate control of the operator, the controller being conveniently placed within his reach. The variation of field strength is effected by means of a resistance placed in the shunt-field circuit of the motor, which decreases the shunt-field current and causes a decrease in the field strength and an increase in speed, producing an extremely simple and effective means of varying the speed of either a shunt or a compound-wound motor.

paratus, thus materially reducing the first cost of an installation. The regulation of motors operating by shunt-field control is good, which is of special importance in the operation of machine tools and in service of any class where constant speed is desirable and where the torque varies between wide limits. The efficiency of motors operating at variable speeds remains practically constant over the range of speed.

Having considered the erecting-shop equipment, the smaller shops next receive

reamer and cutter grinder, Gardner disc grinder.

Carpenter Shop — Fifty-horse-power, constant-speed, type S motor—Hollow-chisel mortiser and boring machine, gaining machine, two-spindle shaper, molding machine, twenty-four-inch by fourteen-inch by nine-foot Daniels' planer, plain mortiser and borer, eight-inch by fourteen-inch planer, three cutters; eighteen-inch rip saw, twelve-inch rip saw, forty-two-inch band saw, twelve-inch cutting-off saw, single horizontal borer, tenoning machine,

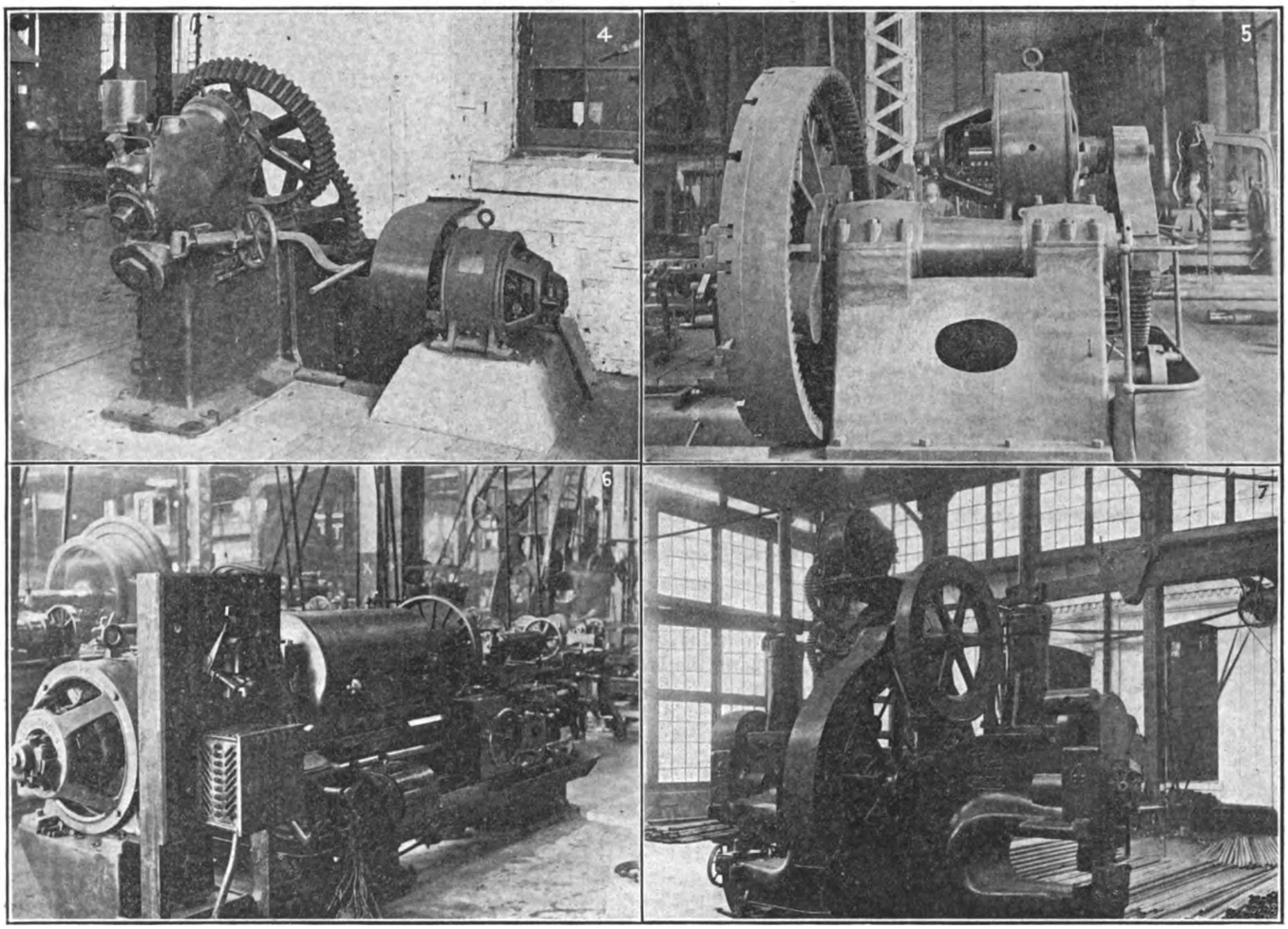


FIG. 4.—SEVEN-AND-ONE-HALF HORSE-POWER MOTOR, OPERATING LENOX BEVEL SHEARS. FIG. 5.—FORTY-HORSE-POWER MOTOR OPERATING NILES DRIVE-WHEEL LATHE. FIG. 6.—SEVEN-AND-ONE-HALF HORSE-POWER MOTOR OPERATING CRANK-PIN LATHE. FIG. 7.—SEVEN-AND-ONE-HALF HORSE-POWER MOTOR OPERATING HILLIS & JONES COMBINED PUNCH AND SHEARS.

One of the most prominent characteristics of this method of control is the simplicity and low cost of control apparatus made possible by the extremely small current which is handled. A second marked characteristic is the increase of speed with decrease of torque, when used as an adjustable-speed motor, the horse-power output remaining practically constant throughout the whole speed range, which makes it peculiarly adapted to machine-tool driving. This system involves the use of a minimum amount of auxiliary ap-

attention, the motors and the machine tools they operate in each department being given in their respective places.

Tool Room—Twenty-horse-power, constant-speed, type S motor—Yankee twist-drill grinder, duplex emery grinder (eight-inch wheels), No. 4 Universal milling machine (Brown & Sharpe), No. 4 Universal milling machine (Cincinnati milling machine), fifteen-inch by fifteen-inch by twenty-foot crank planer, sixteen-inch tool-room lathe, No. 3 Landis universal grinding machine, Sellers tool grinder,

fifteen-inch turning lathe, fifteen-inch swing vertical borer, four-inch pipe cutter, three-inch pipe cutter.

Blacksmith Shop—Thirty-horse-power, constant-speed, type S motor—Two power hammers, light-bar shear, small-bolt header, one-and-one-half-inch bolt header, two-and-one-half-inch bolt header, alligator shears, bar-iron shears, hot saw, fifty-horse-power, constant-speed, type S motor direct-connected to fan.

Boiler Shop—Seven-and-one-half-horse-power, constant-speed, type S motor—Two

Digitized by Google

Hartz flue-welding machines, two flue-cutting machines.

Direct-driven machines operated by constant-speed type S motors—Seven-and-one-half-horse-power motor driving twenty-inch punch and shears, twenty-five-horse-power motor operating plate rolls, ten-horse-power motor operating horizontal punch, seven-and-one-half-horse-power motor driving bevel shears, ten-horse-power motor operating thirty-six-inch punch and shears.

In connection with the boiler-shop equipment there is a flue rattler which is located outside the building and is operated by a twenty-horse-power type S motor. It is forty-eight inches in diameter and twenty-two feet long, and has a capacity of 175-200 flues. An average of five lots per day are cleaned, the exact time for each rattling depending upon the water used in the boilers. The longest flue is twenty-one feet, and they vary from one and one-half to two and one-half inches in diameter.

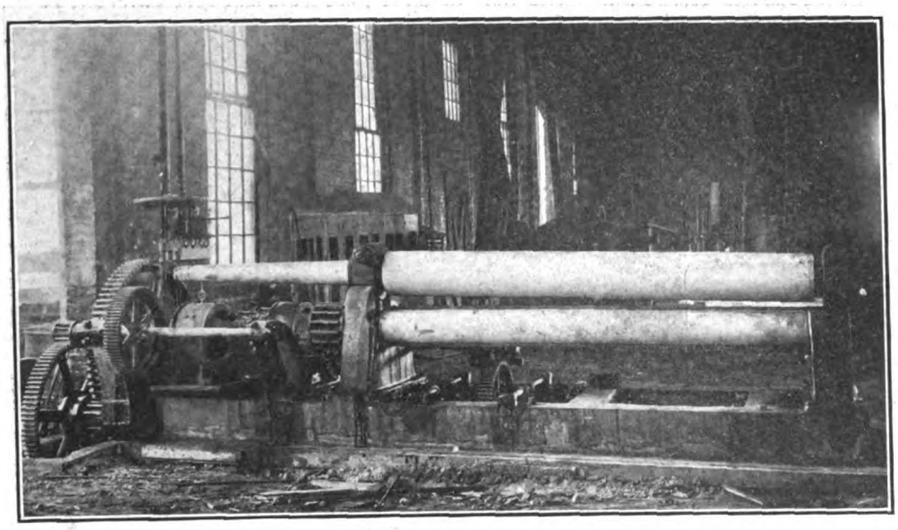


FIG. 8.—TEN-HORSE-POWER AND FIFTEEN-HORSE-POWER MOTORS OPERATING PLATE ROLLS.

Tank Shop—Twenty-horse-power, constant-speed, type S motor—Thirty-six-inch single shear, thirty-six-inch single punch.

In addition to the belt-driven machines there is a ten-horse-power and a fifteen-horse-power, constant-speed, type S motor geared to a plate roll.

Roundhouse Machine Shop—Twenty-horse-power, constant-speed, type S motor—Sixteen-inch engine lathe, twenty-six-inch engine lathe, thirty-two-inch by thirty-two-inch by eight-foot planer, twenty-four-inch pillar shaper, forty-inch upright drill, duplex emery grinder, fifteen-ton arbor press.

Miscellaneous applications—One seventy-horse-power, type S, constant-speed motor driving fan for roundhouse heating system; one ten-horse-power, type S, constant-speed motor driving fan for new erecting-shop heating system; one seven-and-one-half-horse-power, variable-speed, type S motor operating roundhouse turntable; one fifty-horse-power, constant-speed motor operating coal conveyer in locomotive coaling station; one thirty-horse-power, constant-speed, type S motor operating ash conveyer for removing ashes from locomotive ash pit; one seven-and-one-half-horse-power motor operating alligator shears for cutting up sheet scrap (this installation is located at the scrap bins in the shop yards); one twenty-five-horse-power motor operating transfer table.

The preliminary studies and final report, showing the benefits which would be the result of electrically equipping these shops, were made by the Westinghouse Electric and Manufacturing Company in conjunction with the motive power department of the Erie. The results have more than borne out the promises made to the management.

The installation of the new electrical equipment presented many engineering problems, but the work of transformation was carried on without any interruption to the service, and it reflects great credit to the contractors, Westinghouse, Church, Kerr & Company, who installed the plant, and George T. Depue, master mechanic of the Erie Railroad Company, who has charge of the Hornell shops.

The Chicago Electrical Trades Exposition.

It is announced that nearly all the space for the Electrical Show to be held at the Coliseum, Chicago, Ill., in January, 1907, by the Chicago Electrical Trades Exposition Company, aggregating nearly 30,000 square feet, has been sold. So great has been the demand for space that the Coliseum annex will be used for exhibitors. In addition to the exhibitors announced recently, the following firms have signed for space within the last few days: Albert & J. M. Anderson Manufacturing Company, Chicago; Pierce Specialty Company, Chicago; Chicago Compound Battery Company, Chicago; Eureka Electric Company, Genoa, Ill.; Bidwell Electric Company, Chicago; Beck Flaming Lamp Company, New York city; Felix Hamburger, New York city; Dean Electric Company, Elyria, Ohio; American Sewer Pipe Company, Pittsburg, Pa.; American Clock Company, Chicago; Universal Manufacturing Company, Chicago; Shelby Electric Company, Shelby, Ohio; American Instrument Company, Philadelphia.

It has been determined that it will be a physical impossibility to exhibit the Cahill Telharmonium at the coming exposition, but an attempt will be made to give a long-distance test of the telharmonic system. An effort will be made to transmit music from the New York central music station to the Coliseum during the show. The longest test yet made of the system was from Holyoke, Mass., to New Haven, Ct., about 100 miles.

Arrangements have also been made for an installation of the Moore vacuum-tube light.

Non-Resident Lectures at the University of Minnesota.

On Saturday, November 17, F. A. Sager, of the Arnold Company, Chicago, Ill., lectured before the engineering students of the University of Minnesota on "What Is an Engineer-Constructor?" Taking as an example the design and construction of a railroad repair shop, Mr. Sager outlined the steps in analyzing the problem, making preliminary studies of various plans, selecting the best plan, tabulating estimates of cost, making the preliminary report, tabulating and analyzing bids, keeping record of progress and cost of the work, etc. Analogies were shown between the organization of the engineering office and of a football team; electrical, civil, structural, industrial, architectural, sanitary and mechanical engineers corresponding to the line, the purchasing agent as quarter, the constructing and operating engineers as half-backs, and the accountant as full-back. There must be full coordination and cooperation for every part of the team for effective work. In an engineering office loyalty is of the greatest importance, common sense and skill coming next.

On November 22, C. H. Harris, engineer with the Minneapolis General Electric Company, lectured to the engineering students on "The Taylor's Falls Development." Mr. Harris is the resident engineer in charge of the hydroelectric development at Taylor's Falls, which is to furnish 12,000 horse-power at 50,000 volts to Minneapolis, a distance of fifty miles, the ultimate capacity being 24,000 horse-power.

Digitized by Google

American Institute of Electrical Engineers.

The two hundred and eleventh meeting of the American Institute of Electrical Engineers was held at the Edison Auditorium, New York city, on Friday evening, November 23.

Secretary R. W. Pope announced that fifty-four associates had been elected at the meeting of the Board of Directors held in the afternoon, and further said that on Thursday, November 22, upon the invitation of the trustees of the United Engineering Society, the Boards of Directors of the three founder societies met at the new engineering building at five o'clock, and inspected the new building. The office floors are practically complete and ready for occupation; the auditorium and grand entrance hall on the first floor are yet in the hands of the contractors. Resolutions had been passed at this informal meeting authorizing the trustees of the United Engineering Society to proceed with arrangements for the formal dedication of the building, which will take place in April next. Although the societies will occupy these quarters in the course of a month or two, no formal meetings will be held in the building until after the dedication in April next.

At the same meeting Chairman T. C. Martin, of the Building Fund Committee, announced that Mr. George Westinghouse, as representing the various Westinghouse Companies, had contributed to the land, building and endowment fund the sum of $50,000, to be equally divided between the three founder societies toward the payment of the land. This was followed by the announcement that the Allis-Chalmers Company had contributed the sum of $3,500, to be similarly divided between the three societies. This brings the amount pledged toward the payment of the Institute's proportion for the land to $155,000, out of $180,000, which is to be raised.

Two papers were read and discussed at the meeting. The first was by Dr. C. P. Steinmetz and was entitled "The Transformation of Electrical Energy into Light." Attention was called to the low efficiency of transformation of all types of illuminants. The bearing of temperature upon efficiency, and the phenomena known as selective radiation were described, it being shown how they affect the efficiency. The physiological aspect of the question of efficiency was dwelt upon briefly, it being pointed out that a given amount of energy in the form of green or yellow rays gives more light than the same quantity in the form of red or violet rays. Electro-luminescence was described, and the various types of electric lamp were taken up, including the vacuum tube lamps, making use of the phenomena observed in Geissler tubes, and the arc, both open and enclosed as in the vapor arc. The peculiarities of these discharges were explained, and it was shown that for alternating currents carbon is practically the only available material. For direct-current arcs various materials are available, but the metals of the iron group are particularly desirable, since they give a spectrum closely resembling that of daylight, and since the luminosity of the arc is due to the materials of the negative electrode which are carried into the arc by the current itself. In the so-called flame arcs the incandescent material is produced by volatilization due to the high temperature. The former type of arc, therefore, represents the more direct transformation from electrical energy into light. Moreover, in this lamp the efficiency does not depend on the temperature of the electrodes. The best electrode is one formed of a mixture of magnetite and titanium oxides, the former material furnishing the conducting matter for the arc, and the latter the light-giving part. So far it seems that only the green mercury spectrum, the yellow calcium spectrum and the white titanium spectrum offer an efficiency so vastly superior to that of incandescent solids that, as regards the efficiency of light production, no possible improvement in incandescent lighting can hope to approach it.

The second, entitled "New Types of Incandescent Lamps," by Dr. Clayton H. Sharp, was presented in abstract by the author. It will appear, somewhat condensed, in a later issue.

Diagrams were thrown on the screen and explained by Dr. Sharp, and he also gave a practical demonstration of the characteristics of some of the lamps.

Dr. H. C. Parker emphasized the statement made by Dr. Steinmetz that it is not the melting point of refractory substances that determines the efficiency, but it is the point of disintegration or vaporization. He, associated with W. G. Clark, has been experimenting for a number of years on incandescent lamps. One filament tried, which is supposed to have a melting point of 1,800 degrees, has shown an efficiency in experimental lamps of about one watt per candle, with an average life of 700 to 1,200 hours. It is almost impossible to vaporize this substance. If, therefore, we have substances which at low temperatures of 1,800 to 1,900 degrees will give an efficiency of one watt per candle, and if at the same time we have carbon filaments which are running at 1,800 to 1,900 degrees giving an efficiency of only 3.5 watts per candle, and since the carbon filament at least approximates the black body, we certainly know we have substances which have an immense selective radiation in the solid form. In vapors we have the most intense selective radiation without respect to temperature. This is shown in the experiments in connection with the electrodeless discharge. C. C. Trowbridge found that when the receiver is surrounded by liquid air a very considerable luminescence may be obtained and the luminescence may continue for a number of minutes after the electrical disturbance has been discontinued. He has calculated if the number of molecules in the rare gases could be increased the efficiency would be approximating 100 per cent; that is, we can have luminescence in the gas, practically, that is absolutely independent of temperature.

John W. Howell, calling attention to Dr. Sharp's figures which show that the carbon filament has, in sixteen years, improved 2.5 times in value in life at the same efficiency, yet the tungsten lamp is already at least 300 times as long lived at the same efficiency. This condition means a revolution in the art of incandescent lighting and all lighting. This tungsten filament can be most easily made in rather large candle-powers. Forty candle-power would be about the lower limit at 110 volts. It fits in exactly in the place where the carbon filament is weak. The tungsten filament from forty to 200 candle-power is at its best, and at these candle-powers it is more likely to be the competitor of the arc lamp and other high candle-power lamps. The high temperature of the tungsten lamp is of course a large element in its efficiency. Waidner and Burgess state that a polished platinum wire is the most efficient metallic light-giving body, and as some of the tungsten filaments approach very closely in appearance to polished platinum wire it is probable that these forms will be the most efficient.

Percy H. Thomas showed how prettily the corpuscular theory explains the various phenomena observed in all types of lamps, pointing out that heat radiations are probably due to the motion of the atom as a whole, while visible radiations may be due to the internal motions of the atoms. It seems likely that selective radiation is in

Digitized by Google

some way due to the large atomic weights of the bodies exhibiting it. High efficiency, while desirable, must be combined with other desirable features, such as intrinsic brilliancy, color, etc.

John W. Lieb said the performance of the sixteen-candle-power, 3.1-watt carbon-filament lamp is not completely satisfactory with alternating currents of twenty-five cycles. It had been hoped that the characteristics of the tungsten filament, its hanging on to the candle-power, even with large changes of voltage, would make it suitable for low-frequency systems. But it seems to be a race between this physical characteristic and the other one of the extreme tenuity of the filament making the lamp, on the other hand, more sensitive to fluctuations of current. We, therefore, at least as far as the experiments to which Dr. Sharp has referred, still have to look forward to some further developments, some further modification, which may solve this problem.

W. G. Clark said that his work with Dr. Parker had lead him to believe that the ordinary carbon filament is not of even temperature, but is made up of very narrow zones or spots of high incandescence, and possibly, in an unflashed filament, of actual arcing in some places. Some metallic filaments which are white in color at low temperature still radiate as black bodies. A great many white metals turn black before they begin to radiate light. Experiments with thorium oxide, oxide of aluminum, flocculent silicon dioxide, calcium oxide and a number of other white oxide-forming materials indicated that they luminesce or become incandescent direct from their own white color to the characteristic light or wave-lengths which they emit without passing through all of the longer wave-lengths leading up to and through the red end of the spectrum. It is possible to make a non-luminous gas flame luminous by charging it with a silicon vapor which gives silicon dioxide upon coming in contact with the air. The oxidization of carbon in the arc produces a gas which would show little if any luminosity, but silicon dioxide becomes luminous at a comparatively low temperature and an open arc from silicon should form the dioxide and become luminous.

The desirability of securing a light which covers the entire range of visible wave-length is brought out by Steinmetz, but instead of endeavoring to secure this entire range in one material or in two similar materials, as in the magnetite-titanium arc, may we not secure an efficient result by combining materials which show high efficiency at each end of the visible spectrum. As an instance, if we were able to combine the mercury vapor arc with a light from a material which showed its highest efficiency in the red end of the spectrum, the resultant light should be both satisfactory and economical. The carbon filament is, of course, not sufficiently efficient when maintained at the temperature where the red rays predominate, but a combination of the Geissler-tube effect with the mercury-vapor arc would be a step in this direction.

W. J. Hammer dwelt briefly on the historical features of incandescent-lamp development and pointed out that one of the difficulties met by the earlier experimenter with metallic filaments was in finding a proper binding material.

De Lodyguine about ten years ago made a number of metallic-filament lamps, some of which lasted several hundred hours. But he did not succeed in making a commercial incandescent lamp in this way, for the reason given.

C. W. Hogan asked whether the better efficiency of the metallized filament was due to its shape. A triangular filament would give a greater radiating surface than a circular one of equal cross-section.

Professor W. S. Franklin said that substances like calcium oxide, when bombarded by cathode rays, give off luminous radiation in great excess over the heat radiations, and it is possible that we may be able to secure a very high efficiency of illumination by making use of that method. Most of us who have been working on the problems of illumination have been too much dominated by the theory of radiation which has grown up with the notion of the ideal black body. We speak of any radiation differing from that as selective. But suppose we cause the body to radiate, not by heating, but by stretching the molecules out and letting them fly back again, a wide departure may be expected from black body. Such effects may be produced by cathode rays, but the phenomenon should not be called selective radiations, but selective excitation. The substance which shows this property to the most striking extent are the oxides of the two didymiums. They have the property of giving almost the whole spectrum in the solid form, especially when excited by cathode bombardment. These substances give the possibility of being selectively excited, and therefore radiating short waves of enormous strength, even though they may be at a low temperature.

Dr. Steinmetz, in closing the discussion, said he had observed the tarnishing of iron when trying to use it in the mercury arc. Even in a very high vacuum, iron when heated will show different colors. Incandescent silicon, while brilliant, is far below the titanium arc. The increased radiating surface of the triangular surface will radiate more light. Unfortunately, it will also radiate in the same proportion more heat rays. The efficiency would be no better than that of the round filament. By having an exhausted glass tube, a Crooke's tube coated inside with tungsten, and exposed to a cathode discharge, gives a beautiful white glow. The only trouble is that the luminescence excited by the cathode ray is excited by an extremely high-velocity bombardment, and the impact not only gives us light, but gives mechanical fracture and destruction, and such a lamp has limited life. The general difficulty in the use of this cathode bombardment is that the action goes further than merely striking the light wave —it goes into mechanical destruction, and therefore the life of such things is very low.

The maximum efficiency of light given by a tungsten filament at the temperature of self-destruction is something like 0.2 of a watt per candle power. That efficiency was obtained long ago by the flaming-carbon lamps. At the same time the arc is a larger size illuminant. The incandescent lamp has the better advantage of giving better distribution of light by smaller units; at the same time the tungsten filament does not have this advantage as much as the carbon filament, because, at least at the voltage of 110, it can not be brought down to the small units as the incandescent lamp. There are some future developments possible in the increased efficiency of the arc lamp, because even an efficiency of one-quarter of a watt per candle power is ridiculously low from the point of view of the efficiency of the electric motor. We might possibly get still higher efficiency than this, but what we want is not light, but illumination, and then the question of distribution comes in. Again, high intrinsic brilliancy is a disadvantage. In that respect the advantage is with the mercury arc and the vacuum tube. In the question of illumination comes the difference in the physiological effect of different colors. Green is a much more efficient color than red, and the same amount of energy put in a green light gives many more candle power than a red light. The light equivalent of energy is a function of the color, but is also a function of the total intensity. A given amount of energy put into a green light

Digitized by Google

is very many more times effective than the same amount of energy put into a red light when seen at a considerable distance. Where you want to get a low intrinsic brilliancy, as in suburban lighting, the green has great advantage over the reddish yellow. The reverse applies when you go to very high intensity, to glaring light. When the light is used to draw attention for advertising purposes, the reddish yellow is always preferred and is also more pronounced, more glaring than the greenish light. Given lights of different colors, the physiological effects must be considered, as the relative value of the lights is dependent on the different intensity of illumination desired. Irrespective of the absolute efficiency, it may be found that for certain classes of work the mercury lamp is more efficient physiologically than any other illuminant, while for other classes the flaming-carbon arc will hold its field, due to its yellow color. In another case the tungsten lamp will be superior, but we can not speak of absolute relative efficiency of illuminants, because the physiological effect varies with the color and intensity of the illumination.

The meeting was then adjourned.

Magnetograph Records of Earthquakes, with Special Reference to the San Francisco Earthquake.

It has been found by Dr. L. A. Bauer that several times within the last few years earthquakes have occurred in this country which, for some reason or other, were not recorded on the existing seismographs, but were indicated by the records of certain magnetographs. A notable instance was the New England earthquake of March 21, 1904. This was not recorded on the seismographs at Toronto, Canada; Baltimore and Washington, but the magnetograph at Cheltenham, Md., sixteen miles southeast of Washington, gave a distinct record. In the same way a number of earthquakes have been recorded by the magnetograph at Baldwin, Kan. To locate, if possible, the reason for this, a concurrent study of seismograph and magnetograph records, secured during the last few years, has been made. The records secured from the San Francisco earthquake are particularly interesting because of the favorable location of various stations for obtaining results. These were secured at Baldwin, Kan.; Sitka, Alaska; Honolulu and Cheltenham. On the other hand, an equally large earthquake on January 31, the region of which was at sea off the coast of Ecuador, was recorded on the magnetographs of Baldwin, Porto Rico and Cheltenham, but not at Honolulu. This would seem to indicate that the effect can not be entirely mechanical. There is a possibility that an approaching earthquake might, through electric or magnetic effects, give the first indication on magnetographs because of the greater velocity of propagation of such effects than that of the mechanical vibrations. A careful comparison is made of the records available and tables are constructed showing the velocities of the various transverse waves computed along the paths from the region of the earthquake to the observing stations. It is shown that the longitudinal waves, which are the first to arrive at the station, travel with an average velocity of six miles per second; the transverse waves at an average velocity of three and one-half miles; whereas the surface waves travel at a velocity of two and one-half miles per second. The records show that in most cases the magnetograph responds only to the longer surface waves, and not to the preliminary tremors. It seems evident that the magnetograph is giving a record of something not immediately evident from the present seismograph records. The author believes that the effects recorded by the magnetograph are chiefly mechanical ones due to the vibrating motion of the points of support, though there is a possibility of a magnetic effect within a certain prescribed region of the origin of the earthquake. In the case of the San Francisco earthquake it seems evident that the magnetograph records were due simply to a mechanical effect.—*Terrestrial Magnetism and Atmospheric Electricity (Baltimore), September.*

BOOK REVIEWS.

"Elements of Gas Engine Design." Sanford A. Moss. New York. D. Van Nostrand Company. Boards. 198 pages. 3¾ by 6 inches. Supplied by the ELECTRICAL REVIEW at 50 cents.

This book is an attempt to present, in condensed form, the fundamental principles with which the designer of gas engines should be familiar. No effort is made to go into mathematical or constructional details, but the chemical and physical problems involved are clearly discussed. The book is supplemented by a number of valuable tables on the properties of gases.

"American Stationary Engineering." W. E. Crane. New York. The Derry-Collard Company. Cloth. 286 pages. 6 by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $2.

A book intended for the so-called practical man, written by one who thus classifies himself. He evidently has no very high opinion of what are known as experts—men who like to think that they use their brains rather than their hands. The book will be found to contain a great deal of useful information for the man who must run a boiler room and take care of engines. To such probably the absence of threatening mathematical formulæ will be a recommendation.

Electrical Trades' Association of Chicago.

The eleventh annual meeting of the Electrical Trades' Association of Chicago was convened at the Grand Pacific Hotel, Chicago, Ill., Friday evening, November 16. More than eighty manufacturers and jobbers from the central, southern and western states were in attendance. A dinner preceded the business meeting, which was called to order by the president, Frank S. Beardslee. The reports of the officers of the association showed a remarkable increase in membership and an ever-widening field of efficient service. The board of directors was increased, by an amendment of the by-laws, from five to seven members, and the election resulted as follows:

President—Seymour Guthrie, Kellogg Switchboard and Supply Company; vice-president—William A. Browne, M. B. Austin Company; members of the executive board—Thomas I. Stacey, Electric Appliance Company; Harry R. Parsons, Western Electric Company; Frank S. Beardslee, Beardslee Chandelier Manufacturing Company; S. E. Kennedy, Central Electric Company; Frank M. Pierce, Manhattan Electrical Supply Company. James Wolff, New York Insulated Wire Company, was reelected Chicago member of the board of managers of the National Electrical Trades' Association. Frederic P. Vose was reappointed secretary and treasurer.

After the conclusion of the business session, Thomas G. Grier, of the American Circular Loom Company, acted as toastmaster and a delightful programme followed.

Mr. Grier very generously had supplied each guest with a booklet containing the words of the old melodies that have been popular for two or three generations, and, led by Messrs. Parsons and Pierce, the company sung the songs with much gusto and pleasure. Instrumental music was supplied throughout the evening by Tomasco's orchestra. More than twenty of the gentlemen present responded to the invitation of the toastmaster to speak of their regard for the association, and one and all voiced the sentiment that the association service had become an indispensable adjunct to their business and that the underlying principles of cooperation in the exchange of credit information had resulted in safeguarding their credits, protecting their business from financial loss and engendering a spirit of unity and brotherhood among the jobbers and manufacturers of the trade to an extent undreamed of ten years ago.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

An English Pumping Station.

An English electrically driven pumping station has been installed at Black Hill, England, for the Consett Iron Works, to provide the plant with the necessary water. The works are located on the side of a hill, and below it have been constructed two large reservoirs, each with a capacity of 3,000,000 gallons. The water for the various parts of the plant drains into these reservoirs, and in order to return it to the plant a pumping station has been erected at the reservoirs, in which there are three three-throw pumps driven through ropes by direct-current motors. Power is supplied to the motors from a steam-driven generating plant at the works. It delivers the current to the motors at 500 volts. The generators are driven by steam engines, the boilers being fired by spare gas from the furnaces. The engines are rated at 250 horse-power each, and are direct-connected to twelve-pole, over-compounded generators rated at 370 kilowatts. The length of the overhead line is 900 yards. The motors are rated at 120 horse-power each. Each of the pumps is constructed with three rams having a diameter of eighteen inches and a stroke of twenty-two. At twenty-six revolutions per minute they deliver 1,500 gallons under a head of 300 feet. The motor pulley is placed on an independent shaft attached to the motor shaft through a coupling. This is to provide for easy removal of the motor armatures. The lighting system is supplied from a storage battery at the pump house, which is charged from a motor-generator set.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), November* 3.

A New Type of Industrial Condenser.

One of the difficulties in constructing condensers for commercial purposes is that of preventing puncturing of the dielectric. When this consists of glass plates covered with sheets of metal foil the strain on the dielectric near the edge of the metal surface is much greater than that elsewhere, and hence puncture takes place here when the difference of potential be raised to a point which is entirely safe for the other parts of the dielectric. To get around this difficulty in the construction of commercial condensers in which the material is used to the best advantage, Moscicki devised an arrangement in which the dielectric is thicker in the neighborhood of the edge of the metal coating. His first form of condenser consisted of a glass tube closed at one end and contracted at the other, the glass being somewhat thicker at the two ends, so as to interpose here the necessary dielectric thickness. These tubes were silver-plated externally and filled with mercury. This type of design is not altogether suited for industrial purposes, and a modified construction has been evolved which is described here by C. F. Guilbert. In this the tubes have the same shape as in the older design, the upper part being contracted into a neck with thickened walls. The closed end is also thickened. This is silver-plated inside and out, and then copper-plated. Connection is made with the inside coating by means of a plug, and the upper portion of the neck is surrounded by a corrugated porcelain tube which also serves to support the condenser tube. The tube thus held is placed in a blackened brass cylinder filled with oil for cooling and makes connection with the outer coating by means of a collar. The weight of the tube is borne on a rubber ring, so as to reduce the effect of shocks. The tubes thus mounted are grouped together in sets, the interior and exterior coatings being connected together, respectively, and the group is supported on an insulating stand. Condensers constructed in this way may be employed for voltages up to 15,000 or 20,000; in fact, they have been used at 40,000 volts. They vary in length from twenty inches to fifty inches, and the outside diameter is about one and one-half inches. An interesting feature of these condensers is the decrease in the cost per kilovolt-ampere with an increase in the voltage, although the decrease is not directly proportional to the increase in tension. This is due to the larger number of elements required to take care of the increased quantity of charge for lower voltages. The condensers are suitable for producing leading wattless currents for regulating transmission systems, for which purpose they are thought to be superior to over-excited synchronous motors. They may also be used for starting induction motors and for protecting electrical systems against the atmospheric discharges. When used in this way the condensers may be arranged in pairs, a terminal of a condenser being connected to each end of an inductance placed in each transmission line. The free ends of the condensers are then connected together and to the ground. This arrangement provides sufficient static capacity to absorb a rush of current due to an atmospheric discharge. A simpler arrangement consists in using one set of condensers for each inductance, the latter being interposed between the condenser and the apparatus to be protected. A similar arrangement is used for protecting railway motors, a condenser being placed in parallel with the apparatus on the car. They are also suitable for use in radio-telegraphy, for producing X-rays and high-frequency discharges.—*Abstracted from L'Éclairage Électrique (Paris), November* 10.

High-Power Wireless Telegraph Station at Nauen, Germany.

The Gesellschaft für Drahtlose Telegraphie, which uses the Telefunken system, has erected a high-power station at Nauen, near Berlin, Germany. The design of the equipment is the outcome of a long series of experiments and embodies a number of new points. Nauen is about twelve and one-half miles northwest of Berlin. At this point a tower, 100 metres high, has been erected for supporting the antenna. It is a lattice-work triangular structure, the three side girders being formed of riveted sections each eight metres long. They are bolted together and connected to one another by means of diagonal stays, and are carried parallel from the top of the tower to about six metres above the ground. At the foot the three girders join to a cast-steel sphere, which rests on a socket constructed as a sole plate. The pressure is carried through a layer of insulation to the concrete foundation. Steps are provided for mounting the tower, and guys are attached at a platform ninety-six metres from the ground. These guys are formed of a number of round iron stays connected by massive links and led

Digitized by Google

with considerable sag to points 200 metres from the foot of the tower. They are insulated at top and bottom from the tower and the anchors. On account of the high tension employed, which produces a spark one metre long, the upper insulators are arranged in oil. The antenna spreads itself out from the top in an umbrella shape. It consists of six sections, arranged so that the two opposite sections counterbalance one another, the supporting cables being carried over pulleys. For inspection they are lowered generally in pairs, though a single one may be let down. The umbrella consists of phosphor-bronze cables, which, toward the bottom, branch out at a quarter of their length into two fresh cables. There are in all 162 cables, giving a total surface of 60,000 square metres. The sections are anchored to the ground by means of hemp cords and porcelain insulators. The leads to the station-house are carried from the top of the tower and consist of 154 cables in the form of six grids held together by wooden battens. These leads are not insulated from the tower, so that the latter forms a part of the oscillating system. The earthing consists of 108 iron wires arranged fanwise in the earth, which spread out in the same way as the air end into 324 wires. At the centre they are joined together and are led to the station-house. The source of power at the station is a thirty-six-horse-power steam engine.—*Abstracted from the Electrician (London), November 2.*

Rational Lightning Rods.

It is shown by A. Breydel that when two charged Leyden jars are discharged by bringing their inside and outside coatings, respectively, into contact, that the discharge from the inside coatings is quiet and may take the brush form, while that between the outside coatings is violent and disruptive. It is the latter type of discharge that resembles lightning, and it may be profitably studied in developing a rational system of lightning protection. The form of protection proposed by Franklin is a straight rod pointed at the tip, and this is supposed to protect a circular area the diameter of which is equal to the height of the rod. An improved system was proposed by Melsens, which consists in placing discharging points at all the salient points of the roof, connecting these together by a suitable system of conductors and providing suitable grounds. The system proposed by the author is one in which strips of copper or galvanized iron are carried along the angles of the roof, these strips being provided with small vertical rods of the same material. These bands form a metallic cage bristling with discharge points. They are inexpensive and are thought to give better protection than either of the other two systems. This was shown experimentally by making models of the three systems and bringing over them discharge points from a static machine. A silent discharge always takes place to the third system until the points approach very close to the simple, but longer, rod of the Franklin type. It is, of course, necessary to connect the bands through suitable grounds at the base of the plate, and these connections should be insulated from the building so as to avoid danger of side flashes. The discharge points may be made of galvanized iron wire about one and one-half millimetres in diameter. Soldered joints should be avoided everywhere.—*Abstracted from the Monthly Bulletin of the Société Belge d'Électriciens (Brussels), October.*

The Calculation of Star Resistances.

When an instrument such as a wattmeter or a reverse-current relay is used on one phase of a three-phase system, some form of external resistance is usually provided, so arranged and proportioned that the phase of the current in the shunt coil of the instrument shall, as nearly as possible, coincide with the phase of the main current in the series coil when the power-factor is unity. This resistance is usually arranged in star form, two of the points being connected to two phases of the system, the third connected to the shunt coil of the resistance, the other end of which is connected to the remaining phase of the system. In order that the proper phase relations may be obtained, the resistance of the two independent legs of the star must be equal, and if the junction point is to be a true neutral the resistance of the remaining leg, plus the resistance of the shunt coil of the instrument, must be equal to that of each of the other legs. However, it is not necessary for the junction point to be a true neutral in order that the current of the shunt winding shall be in the correct phase, and a method is here given by Alfred Still of computing the value of the resistance employed in order to obtain the desired relation. It is shown that by employing an unbalanced arrangement there may be less power wasted in heating the resistance. If, for example, the two free resistances are increased, while that in series with the instrument shunt is decreased, the phase of the shunt current remains unaltered, and it may maintain its original value, although the current passing through the circuit formed by the other two resistances is decreased. These simple relations hold only when the inductance of the instrument is negligible, but when this must be reckoned with it is possible, by unbalancing the auxiliary resistance, to bring the shunt current into the proper phase. These solutions are shown diagrammatically and application made to several examples.—*Abstracted from the Electrical Engineer (London), November 9.*

Fracture of Axles Originating in Drilled Holes.

There is an increasing number of railway cars in the United States lighted by electricity generated by a dynamo carried on the car and driven by a belt or chain from a pulley on one of the axles of the car. Although it is generally understood that it is not good practice to drill any hole in the car axle when applying such equipment, it does not appear that the danger of doing so has been recognized. Attention is called here to a recent discussion of this matter by Lucien Alphonse Lagros, who says that it is well known that in many materials a drilled hole will prevent the spreading of a crack, and the extension of a crack in a casting or forging is frequently stopped by this means; but the fact that in some cases a drilled hole will cause the commencement of a crack does not appear to be so generally appreciated. Cracks may be expected to appear in any material subject to alternating stresses at places where there is an abrupt change of section or a notch or groove has been made by a cutting tool in a turned surface. Locomotive engineers have for years past recognized the importance of these details and their influence on the life of both cranked and plain axles. As an example, two fractured street railway car axles were described, the fractures in which occurred through the centre of shallow-drilled holes. The first axle failed while at work after a run of 15,380 miles, and the second after running 13,900 miles. In this case the crack was detected before fracture took place. The diameter of the axle at the fracture was in each case three and one-quarter inches, and the cracks occurred several inches from the key seats and at points where the stress would not be a maximum. The drilled hole was made to receive the point of a set-screw to prevent endwise motion of the chain-wheel. The lesson learned from this accident resulted in the use of pairs of clamped plates gripping the axle and bolted to one another, instead of set-screws. It is urged that where the undesirable practice of drilling holes in axles or shafts has been followed, these parts should be carefully examined to detect any signs of fracture as soon as they appear.—*Abstracted from the American Machinist (New York), November 15.*

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

ORGANIZATION AND CONDUCT OF A NEW-BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.[1]

BY JAMES L. WILTSE.

A commercial or business department is a necessity with a central station, or in other words, it is the life blood of the central station. Its value is twofold; first, that it brings the company into close relations with the public, and second, that it increases the business of the company. The importance of this department is recognized by many central station managers, and with great resultant benefits to their companies.

This department is to be organized in a company which has had no separate department to take care of its commercial business. It will have charge of all present and prospective customers of the company, excepting the collection of bills. The principal object is to increase and hold the business of the company.

The first thing in the organization of this department is the selection of a competent head for the department. This is a question of the utmost importance to a central station manager, and great care should be exercised in selecting a man who realizes the importance and responsibility of the position. He should be a man who has had central station experience, and one who realizes the necessity of tactful treatment of those with whom he comes in contact.

The principal duties of the head of the department will be to take entire charge of such department and to look after the company's interests in securing and holding business. He will be responsible for the acts of his solicitors, and it should be his duty to see that all possible efforts are put forth by his men in the direction of following up and securing new business. He also settles questions of rates, guarantees, line extensions, and all the minor matters connected with the wishes and requirements of the public. He should take care of all complaints from customers, and should also be capable of taking complete charge of advertising.

[1] In the prize contest carried on by the Cooperative Electrical Development Association this paper received an honorable mention.

Having secured our contract agent the next important consideration is the selection of solicitors for outside representatives. As to these, two will be sufficient to start with. These men should have had some experience with central station work and have a knowledge of light and power engineering. They should be paid a straight salary. This is more advisable than paying them on a commission basis, as better men can be secured by this method of compensation. Each solicitor should be given a certain territory in which his duty will be to take care of the present customers, and to secure new business. These men are to report at the office once a day, make a report of each call and the results, and issue all necessary orders to the proper departments to make connections, etc., and for care of business secured by them.

The contract agent should have an assistant to take charge of the office, see that the solicitors' work and reports are kept up and take general charge of the details of the office. This man should be capable of taking care of all customers coming into the office.

We have now the organization ready to start the sale of our product. This brings up the question: "How shall we push the sale of electric current?" or, "What method shall we adopt to secure new business?" Here is a large field, and if the company will work all of its branches within reasonable limits the growth of the central station business will surely increase greatly.

There are two channels through which we should go to get business. One is through advertising, the other through the outside representatives or solicitors. Advertising is essential, because it informs the public that you are after business. Advertising for this purpose simply means the educating of the public to the adaptability of electricity to the every-day needs of the office, the factory and the home. Many are diffident regarding its use on account of lack of knowledge. Therefore, an educational campaign is advisable to train and familiarize them with the subject. Advertise freely in the local newspapers, as the majority of the people in the small cities read the local papers.

Another good form is in mailing literature in the form of pamphlets or circulars relating to the many advantages and uses of electricity. Enclose with each a return post-card, so that it can be signed and returned for the purpose of having a representative call. This not only advertises your product, but gives them a "lead." This system of advertising should be checked up, and, where necessary, followed up with more advertising, as well as personal canvass.

As a means of keeping present customers awake to the many uses of electricity, a small paster should be attached to their bills, giving a brief description of the articles you wish to advertise or place before them; such as fans, flat-irons, heating and cooking utensils, etc.

Another good scheme is to erect an attractive electric sign outside of the office. This shows that the company believes in the efficiency of electric signs, and also helps to promote the sign business.

Right here, I might say that an attractive office, fitted up with fixtures, shades, etc., giving ideas regarding illumination, and also an exhibition of electric cooking, heating and other electrical devices, will prove a very good advertisement.

The next and the best method of getting business is through the solicitors. We have two men to start out, and as they have been given such a good lead through the advertising, it is so much easier for them to get business, either through canvassing and answering enquiries or follow-up work on advertising.

With all central stations the peak load is generally in the earlier part of the evening, and it is therefore an important item for the company to secure business which will even up the load. To do this it is necessary for the business department to work on installations such as power and heating.

In order to develop the power business, the solicitor should be familiar with the other forms of power and state their comparative disadvantage. He should also be able to lay out power installations in the most economical way, and see that customers follow suggestions and get the desired results.

Another good way to increase business,

Digitized by Google

if there are many small users of power who can not afford to lay out the money for a new electric equipment, is to advance the cost of the motor or motors, which can be repaid in monthly instalments. This means revenue for the central station, and should, therefore, be given special attention. The solicitors should keep close watch on all gas engines and when they break down or give trouble get on the ground and talk electric power.

In addition to the power business, there is a newer field for the use of electric current which will also help to even up the load on the company's system. This is electric heating. Of the revenue-producing heating devices, the electric flat-iron has already begun to show results to central station companies which have had the foresight to actively push its use. There are also heating and cooking devices, which, while not great revenue producers, are good advertisers, and help to swell the gross receipts. The best method of increasing this business is to deliver these heating and cooking devices on thirty days' trial, and if same are satisfactory they should be sold at practically cost. With the electric flat-iron it is in most cases advisable to lend the iron to the customer, and the increased current consumption will soon repay the company.

Besides the many advantages of electricity over the other forms of illumination, there is one especially important point to bear in mind in securing this business, and that is, the proper layout of the lights. It is, therefore, needful that the solicitors have a knowledge of illuminating engineering, as in some cases it is only by this method that customers may be secured and satisfied.

The electric sign business should be given attention, and the company should furnish and install signs on the premises of customers free of charge. This method has met with much success in many central stations. The usual form is that customers are required to sign a contract with a minimum charge per month. The company could furnish clock switches for signs where customers desire the sign to burn after the closing hours. It is to their interests to do this, as it not only means increased current consumption, but induces other merchants on the street to make their places attractive by night as well.

The idea is for the central station to work up the matter of proper illumination and get the merchants in the city to make a more liberal use of light, not only during open hours, but after stores are closed for the evening.

In a new department of this kind we must initiate an accurate system of keeping records and following up new business. To do this the solicitors should be provided with a small card index file, in which they should keep a record of all prospective business and see that it is followed up properly. They shall note the date and result of every call. In addition to this, they should make a separate report to the office of every call. Agents should be furnished with blank forms for this purpose. These should be of three kinds, each a different color; one form to be used when a customer's application is secured, another form for prospective business, where customer will consider the use of current, and the other form for holding present business or other miscellaneous reports. After checking these reports in the office they should be filed, excepting reports where people are considering the use of current, which should be filed temporarily and followed up until contract is closed.

This card can be used to keep a complete record of the customer's installation, etc., and any other records necessary can be entered on the other side of the card.

All records of this office should be filed according to location.

Two card catalogues should be kept, one for connected, and the other for disconnected customers.

The solicitors should make out the working orders for the business secured by them. After being checked and recorded in the office, the order should then be approved by the credit department. After it has been properly approved it is forwarded to the installation department to do the work.

The office is to keep a record of all business secured, and this can be done by keeping a report showing each day's business, as follows:

*Address*_____ *Business*_____

*Name*_____

*Application Dated*_____ *Rate*_____ *Solicitor*_____

Order Issued	Installation	Connect or Disconnect	Com leted	Remarks

These sheets can be totaled up each day, and at the end of the month a report can be readily made showing the business secured during the month.

SOLICITOR'S DAILY REPORT

Locatio _____ *Present Form Power*_____

*Name*_____ *Estimated H. P. Required*_____

*Business*_____ *Used for*_____

*Present Lighting*_____ *Will customer consider*_____

*Probable Installation*_____ *Remarks*_____

*Wired*_____

*Date*_____ *Checked by*_____ *Solicitor*_____

The above is a form which can be used for this purpose.

All forms to be printed the same, but each form to have a different color.

In this way the solicitor's work can be checked up, and every month a report can be made up of the number of calls, and the amount and kind of business secured by him. A customer's card should be kept as follows:

To operate a department such as outlined here, the cost will be approximately as follows:

	Per Year.
Salary of contract agent	$1,800
Two solicitors, each $18 per week	1,872
One clerk, $12 per week	624
For advertising	2,000
Total	$6,296

REPORT OF BUSINESS SECURED,_____ 1 __

Name	Address	Incs.	Arcs	Power	Misc.	Remarks	Solicitor

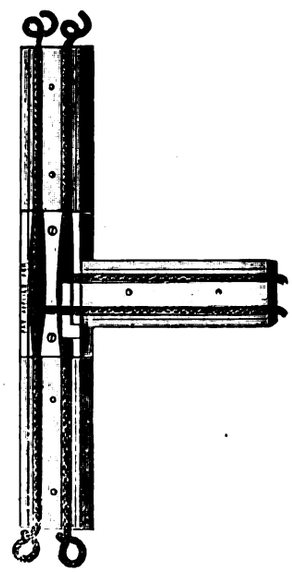
Digitized by Google

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A New Splice Protector.

The accompanying illustration shows a new splice protector placed on the market by Jordan Brothers, 74 Beekman street, New York city. This splice protector affords a solid, substantial soldered and insulated splice and provides a fire and water-proof porcelain protection at the point where the insulation resistance of the rubber cover on the wire is impaired by the splice. The splice is held in position by the capping of the molding and is practically invisible. The illustration shows the protector in place before the capping has been attached. This does



A New Splice Protector.

away with exposed wires at the point where the splice is made and obviates the possibility of capping nails being driven through the splice. The splice is made for two or three-wire or any combination of branches.

The Apple Ignition System for 1907.

In this period of gas-engine-ignition progress the demand for a better and more reliable method of obtaining all possible power out of the gaseous mixture has called forth many new and meritorious ignition devices.

It is an accepted fact that the ignition factor of gas-engine development has not, with two exceptions, advanced with as rapid a pace as the combustion engine itself. We are, as it were, in a period of ignition unrest—a period reached and passed by gas-engine designers some time ago, to give place to the conservative development of the single type of motor.

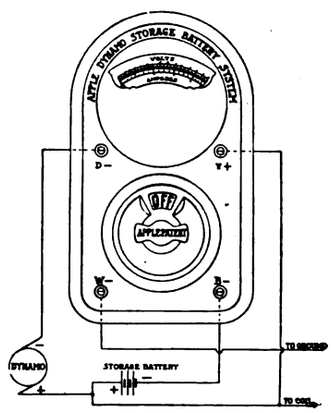
Apple Ignition System—Voltmeter and Four-Way Switch.

The Dayton Electrical Manufacturing Company, Dayton, Ohio, has placed on the market as part of its 1907 system a combination indicating snap-switch, volt ammeter and automatic cutout, assembled in a hard-rubber case, not occupying more than six by three and one-half by three and three-quarters inches of space. A study of this switch and meter panel reveals at once the fact that it enables the operator to obtain complete knowledge and control of his ignition system.

This switch is designed to be used with the Apple battery charger and a storage battery. Not only does it enable the engine user to determine the exact ampere consumption of every coil, but it also enables him to charge his battery at the same rate at which discharge takes place, thus maintaining the battery in a constantly charged and high state of efficiency at all times.

As previously stated a combination volt ammeter is mounted on the front of a small hard-rubber dashboard box directly above a four-way switch. This switch is of the rotary snap type. The switch dial has four indications—"off," "battery volts," "ampere discharge," "ampere charge." When switch is on "battery-volt" position the exact voltage of storage battery may be determined. On this position the car may be run from the storage battery direct. The next position, "ampere discharge," shows the ampere rate at which the current is being consumed by each individual coil, providing the engine is turned to each coil contact respectively or all of the coils when the engine is running. "Ampere-charge" position denotes the rate at which the Apple dynamo is charging the storage battery. By means of an adjustable governor fitted to the dynamo the ampere-charging rate may be varied at will. However, this charging rate, when once "set" by the operator, will remain constant regardless of the speed of the engine. This is due to the operation of the Apple automatic friction governor, whose principles are well known.

To obtain the highest efficiency from an ignition system the battery must be kept in a healthy, fully charged condition. This condition is obtained and maintained by the dynamo, automatic friction governor and switch. Furthermore, on this third position, the position which connects the



Apple Ignition System—Diagram of Connections.

dynamo in parallel with the battery, the dynamo constantly charging the battery and the ignition-current supply being drawn from this battery, an automatic cut-out affixed to the rear of the meter panel is thrown in the circuit. Should the dynamo current fall below the proper consistent charging rate this automatic cut-out severs the connection between the dynamo and storage battery by a positive break of the cut-out armature, and when the proper charging rate is attained connections are again made between dynamo and battery. This cut-out would also work should the engine stop while switch was on third position. There is, therefore, no danger of the battery deteriorating by reason of its current flowing through the dynamo. The fourth

Digitized by Google

position is the "off" position. All connections are open.

The additional value of a system of this nature, especially at this time of coil consumption agitation, becomes apparent. The well-known Apple dynamo storage battery system furnishes its owner with as much current as he may desire. He is therefore enabled to use coils giving a spark of hotter intensity with a consequent gain of power.

Another innovation in ignition work is the employment by this company of a flexible shaft drive wherever necessary. The company has had this feature in mind for a number of years, and the flexible drive as it is placed on the market is the result of numerous experiments and previous models. The shaft therefore may be looked upon as an assured success. By means of this flexible drive the dynamo may be affixed to the running board or under the seat. It is possible to apply this system much more readily than has previously been the case with some makes of cars. The governor will be fitted with ball bearings. Ball-bearing guides for the flexible shaft will also be provided.

The strides which this company has taken in the last year or so toward the perfection of its system of ignition have been augmented by the addition of these three new features for 1907, the flexible drive, the adjustable governor and the combination switch and meter panel.

DIESEL ENGINES FOR INTERURBAN RAILWAY SERVICE.

BY NORMAN McCARTY.

The records of the Diesel oil engine in this country and abroad have demonstrated—

1—The consumption of fuel per brake-horse-power in the smallest engine is not fifteen per cent greater than that of the largest units, and in every case is within the builders' guarantee of twelve and one-half gallons of oil for each 100 kilowatt-hours delivered at the switchboard under the operating conditions of the system as proposed in this article. The actual fuel consumption of a 225-brake-horse-power unit at full load is ten and one-fourth gallons for each 100 kilowatt-hours, with a generator efficiency of ninety per cent.

2—That the consumption of fuel per brake-horse-power is practically constant from half-load to the rated capacity of the engine.

With the above facts established as they have been by the records of many plants in actual operation there should be no objection to the installation of Diesel oil engines for interurban railway operation, in so far as relates to fuel economy. It is also safe to assume that the actual labor required to operate a number of Diesel primary stations will be less than that required for a central steam station together with that needed for the necessary transformer stations.

The only objection to be raised would refer to the continuity of service, the extreme variation in the load and small overload capacity of the internal combustion engines. The installation of a small storage battery in each station meets these objections and the desirability of the installation of Diesel engines and low-tension direct current as a substitute for steam equipment and high-tension current, either with transformers or single-phase motors, becomes merely a question of first cost and future operating economy. The following is offered as a close estimate of the comparative cost for the installation and operation of a fifty-mile road, with five fifty-ton cars operating at thirty miles an hour on one-hour headway for eighteen hours:

There would be four power stations, each with the following equipment: one 150-kilowatt direct-current, 650-volt unit; one 240-ampere-hour storage battery.

The four engines would deliver 600 kilowatts, and sixteen hours of actual operation at full load would be sufficient for engine service, making a total output of 9,600 kilowatt-hours per day.

The storage batteries would operate the road for the balance of the day, including owl cars and light and power for car barns when the engines were idle.

The total fuel oil required would be 96 $\times$ 12½ = 1,200 gallons, which at three cents would make $36, the fuel cost.

The labor required for operating the four stations would be as follows, divided into two shifts of ten hours each:

One chief engineer and electrician	$ 5
Eight assistants at $3 per day	24
Total cost for labor per day	$29

Supplies (lubrication and waste), $1.50 per day for each station, or for four stations, $6.00 per day, making the operating expense:

Fuel	$36
Labor	29
Supplies	6
Total	$71

The cost per kilowatt-hour (fuel, labor and supplies) would then be 7.4 mills.

The Diesel station would deliver to the low-tension feeders all of the current generated while the steam plant, operating through high-tension lines with transformers and rotaries, would probably not do better than sixty-five per cent, so that a steam plant must deliver current on the switchboard at the central power-house at not to exceed five mills per kilowatt for fuel, labor and supplies to equal the economy of the Diesel engine for current delivered to the low-tension feeders.

As the amount of low-tension copper would be exactly the same regardless of the system installed, this cost can be eliminated from the comparison of the two systems, so also the cost of the track and bonding.

The cost of each rotary station building would about equal the cost of building for each Diesel station and we have only to compare the cost of the steam plant, electrical equipment and building, plus the high-tension line and transformer station equipments, against the cost of the Diesel engines, with generators and storage batteries as follows:

Each Diesel station consisting of one 225-brake-horse-power engine, one 150-kilowatt, direct-current generator and switchboard, one 240-ampere-hour battery, which could be completely installed, including foundation, for $35,000; or four stations for $140,000.

A steam-driven plant for a road of this character, however, would install in the power-house two 600-kilowatt units, one of which would act as a reserve under usual operating conditions. Each substation would in all probability be equipped with two 300-kilowatt rotaries, with step-down transformers and devices necessary for their operation, one of the 300-kilowatt units being relied on as a reserve capacity.

A fair average cost of this equipment using rotary substations would be about as follows:

A 1,200-kilowatt steam station including engines, boilers, stack, generators, step-up transformers, switchboard and auxiliaries, at $95 per kilowatt, completely installed	$114,000
Building foundations	15,000
Fifty miles of three-phase, high-tension line, at $650 per mile	32,500
Four transformer stations, equipment complete	64,000
	$225,500
Showing a saving in first cost for the Diesel system of	$85,500

The installation of the storage battery in connection with the Diesel engine would eliminate any necessity for reserve generating apparatus, as the combined capacity of the generating equipment and storage reserve in each station would be equal to the demand for intervals long enough to meet extreme operating conditions or peak loads.

The items of interest and depreciation

Digitized by Google

(repairs) are in favor of the Diesel installations, as the first cost is less than that of a high-tension system, consequently less interest charges, and even, if we assume that the repairs on the Diesel engines are equal to the combined repairs of steam engine and boiler installations, the expense of maintaining the high-tension line and transformer stations would greatly exceed the expense of maintaining the storage batteries connected with the Diesel system.

The above statement, as presented, is exceedingly conservative, and probably more favorable to a steam-driven, high-tension system than the average figures for actual operation on a system of this size would show.

Perhaps the strongest argument to be presented in favor of the system proposed next to its simplicity and operating economy is the advantage of being able to build for present needs without in any way affecting the economy, reliability, or flexibility of the line as the future extensions become necessary or additional service added to existing lines. Each section having its own power-equipment, additional sections can be added from time to time, and equipped as though they were separate properties, while additional engine units can be added to each station as the service develops and demand for power increases. The investment can be limited to the immediate necessities without any thought as to future extensions or heavier traffic, with the advantage of decreased interest charges and a much higher operating economy because the generating units installed are always properly proportioned to the service as it exists at that time.

Blue-Print Washing Machine.

A machine devised for washing long rolls of blue-print paper printed by one of the continuous systems is being used in England. The full value of the continuous printing system can not be enjoyed if it afterwards becomes necessary to develop and wash the paper sheet by sheet. In the present machine, which is described in *Engineering* (London) for November 9, the roll of paper, after having been printed, is passed through the washing solution by means of rubber rolls driven by a small motor. A wash spray is provided for use when necessary. From the washing tank the paper passes through rubber-coated rolls which express most of the water, and then is carried through a drying oven, from which it emerges finished and dried. The oven is heated either by steam, gas or electricity.

FIRE-PROOF INSULATED MAGNET WIRE.

BY W. H. EASTON.

One of the striking tendencies of modern engineering practice is the growing demand for indestructible materials. Steel and concrete buildings, all-steel cars, fireproof theatre furnishings, etc., demonstrate the desire to obtain structures that resist those forces that combine for their destruction. The growing use of fire-proof magnet wire illustrates this tendency especially well, and it is gradually eliminating from electrical machinery the weak point, *i. e.*, inflammable insulation.

It has been the great misfortune of electrical development that the great majority of substances used for insulation are incapable of resisting heat. In view of the fact that electrical energy always produces heat, this almost rises to a positive engineering error. Cotton has been the standard insulation for magnet wire, but the use of cotton as an insulator is very much like the use of a metal with a low melting point (such as Wood's or Rose's metal) for a conductor. For, while admirable in every other of its properties, cotton is unfortunately incapable of resisting continuously a temperature of much above the boiling point of water. Burnt-out arc lamp and armature coils and roasted fields are a common occurrence and are responsible for a tremendous economic loss.

The problem of heat-resisting wire has been the study of half a century, and has been solved in various ways with more or less success. Asbestos has been, of course, the basis for the insulation of every wire of the class mentioned, and for many years inventors have been trying various methods of applying asbestos paper or twine to wire. The paper or twine has held upon the wire in most cases, either with cotton thread or a heavy coating of organic paint. In either case the strength of the whole is not more than the strength of the weakest part.

The Heany fire-proof insulated magnet wire is the last form to be produced. It differs from all previous attempts inasmuch as the asbestos is used in the fibrous condition without being worked into twine or paper. The fibres of asbestos are applied in a filmy condition to the conductor and are then saturated with an inorganic cement which forms a homogeneous, durable, flexible, uniform covering, in the nature of a paint which can be built up from a thickness equivalent to a single wrap of cotton to any desired diameter. The result of this structure is to produce an insulation that can not be destroyed by heat, no matter of what degree. There is nothing in it that can burn or decompose (except a very slight amount of gluey matter used to make the filmy insulation adhere temporarily to the wire), and coils may be obtained by the use of this wire that are practically indestructible, except be lightning or mechanical injury. In fact, coils can be made red hot without short-circuiting. This has frequently occurred in practice in the case of arc-lamp coils.

A study of the destruction of cotton-wound coils shows that they usually burn out in one of three ways:

1. By lightning. No insulation suitable for magnet wire will withstand this.

2. By being suddenly overloaded so that the temperature of the conductor rises beyond the carbonizing point of cotton. This is not apt to happen in carefully designed and properly used apparatus, but accidents do happen occasionally. The use of fire-proof insulated wire prevents destruction unless the temperature is so high as to fuse the conductor. Proper fuses should prevent the latter catastrophe, but they are often powerless to prevent a sudden rush of current that will burn out cotton, until after the damage is done.

3. By a gradual carbonizing of the cotton, rendering it friable and conducting. This is the usual course of events and it is the final fate of every cotton-wound machine, unless a very large factor of safety is allowed or mechanical injury gets at it first. The heat invariably produced while a machine is in use gradually drives out the moisture in the cotton, causing it to lose its strength. A continuation of the elevated temperature (and practically every electrical machine runs fairly hot) roasts the cotton and carbonizes it. Either the cotton finally becomes a conductor and short-circuits, or it falls to powder, allowing the adjacent conductors to touch—the result is the same in either case.

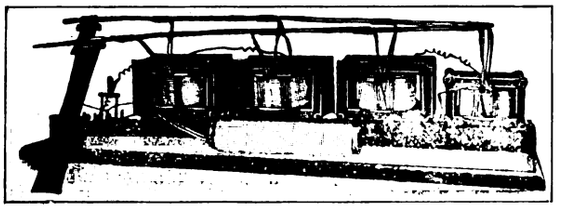
With fire-proof insulation the gradual roasting is entirely obviated. The continued temperature of 200 to 300 degrees Fahrenheit has absolutely no effect on the insulation, and in consequence coils have an almost indefinite life instead of from six months to a year, which seems to be the average life of a street-railway field coil. This gradual roasting is the fate of any insulation that contains a large percentage of organic matter, whether it also contains asbestos or not.

All heavy-service apparatus, such as rolling-mill, traction and crane motors, arc lamps, lifting magnets, transformers,

Digitized by Google

blow-out coils, etc., are in constant danger of burnouts, and it is in these forms of apparatus that the fire-proof wire is being most extensively used.

The breakdown point of the insulation 0.010 inch thick is about 600 volts. Its ohmic resistance is equivalent to cotton of similar thickness and under similar atmospheric conditions, when cold. At elevated temperatures, fire-proof insulation has a much greater ohmic resistance, however, and it is probable at operating temperatures a motor wound with fire-proof insulated wire would be more efficient than one wound with cotton.



BANK OF TRANSFORMERS WOUND WITH FIRE-PROOF WIRE.

The accompanying illustration shows a bank of indestructible transformers with a regulating reactance coil. These transformers are used to heat-resistance furnaces and take 110 or 220 volts at the primaries and deliver eleven or twenty-two volts at the secondaries. They can be overloaded indefinitely if it is required. They are wound with the Heany fire-proof insulated magnet wire, and are made up with mica, asbestos tape and twine.

Two Thousand Six Hundred Dollars in Prizes for an Electrical Solicitor's Handbook.

The Cooperative Electrical Development Association, Cleveland, Ohio, announces an offer of $2,600 in prizes for an electrical solicitor's handbook. It will be remembered that earlier in the year the Cooperative Electrical Development Association awarded $1,000 in prizes for papers on the subject of the organization and conduct of a new-business department suitable for central stations in cities of 50,000 population and under. The prize winners were announced at the Atlantic City (N. J.) convention of the National Electric Light Association, the committee which sat in judgment upon the papers being appointed by President Blood, of the National Electric Light Association. Through the cooperation of the technical press and also by means of distribution in pamphlet form, these papers have received widespread publicity.

The present prize offer is the result of the joint action of the Cooperative Electrical Development Association and a cooperating committee of the National Electric Light Association. It is hoped by this means to secure contributions from managers of new-business departments and solicitors, which may be compiled into a handbook for use by central station men generally. The contributions will be divided into three classes, and the prizes will be awarded as follows:

One thousand dollars for the "Light" section, of which $500 will be awarded as the first prize, $300 as the second prize, and $200 as the third prize.

One thousand dollars for the "Power" section, of which $500 will be awarded as the first prize, $300 as the second prize, and $200 as the third prize.

Six hundred dollars for the "Heat" section, of which $300 will be awarded as the first prize, $200 as the second prize, and $100 as the third prize.

A pamphlet is in course of preparation, which will contain general suggestions for the benefit of those who will compete for these prizes. This pamphlet will be sent to any one interested upon request.

A committee appointed by the National Electric Light Association will sit in judgment upon the contributions, and its decision, which will be arrived at just before the next convention of the National Electric Light Association, will be announced at the convention.

The winning contributions, or a combination of winning contributions, will be utilized in such a manner as to confer the greatest benefit to the electrical business along lines which will be determined by the joint committee at some future time.

This offer affords an opportunity for the man connected with the commercial development of central station practice to make a valuable contribution to the literature of the subject, to increase his prestige and establish his reputation, and at the same time to secure a pecuniary reward commensurate with the effort made.

Automatic Electric Motor-Driven Pumping Plant.

A successful induction motor-driven pumping plant for supplying railroad water tanks is in operation on the Lake Shore & Michigan Southern, at South Bend, Ind., is described in the *Railroad Gazette* for November 23. The pumping outfit consists of two Worthington single-stage turbine pumps, each direct-connected to a six-pole, seven-and-one-half horse-power, three-phase, 440-volt General Electric Company induction motor. Two pumping sets are installed, so that in case one set fails, repairs can be made without shutting down the plant. Power for operating the induction motors is taken from the lines of the St. Joseph & Elkhart Power Company.

The pumping house is a round brick structure, erected at the top of a concrete-lined wall. The floor is of concrete, supported by I-beams, and is ten feet below the level of the ground. On this the pumps are erected, and for keeping the pump room dry, four ventilating ducts are built into the wall of the pump house, the outlets appearing in the pilasters in the exterior view.

Each pump discharges water through a two and one-half-inch pipe, connecting with a four-inch main which leads to the supply tank. This tank is located at the side of the tracks about 100 feet from the pumping station. The controlling device is arranged in the housing on the roof, the motors being started and stopped automatically by a small oil-switch operated by a float which has a vertical movement of about one foot. The difference in level in the tank corresponds to 3,000 gallons of water. This is the average amount taken by a locomotive, and is replenished by the pumping set in about twenty-five minutes. The supply tank holds about 50,000 gallons and could supply fifteen locomotives within a few minutes if necessary. However, such a heavy demand will probably never be made, and in actual practice the pumps stand idle for the greater part of the time.

To Harness Victoria Falls.

A despatch to the New York *Sun* from Berlin states that the long-discussed scheme of harnessing the Victoria Falls of the Zambesi river will be begun immediately with united British and German capital. When the works are completed, electric power will be supplied to the industries of Rhodesia and the Transvaal, including the Rand. Probably many railways will be electrified later on, getting their power from the same source.

The Kaiser is greatly interested in the undertaking. He has sent a message to the London branch of the syndicate expressing great pleasure to find serious Britons and Germans cooperating in such an enterprise because it furthers the cause of international peace, which he has so much at heart. The British have the predominating interest in the scheme and will control it.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

SAO PAULO TRAMWAY—At a special meeting of the stockholders of the Sao Paulo (Brazil) Tramway, Light and Power Company, Limited, held recently, the propositions to increase the capital stock of the company from $7,500,000 to $8,500,000 and to increase the directorate from nine to ten members were ratified.

NEW POWER SYNDICATE—It is announced that Buffalo (N. Y.) capitalists have formed a syndicate to take over the charter granted in 1893 to the Economic Power and Construction Company. This gives the company very broad powers in regard to the securing of property for its purposes. The capital of the syndicate is stated to be $2,500,000.

TO INCREASE CAPITAL STOCK—The New York & Port Chester Railroad Company has applied to the state railroad commission for authority to increase its capital stock from $250,000 to $20,000,000 and for permission to issue a mortgage for $20,000,000 toward the expense of building the road. President W. P. C. Gotshall testified that the road's construction will cost $40,000,000. The commissioners took the matter under advisement until December 11.

NEW HAVEN ROAD BUYS TROLLEY LINES—The New York, New Haven & Hartford road has acquired the Ray system of street railways, including seventy miles of electric lines in northern Rhode Island and southern Massachusetts. The terms were not given out. The lines included are the Woonsocket Street Railway Company, paid-in capital, $300,000; the Milford, Attleboro & Woonsocket Street Railway Company, $318,000; the Columbian Street Railway Company, $100,000, and the Providence & Burrillville Street Railway Company, $417,000. The New Haven now controls practically all the street railways between Providence and Worcester.

WIRELESS CONSOLIDATION DENIED—The announcement made last week of the consolidation of the interests of the Marconi and De Forest Wireless Telegraph Companies into the United Wireless Telegraph Company, organized with a capital of $20,000,000 under the laws of Maine by Abraham White, president of the American De Forest Company and others, is denied by John W. Griggs, president of the Marconi Wireless Telegraph Company of America. Mr. Griggs states that the United Wireless Telegraph Company has not secured fifty-one per cent of the Marconi company's stock, and that the Marconi officials are not interested in any way in the United company. It is also said that the London Marconi Company has no information concerning the merger and does not consider such possible.

THE NEW YORK & NEW JERSEY RAILROAD COMPANY announces that the tunnels which it is building from Morton street, Manhattan, to a point contiguous to the Lackawanna railroad station, Hoboken, N. J., will be in operation by about July 1, 1907. The company is not going to wait until the extensions of the old Morton street tunnel route are built before running cars through the tunnel. The contract for furnishing the tunnel with an electrical equipment was awarded a month ago, and the proposed power plant to be erected in Washington street, between Jersey City and Hoboken, as well as three substations, will be built early next summer. It is possible that by July 1 the Sixth avenue (Manhattan) extension will be built up to Fourteenth street and that the Astor place extension will also be ready for use. The company's terminal station is to be at Sixth avenue and Thirty-third street.

PLANS FOR UNION OF CHICAGO EDISON AND CHICAGO SUBWAY COMPANIES—Plans for the union of the Chicago Edison Company with the Chicago Subway have been changed, so that instead of a guarantee of dividends reaching nine per cent, the Chicago Subway, through a sub-company, will issue $27,000,000 four and one-half per cent fifty-year bonds for the $13,500,000 share capital of the Chicago Edison Company. This will guarantee the nine per cent dividends of the Chicago Edison Company. The stock will be placed under the collateral trust four and one-half per cent bonds. It is estimated that the development of the Chicago Edison Company will require $15,000,000 in the next five years, which the Chicago Subway must furnish in one way or another. To cover these requirements and the financing of the subway a blanket mortgage of $100,000,000 is under consideration. It is stated that eighty per cent of the Chicago Edison Company shareholders have signified directly and indirectly their assent to the sale of their stock to the Chicago Subway.

EXTENSIVE UNDERGROUND TELEPHONE SYSTEM—The Delaware & Atlantic Telegraph and Telephone Company has completed its conduit system between Wilmington, Del., and Philadelphia, Pa., and it is now in use, the overhead wires having been abandoned so far as the trunk lines are concerned. Some of the pole lines will be retained for use as branch lines, for the convenience of settlements and subscribers along the route, but all of the through wires are now under ground. The underground system between Philadelphia and New York, built by the Bell Telephone Company, with which the Delaware & Atlantic is affiliated, is also finished and in use. The company is now planning an underground system between Wilmington and Washington, and has men at work making the survey, and the company will, in all probability, construct the line next year. It will employ the same method as that used in building the Philadelphia line, beginning operations at several points simultaneously and have the men work toward each other. When this work is completed the Bell Telephone Company and the Delaware & Atlantic Telegraph and Telephone Company will have a complete underground system between the national capital and New York city. When the tunnels under the North and East rivers are completed the cables will be run under the rivers, giving connection with all of the boroughs of New York city.

RAPID TRANSIT LINE FROM BUFFALO, N. Y., TO NIAGARA FALLS—A certificate of necessity has been issued by the state railroad commission to the Frontier Electric Railroad,which is to be a new line of the International Railway Company, running over its own right of way from Buffalo to Niagara Falls. Engineer Ricker, of the International Railway Company, testified before the commission that the construction of the new line would cost, exclusive of terminals, about $2,300,000. The road will run over a route similar to the one now used by the company's Niagara Falls line, about half a mile to the eastward. President Henry J. Pierce, of the International Railway Company, states: "It is the company's plan to build and operate the best appointed and the fastest suburban electric railway in America. The schedule will call for a forty-five-minute run. The cars will be of the most improved type and the roadbed will be the best that the engineers can lay. Work will begin early next summer, and the road will be in operation late next fall. The old line to the falls will be continued as at present. The traffic on the falls line has grown so rapidly, and has reached such proportions, that at times there has been great difficulty in handling the crowds. More people come to the falls every year, and the trolley route from Buffalo is growing in popularity. The company has become convinced that in the near future its present service will be entirely inadequate, and the new line will be built to meet the demands of the increasing traffic."

NEW PUBLICATION.

A NUMERICAL LIST OF PUBLICATIONS IN FORCE—The Allis-Chalmers Company, Milwaukee, Wis., has published a numerical list of publications in force October 1, 1906. This includes matter descriptive of electrical machinery, flour-mill machinery, mining and crushing machinery, power machinery, pumping machinery and saw-mill machinery. Within the past fifteen or sixteen months the company has covered with new bulletins about eighty per cent of its products. This has taken nearly eighty publications, averaging about twenty-four pages. When the list of bulletins is completed the number will be considerably in excess of 100.

Digitized by Google

PERSONAL MENTION.

MR. LE ROY CLARK has been elected president of the National Steel and Wire Company, succeeding Mr. Everett B. Webster, who resigned some time ago. Mr. Clark is also president of the Safety Insulated Wire and Cable Company, a subsidiary concern of the National company.

MR. EVERETT W. BURDETT, a well-known lawyer representing several of the largest electrical firms in Massachusetts, addressed the Lowell (Mass.) section of the American Institute of Electrical Engineers recently on the subject, "Public or Private Ownership of Public Utilities—Which is Preferable?"

MR. ROBERT McF. DOBLE, of Colorado Springs, Col., formerly of San Francisco, Cal., has been retained as consulting and supervising engineer by Messrs. Curtis & Hine, general managers of the recently organized Central Colorado Power Company, in the development of their large hydroelectric power projects on the Grand river, Col.

MR. CHARLES M. JACOBS, consulting engineer of the Pennsylvania, New York & Long Island Railroad Company, and who as such planned and has had charge of the work of the Pennsylvania Railroad tunnels under the North and East rivers and Manhattan, has been retained by the French government in the undertaking of building a tunnel under the River Seine, from Rouen to Havre. Mr. Jacobs has prepared plans for the work and presented them to the government officials. Mr. Jacobs built the Ravenswood gas tunnel, the first one under the East river, and the four tubes under the North river, two for the Pennsylvania Railroad and two for the Hudson Tunnel Company, from Jersey City to Christopher street, Manhattan, and the work is three-fourths completed on two tunnels being built from the Pennsylvania Railroad station, in Jersey City, to Chambers street, Manhattan.

OBITUARY NOTES.

MR. DANIEL J. LUDWIG died on November 14 at his home in Brooklyn, N. Y. He was born in Watsontown, Pa., sixty-four years ago and served in the Civil War as a government telegrapher. Later he became superintendent of the commercial news department of the Western Union in New York city, afterward entering the service of the Baltimore & Ohio Telegraph Company. He subsequently became superintendent of the Equitable Manufacturing and Electric Company, and at the time of his death was in charge of the Brooklyn office of the Stock Quotation Telegraph Company. The widow and two sons survive him.

COLONEL WILLIAM H. REYNOLDS, well known in financial circles of New York city, Paris and London as a promoter, died at his home, 42 West Ninety-third street, New York city, November 9, after an illness of four weeks. The cause of death was pneumonia. He was born in Providence, R. I., in 1827. At the outbreak of the Civil War he joined the First Rhode Island Infantry, of which he became the commander, displaying high qualities as a leader. At the close of the war he became a cotton broker in New York. When the Bell Telephone Company determined to introduce its system abroad Colonel Reynolds was selected to be the representative, and spent about a year in England and on the Continent in the interest of the company.

ELECTRICAL SECURITIES.

While the stock market was extremely irregular during the past week, the general tendency was upward, with considerable net gains at closing. Monetary conditions continue to be a dominant factor in the market's influence, but there has been a considerable easing in rates. An interesting incident in electrical securities was the recent announcement of an increase in the stock of the General Electric Company from $60,000,000 to $80,000,000. The good showing made by the Interborough-Metropolitan, and the nearness to completion of several of the tunnel roads joining Manhattan with Long Island and New Jersey, centre attention on these industrials. It is said that the prosperity of electrical manufacturers at the present time is unprecedented, and the indications are that this condition will continue for some time.

ELECTRICAL SECURITIES FOR THE WEEK ENDING NOVEMBER 24.

New York:	*Closing.*
Allis-Chalmers common	17½
Allis-Chalmers preferred	44½
Brooklyn Rapid Transit	79⅛
Consolidated Gas	138½
General Electric	175
Interborough-Metropolitan common	36½
Interborough-Metropolitan preferred	76½
Kings County Electric	150
Mackay Companies (Postal Telegraph and Cables) common	73
Mackay Companies (Postal Telegraph and Cables) preferred	69
Manhattan Elevated	143
Metropolitan Street Railway	106
New York & New Jersey Telephone	126
Western Union	85¼
Westinghouse Manufacturing Company	151

The stockholders of the General Electric Company, at a special meeting held at Schenectady, N. Y., on November 20, voted to increase the capital stock of the company from $60,000,000 to $80,000,000. The stock represented at the meeting amounted to about 420,000 shares.

During the year ended June 30, 1906, the Brooklyn Rapid Transit Company expended $8,414,135 for construction and betterments. During the previous year it expended $5,596,811 for the same purposes. During the last fiscal year the combined operating expenses of the system amounted to $10,441,377, against gross earnings of $18,473,328. The operating expenses for the previous year amounted to $9,803,870, against gross earnings of $16,333,444. The percentage of operating expenses to gross in 1906 was 56.52, as compared with 60.02 in 1905. The increase in gross in 1906 was equal to 13.1 per cent, against an increase equal to 6.5 per cent in operating expenses.

The annual meeting of the Metropolitan Securities Company will be held at the office of the company, 621 Broadway, New York city, on December 12. For the purposes of this meeting the transfer books closed on November 27 and will reopen on December 13.

At the special meeting of the stockholders of the Western Union Telegraph Company, the directors, or executive committee, were authorized to sell at any time, in their discretion, part or the whole of $25,000,000 four per cent gold bonds maturing November 1, 1936.

Boston:	*Closing.*
American Telephone and Telegraph	136
Edison Electric Illuminating	230
Massachusetts Electric	69
New England Telephone	129
Western Telephone and Telegraph preferred	80

The American Telephone and Telegraph Company's instrument output for October is as follows: gross output, 174,107; returned, 74,382; leaving net of 99,725. Since January 1 the gross output has been 1,680,296, and the returned 555,707, leaving a net output of 1,124,579. The total now outstanding is 6,922,562.

Stockholders of the Edison Company, of Boston, at a special meeting, voted to authorize the directors to petition the gas commissioners for authority to issue 24,200 additional shares of stock.

Philadelphia:	*Closing.*
Electric Company of America	12⅛
Electric Storage Battery common	69¾
Electric Storage Battery preferred	69¾
Philadelphia Electric	8⅜
Philadelphia Rapid Transit	22¾
United Gas Improvement	97¾
Chicago:	*Closing.*
Chicago Telephone	118
Chicago Edison Light	143
Metropolitan Elevated preferred	72½
National Carbon common	86
National Carbon preferred	119
Union Traction common	—
Union Traction preferred	—

Metropolitan Elevated is showing considerable strength, advances having been made in both the common and preferred. It is now believed that dividends will be resumed after the first of the year or in the early spring.

It is stated that efforts to secure a dividend on the preferred stock of the Northwestern Elevated Railroad Company have been renewed by the stockholders, who a year ago petitioned the voting trustees for a disbursement. When the petition was presented to the trustees last year the petitioners were given to understand that the consolidation of the four elevated roads of Chicago was in a fair way of being worked out. It was understood at that time that within a year the deal would be completed under such an arrangement as would be beneficial to the holders of Northwestern preferred. The trustees of the Northwestern Elevated have agreed to give the request of the stockholders careful consideration.

Digitized by Google

ELECTRIC LIGHTING.

BASIN, WYO.—An electric light plant has been established at Basin.

COOPERSVILLE, MICH.—The village of Coopersville will install an electric light plant.

PENNSBURG, PA.—By a vote of 211 to 57, Pennsburg decided to increase its debt to $15,000 for the purpose of establishing a municipal electric light plant.

BERGEN, N. Y.—The village board has granted a franchise to the Genesee County Electric Light, Power and Gas Company, Batavia, N. Y., to construct and operate a plant in the village of Bergen.

FREELAND, PA.—The electric lighting contract has been awarded to the Freeland Consumers' Light Company. The contract is to run for three years, and lights are to be furnished at $60 each.

WILMINGTON, DEL.—The Commercial Light, Heat and Power Company, which recently obtained a franchise in this city, has turned over to the city treasurer $12,500 of the $50,000 which the company agreed to pay for public rights.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company will enlarge its plant. The company has purchased three lots on Main street, and will erect a three-story pressed-brick building to be used as a warehouse and stable.

ST. CATHARINES, ONTARIO—The city council has passed a by-law authorizing the agreement with the Lincoln Electric Light Power Company to continue the contract for eighty arc lights at $72.50 per light, which expired on November 1.

PEMBROKE, ONTARIO—By the new agreement between Pembroke and the Pembroke Electric Light Company, the company gets a franchise to erect poles and wires in the town for a period of thirty years, from January 1, 1907, and a further period if agreed upon.

SANFORD, N. C.—At a special meeting of the board of aldermen of the town of Sanford a franchise was granted the Buckhorn Power Company to enter the town. Under this franchise this company is to furnish lights by December 20 and power for manufacturing plants by July 1, 1907.

COLUMBUS, OHIO—The sinking fund trustees have accepted the $140,000 bond issue recently authorized by council for the municipal light plant. Ninety thousand dollars of the issue is to be expended for additional machinery, the remainder to be used for taking up defective bonds.

TOLONO, ILL.—The Tolono Ice, Light and Power Company has been formally organized. Officers for the balance of the year were elected as follows: H. W. Riley, president; Edward L. Brya, secretary and treasurer; A. L. Van Meter, manager; I. A. Manley, M. L. Van Meter, E. L. Brya, directors.

BLACKSBURG, VA.—The directors of the Blacksburg Power and Supply Company have placed an order with the Weber Gas Engine Company, of Kansas City, for the immediate installation of the machinery for the company's power and heating plant. The company expects to have the system in operation by January 1, 1907.

NEW IBERIA, LA.—W. P. Conery, representing the Bayou Teche Electric Light and Railway Company, of New Orleans, appeared before a special meeting of the city council recently with a proposition to buy the municipal electric light and waterworks plant. He agrees to assume the unpaid indebtedness of the plant, amounting to about $40,000.

MOBILE, ALA.—Mobile is considering the advisability of establishing a municipal lighting plant. The figures on which it bases its judgment in the matter are those obtained from Jacksonville, Fla. Jacksonville, nearly four years ago, obtained a lighting plant at a cost of $69,275, and by the end of the second year is said to have made the plant pay for itself in full.

TACOMA, WASH.—The city council has decided to ask bids for the installation of an electric plant to generate current for lighting the city. The city already owns its lighting system, but buys its current from the Seattle-Tacoma Power Company, whose contract expires in one year. Recently bids were asked for renewal of the contract and the proposals submitted were considered too high.

WINDSOR, ONTARIO—The finance committee of the council is in correspondence with the hydroelectric commission of the government in regard to bringing Niagara power to Windsor. Two schemes are being considered, one to secure just enough power to meet the demands of the city, the other to secure power for Windsor, Walkerville and Sandwich, making Windsor a distributing centre.

CENTERVILLE, MD.—At a special meeting the Centerville Light, Heat and Power Company was incorporated and the following officers were elected: W. J. Peall, president; Walter T. Wright, vice-president; J. Fletcher Rolph, secretary; Pere T. Forman, treasurer. The plant is to be operated day and night, and will not only furnish heat, light and power to the town, but will extend its lines into the country.

GEORGETOWN, WASH.—The Georgetown city council has issued permits to the Seattle Electric Company for the construction of power-plant buildings. When completed these will cover a ground space of 130,000 square feet and cost $1,000,000. The first of these buildings, which, with the machinery, is costing in excess of $500,000, is nearing completion. The buildings are to be wholly of reinforced concrete.

GREENVILLE, OHIO—The plant of the People's Electric Light, Heat and Power Company, which recently went into the hands of a receiver, has been sold for $15,000 to J. T. Blair, representing the second-mortgage bondholders. The original cost of the plant was $125,000. A committee, consisting of J. T. Blair, Frank Taylor and W. C. Pettit, has been appointed to look after the affairs of the company until a new board of directors can be elected.

RICHMOND, VA.—The council committee on light has declined the offer of the Virginia Passenger and Power Company to renew its contract for lighting the city for five years at $50 a light, and has entered into a contract with the company for one year from July 1, 1907, at $54.75 a light, with the privilege of renewing the contract for another year at the same rate. The company is to supply 800 arc lights of 1,200 candle-power each.

GREELEY, COL.—The Northern Colorado Power Company has purchased the Longmont, Loveland, Berthoud, Fort Collins and the Greeley power and electric light plants. The sale of the Greeley plant was closed in Denver by William Mayher, its manager for the last ten years. All the stockholders of the Greeley plant have sold their interests outright, with the exception of Mr. Mayher, who retains considerable stock, and is a director in the new company.

STOCKBRIDGE, MASS.—A Stockbridge lighting company has been organized, with Allen T. Treadway, president; Charles E. Hull, treasurer; Edward T. Hull, clerk. These officers, together with Daniel B. Fenn and Alexander Sedgwick, constitute the board of directors. All the capital stock has been subscribed for—$25,000 divided into 250 shares of $100 each. The system will be installed early in the spring, so that it may be in working order by the first of May.

AKRON, OHIO—To compete with local natural-gas companies, the Northern Ohio Traction and Light Company will make a reduction of fifty per cent for lighting, beginning January 1. The reduction will be from twelve to six cents per unit. The new rate with discount for prompt payment will mean a cut of sixty-seven per cent from the present rates. Additional machinery for lighting has been installed and the company will be prepared to supply almost the entire city. The same reduction is being made in Barberton.

ORANGE, N. J.—The Orange common council has passed resolutions awarding contracts for the municipal lighting plant to the Crocker-Wheeler Company and the Western Electric Company. The Crocker-Wheeler estimate totalled $33,047, and the concern will provide for that amount three Ball & Wood tandem-compound engines, three standard Crocker-Wheeler alternating-current generators, a switchboard complete and 350 arc lamps installed complete. The Western Electric Company, whose bid was $17,400, will furnish 1,200 shaved chestnut poles and approximately thirty miles of copper wire, covered.

Digitized by Google

ELECTRIC RAILWAYS.

INDEPENDENCE, KAN.—Work has been begun on the interurban electric railway to connect Independence, Chanute and Fort Scott.

TOLEDO, OHIO—The Toledo & Western Railway Company's property is to be sold at public auction at Sylvania, Ohio, December 5, at 12 o'clock noon.

NEWCASTLE, IND.—Contracts have been awarded for the power plant which the Indianapolis, Newcastle & Toledo Railway will erect west of Newcastle. The contract price is about $40,000.

BELLEVILLE, ILL.—An ordinance has been passed granting the Mascoutah & Belleville Electric Railway Company the right to construct and operate an electric line over certain streets in Belleville.

MUSKOGEE, I. T.—A movement is on foot for the building of an electric line between this city and Fort Smith, Ark. General Ira L. Reeves, who pushed to completion the street-car system in Muskogee, is at the head of the movement.

FLINT, MICH.—Franchises and rights of way have been secured for the extension of the Detroit, Flint & Saginaw electric line, from Frankemuth to this city. When this link is built electric cars can be run between Detroit and Bay City.

SPRINGFIELD, ILL.—The secretary of state has issued a license to incorporate to the Evansville, Mount Carmel & Northern Railway Company to construct a road from a point on the Cairo, Vincennes & Chicago Railroad, near Mount Carmel, Ill., to a point on the Wabash river between Illinois and Indiana.

OMAHA, NEB.—Omaha & Council Bluffs Street Railway Company will increase the capacity of its power-house in Omaha by the addition of $250,000 worth of machinery. The increase is made necessary by reason of additional car service and of the opening of two suburban lines finished recently by the company.

ATLANTA, GA.—The Georgia Securities Company, through its president, Clifford L. Anderson, and its secretary, Alfred Boylston, has filed its acceptance of the ordinance recently passed by council granting certain franchises for the use of a number of the city's streets in the construction of the Atlanta, Griffin & Macon electric railway.

MARYSVILLE, OHIO—The Magnetic Springs & Northern Electric Railroad, which is now being constructed from the former place to Richwood, La Rue and Kenton, has been granted a franchise by the county commissioners to operate the road along the county pikes 700 feet this side of Richwood and 200 feet on the north side of Richwood.

ATLANTA, GA.—S. S. Busch, Atilla Cox, Jr., and other Louisville capitalists, have purchased from J. L. Bass the entire street-railway and lighting system at Rome, Ga., at $300,000. Of this amount the franchise is valued at $40,000. The actual consideration is said to have been $175,000, the balance of the purchase money to be spent in improvements.

ATLANTA, GA.—The Georgia Railway and Electric Company is planning extensive additions to equipment, in order to relieve the congestion in street-car traffic, which has for some time seriously impaired the service. About twenty-five new cars will be added to the equipment this winter, of which nine will be of the semi-convertible type, with double trucks.

CHAMBERSBURG, PA.—A movement is on foot at Hancock to build a trolley line from McConnellsburg, Pa., *via* Hancock, to Berkeley Springs, W. Va., twenty-eight miles, passing through three states in that distance. McConnellsburg is in the midst of a rich farming country, thickly populated. The town is the county seat of Fulton county. A number of capitalists are said to be interested in the project.

ANNAPOLIS, MD.—At a meeting of the stockholders of the Washington, Baltimore & Annapolis Electric Railway the capital stock of the company was increased from $4,000,000 to $5,250,000. The increase will be through the issue of 25,000 additional shares of capital stock of the par value of $50 each. This company is building the new line from Baltimore to Washington, and owns a branch to Annapolis.

LINCOLN, NEB.—The stockholders of the Citizens' Railway Company have voted to double the capital stock of the corporation and will begin the construction of several new lines at once. One of these lines will be built to the southern limits of the city, tapping one of the best-paying territories of the traction company. The present capital stock is $100,000, and under the new arrangement will be $200,000. Much of this has already been subscribed.

ATLANTA, GA.—At a meeting of the common council of Hapeville, a franchise to lay tracks and operate electric cars within the limits of the town was granted to the Georgia Railway and Electric Company. Work on the road will start within a month and it is expected that cars will be running by the middle of March. The company, however, has been allowed one year to get the road in operation. The road will run to East Point, where it will connect with the main line.

COLUMBUS, OHIO—Philip R. Peters, Edward Delancy, McClellan Matens, Louis J. Snyder and Philip Rising have incorporated the Lancaster Traction and Power Company, of Lancaster, Fairfield county, Ohio, with a capital stock of $400,000, of which $200,000 is six per cent non-cumulative preferred. The new company will take over the existing street railway, lighting and power plants in Lancaster, and also the traction lines running from Lancaster to the Boys' Industrial School. Interested in the companies are R. E. Sheldon and E. K. Stewart, of the Columbus Railway and Light Company, and Cincinnati and Philadelphia men.

NEW YORK, N. Y.—At a meeting of the board of supervisors of Nassau county a franchise was granted to the Huntington Railroad Company to build its electric line over that section of the proposed route in the town of Oyster Bay from the Suffolk county line in Farmingdale southwardly to the Suffolk county line. The franchise was granted for a term of fifty years, free of cost, with a privilege of renewal for fifty years more at the expiration of the above-named period, at the rate of $5 per year for every 100 feet of track, with an increase every twenty-five years thereafter. Work is to be commenced within one year, the road to be completed and in operation within three years.

MILWAUKEE, WIS.—The Milwaukee & Fox River Valley Electric Road is the name of a proposed line incorporated by J. M. Seaman, of Sheboygan, and which, it is said, will connect with the Milwaukee Northern electric line at Cedarburg, extending from that point north to Fond du Lac. Mr. Seaman's plans are for a line to Plymouth, Elkhart Lake, Stockbridge and along the east side of Lake Winnebago. The Milwaukee Northern line will run alongside the right of way of the Northwestern road to points many miles distant from the other route to Fond du Lac. Reports from Sheboygan are that the new road will have a right of way over the double track of the Milwaukee Northern into Milwaukee.

SALT LAKE CITY, UTAH—The board of county commissioners has granted franchises to Salt Lake's two electric railway companies for interurban lines running between Salt Lake City, Bingham, Garfield, Sandy, Halliday and Bingham Junction. One franchise was granted to Harry P. Clark for an interurban electric railroad between Salt Lake City, Bingham, Garfield and Bingham Junction. The other was granted the Utah Light and Railway Company for a line between Salt Lake City, Sandy, Halliday, Garfield and Bingham Junction. The franchises granted give the two companies the right to construct and maintain the roads, to haul freight, express, passengers, baggage, United States mail and all other materials between any and all stations on the lines.

MOUNT VERNON, N. Y.—The New York, Westchester & Boston Railroad Company, which for months has been pushing the construction work on its proposed four-track electric road from 177th street in the Bronx to the Port Chester and Connecticut line, has practically stopped work in the upper part of the Bronx and in this city. This, it is explained, is due to the fact that the company has thus far failed to obtain a considerable portion of its right of way both in the Bronx and in Westchester county east of Mount Vernon. In Pelham Manor the company has been enjoined by the courts, and in New Rochelle the aldermen have refused to grant a franchise. It is said that the company will stop entirely unless the desired rights are obtained very soon. It is reported that negotiations looking to the purchase of the Port Chester road by a competing line which holds franchises through all the towns in Westchester county to Port Chester are now in progress.

Digitized by Google

TELEPHONE AND TELEGRAPH.

KEOKUK, IOWA—The Mississippi Valley Telephone Company will erect a new office building.

MASON CITY, IOWA—The Western Electric Telephone Company will install a central-energy system.

WAHPETON, N. D.—The Northwestern Telephone Exchange Company has let the contract for an exchange at Wahpeton.

JEFFERSON, GA.—Workmen are erecting a telegraph line along the right of way of the Gainesville-Midland Railroad, between Jefferson and Athens.

BURLINGTON, IOWA—The Gate Telephone Company has been incorporated with $10,000 capital. It is affiliated with the Mississippi Valley Telephone Company.

BETHPAGE, TENN.—The citizens of Westmoreland have organized a local telephone company. Westmoreland is twenty miles from Gallatin on the Scottsville branch of the Louisville & Nashville Railroad.

DETROIT, MICH.—The Michigan State Telephone Company has sold $1,250,000 six per cent three-year debenture bonds to N. W. Harris & Company, of New York city. The proceeds are to pay for new construction.

WARRENSBURG, N. Y.—The Chestertown Telephone Company is constructing a line from Horicon to Hague *via* Graphite, When completed, direct communication will be established with Lake Champlain points.

ANNAPOLIS, MD.—The Chesapeake & Potomac Telephone Company, it is said, proposes to submit to the council an ordinance asking the use of certain city streets in Annapolis for the laying of conduits. This will eventually mean the placing of all wires underground.

BROOKLYN, N. Y.—Work on a new wireless telegraph station in the Brooklyn navy yard has been started. The new building will be of brick and will cost about $8,000. It will be equipped with two masts and will be about five times the size of the station now being used.

BIRMINGHAM, ALA.—The Southern Bell Telephone and Telegraph Company is putting in telephone exchanges at Cordova and Carbon Hill in Walker County. The People's Telephone Company is putting in an exchange at Oakman, in the same county, which service will be extended to several mines in that section.

WINDSOR, ONTARIO—The city council has accepted a proposition made by the Bell Telephone Company for a renewal of its franchise in Windsor for a term of five years, the company to place its wires in conduits on certain streets, remove its poles from Goyeau street, give the city six free telephones and pay $750 per year for the five years.

PITTSFIELD, MASS.—Pittsfield and Springfield are to have an extra toll line early next season at an estimated cost of $40,000. There are now four direct toll lines and three auxiliary lines, which the growing business of Pittsfield finds insufficient. The proposed line will run through West Springfield, the north end of Westfield, Montgomery, Chester Center, Middlefield, Hinsdale, Dalton to Pittsfield.

TROY, N. Y.—The New York & Vermont Home Telephone Company, of Troy, has been incorporated with the secretary of the state, with a capital stock of $100,000, to operate telephone lines in Rensselaer, Washington, Saratoga, Warren and Essex counties. The company will be similarly incorporated in Vermont. The directors are: W. Levis Burk, William C. Colburn, James H. Caldwell, Irvings S. Freeman and William Connors, of Troy; William L. Hitchcock, of Cambridge, and Clarence E. Parker, H. J. Stevens, Floyd E. Cole, of Granville.

DATES AHEAD.

American Society of Mechanical Engineers. New York city, December 4-7.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.

Jamestown Ter-Centennial Exposition. Norfolk, Va., April 26 to November 30, 1907.

Northwestern Electrical Association. Milwaukee, Wis., January 16, 1907.

INDUSTRIAL ITEMS.

THE AITON MACHINE COMPANY, Harrison, N. J., in bulletin No. 3 illustrates a new armoring machine.

QUEEN & COMPANY, INCORPORATED, Philadelphia, Pa., have published a small catalogue devoted to portable test sets for all uses.

THE CENTURY ELECTRIC COMPANY, St. Louis, Mo., has ready for distribution bulletin No. 7, describing and illustrating single-phase, alternating-current motors.

THE TRAY PLATE BATTERY COMPANY, Binghamton, N. Y., it is rumored, will soon occupy a new factory and will have greatly increased facilities.

THE S. H. COUCH COMPANY, Boston, Mass., has removed its offices to 156 Purchase street. The company has been growing constantly and this change is necessary to meet the demand for more commodious quarters.

THE PHOENIX GLASS COMPANY, New York city, is mailing a unique Thanksgiving reminder to its patrons. The company states that its inner-globe proposition is a cause for thanksgiving to all who accept it.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has published bulletin No. 1417, describing smelting furnaces and accessory equipment. This apparatus is made by the mining machinery department.

THE ROCKWELL ENGINEERING COMPANY, New York city, has ready for distribution a series of literature devoted to fuel oil and burning appliances, welding furnaces, rivet-heating furnaces, brazing furnaces and metal-melting furnaces.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, in catalogue No. 1 describes and illustrates crushing and pulverizing machinery. Among the applications illustrated there are several installations of electrically driven pulverizers.

THE NERNST LAMP COMPANY, Pittsburg, Pa., has published a handsome booklet devoted to the new Pennsylvania terminal in New York city. The booklet is a short study of the lighting of this terminal.

THE WESTINGHOUSE TRACTION BRAKE COMPANY, Pittsburg, Pa., has ready for distribution a bulletin descriptive of the direct-current unit, T-2001. The text describes the Westinghouse straight air-brake equipment, schedule SM.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., will be pleased to send its November catalogue to any one interested upon request. This bulletin is devoted to a description of panel boxes. In addition to the descriptive matter, which is highly interesting, the physical appearance of this bulletin is considerably above the average in attractiveness.

THE A. D. GRANGER COMPANY, 95-97 Liberty street, New York city, has published a handsome catalogue descriptive of "Star Safety" water-tube boilers. In addition to a careful description of the boiler there are several illustrations of the details of the boiler and reproductions of views of a number of buildings where these boilers have been installed.

THE CLEVELAND GAS AND ELECTRIC FIXTURE COMPANY, Cleveland, Ohio, has put on the market an innovation in the fixture trade, which it calls its "C" box line fixtures. These goods are boxed in a small package, which is convenient for carrying in stock on shelves, and they are being received with great favor by the trade. The company is building a new factory at Conneaut, Ohio, with double the floor space of its present factory at Cleveland. Part of this equipment is already in operation.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., announces that in addition to the two alternating-current generators now in operation at the Kingsland repair shops of the Delaware, Lackawanna & Western Railroad there is to be installed an additional alternating-current, engine-type generator of 300 kilowatts, 480 volts, 225 revolutions per minute, three-phase, sixty cycles, to furnish the increased demand for power. The other two alternating-current machines have been working a little over a year.

THE BLAKE SIGNAL AND MANUFACTURING COMPANY, 246 Summer street, Boston, Mass., announces that the "Climax" solder-

Digitized by Google

ing flux tube, which was formerly put up by the Climax Manufacturing Company, Boston, Mass., has been taken over and all patents, rights, good will, etc., as far as the soldering flux tube is concerned, are owned by the Blake company. The tube will be put out in connection with the other Blake patents, such as the Blake tube flux. The Blake company announces that it has improved the quality of the tube and is prepared to fill all orders promptly.

THE STEEL CITY ELECTRIC COMPANY, Pittsburg, Pa., has appointed V. C. Gilpin, 120 Liberty street, New York city, its New York representative to succeed W. J. Bramhall. Mr. Gilpin will have charge of sales in the New York district and vicinity, and will have on hand also a large stock of goods for the purpose of making quick deliveries. The Steel City Electric Company manufactures Fullman lock nuts, Fullman patent floor outlet boxes and other electrical and mechanical specialties.

M. W. DUNTON & COMPANY, 65 Atlantic avenue, Providence, R. I., announce that a recent inventory of stock on hand showed 7,244 pounds of regular sizes of braided cotton sleevings for insulating purposes, in addition to a large quantity of special sleevings which are constantly being made up for large manufacturers. When one stops to think that it requires from 300 to 1,500 feet, according to size, to make a single pound, the enormous quantity carried by this firm will be appreciated.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has issued a booklet of twenty-eight pages entitled "Holiday Suggestions." The cover design is in three colors and is appropriate, suggesting as it does the holiday season. The first few pages are devoted to electric reading and desk lamps, many handsome designs being shown, and the next two pages to electric heating devices, the electric chafing-dish and flat-iron being given prominence. Considerable space is devoted to miniature street railways, motors, engines and motor boats. There is also descriptive matter concerning learner's telegraph outfits, flashlights, electric clocks and many other electrical novelties. Copies of this publication may be had upon request.

THE NEW YORK ELECTRIC CONTROLLER COMPANY, 21-27 New Chambers street, New York city, manufacturer of automatic electric controlling devices, reports a steadily growing demand for and great success with its apparatus. The devices which the company makes a specialty of were developed and put in use two years ago, and they were so successful in operation that the company is now receiving reorders from the same customers. The elevator controller works on any kind of a motor-driven elevator and is said to be absolutely safe and sure in its action. The controllers permit the stopping and starting of the motors from any number of points by means of any ordinary snap-switch carrying one-tenth ampere of current. This means a saving in current consumption, as the motor is so easily started and stopped that the employés do not keep it running when not actually needed, and electrical troubles due to use of hand rheostat and switch are eliminated. The wiring is simple and inexpensive.

THE NATIONAL BRAKE AND ELECTRIC COMPANY, Milwaukee, Wis., announces among recent orders for air-brake equipments the following, many of which are repeat orders: Chicago Union Traction Company, Chicago, Ill., 120 equipments; United Railroads of San Francisco, San Francisco, Cal., 110 equipments; Seattle Electric Company, Seattle, Wash., thirty-eight equipments, fourteen trailers; Norfolk & Portsmouth Traction Company, Norfolk, Va., thirty-three equipments, eight trailers; Chattanooga Railway Company, Chattanooga, Tenn., twenty-seven equipments; Northern Ohio Traction Company, Akron, Ohio, twenty equipments; Washington Water Power Company, Spokane, Wash., sixteen equipments, five trailers; Rhode Island Company, Providence, R. I., fourteen equipments; Public Service Corporation, Camden, N. J., thirteen equipments; Oakland Traction Construction Company, Oakland, Cal., ten equipments; Georgia Railway and Electric Company, Atlanta, Ga., ten equipments; St. Louis Car Company, for Tampa & Sulphur Springs Railway, Tampa, Fla., eight equipments; Illinois Steel Company, South Chicago, Ill., eight equipments; Union Street Railway Company, New Bedford, Mass., six equipments; Central Pennsylvania Traction Company, Harrisburg, Pa., six equipments; Augusta-Aiken Railway and Electric Company, Augusta, Ga., four equipments; R. W. Blackwell & Company, Ltd. (foreign), six equipments; Knoxville Railway and Light Company, Knoxville, Tenn., three equipments; Spokane Traction Company, Spokane, Wash., three equipments; Lookout Mountain Railway Company, Lookout Mountain, Tenn., two equipments; McGuire-Cummings Company (car builders), Chicago, Ill., two equipments; Butte Electric Railway Company, Butte, Mont., two equipments; Illinois Traction System, Danville, Ill., one equipment; Johnstown Passenger Railway Company, Johnstown, Pa., one equipment; International Railway Company, Buffalo, N. Y., one equipment; Duluth Street Railway Company, Duluth, Minn., one equipment; Indiana, Columbus & Eastern Traction Company, Newark, Ohio, one equipment; Everett Railway, Light and Power Company, Everett, Wash., six equipments. In addition the company has received orders for over 800 of the new type N oil-pneumatic governors and 400 emergency valves since the close of the recent Columbus street-railway convention.

NEW MANUFACTURING COMPANIES.

ALBANY, N. Y.—The K. W. Electrical Engineering Company, of Buffalo, has been incorporated with a capital of $15,000. The directors are: L. W. Whipperman, G. E. Morgan and E. W. McIntyre, of Buffalo.

ATLANTA, GA.—W. E. Carter, E. D. Kennedy, F. A. Hoyt and F. P. Provost have incorporated the W. E. Carter Electric Company with a capital of $5,000. Its purpose is to manufacture and sell gas and electric supplies.

DAVID CITY, NEB.—An electric supply company has been organized in David City with a capital of $50,000, with Edward Butler as president; M. L. Lane, vice-president, and J. R. Evans, secretary and treasurer.

Record of Electrical Patents.

Week of November 20.

836,088. LETTER FOR ELECTRIC SIGNS. Horace B. Camp, Akron, Ohio. Filed July 3, 1905. A sign with recesses for incandescent lamps.

836,093. IGNITION DEVICE FOR EXPLOSION ENGINES. Adolphe Clément, Levallois-Perret, France. Filed October 2, 1902. An igniter for multi-cylinder engines.

836,107. SECONDARY BATTERY. Louis H. Flanders, Wilkinsburg, Pa., assignor to the Westinghouse Machine Company. Filed April 15, 1905. The electrodes are encircled by an insulating member.

836,122. HIGH-POTENTIAL INSULATOR. Fred M. Locke, Victor, N. Y. Filed March 23, 1903. The supporting member is provided with a tapering hole for receiving the tapering holding bolt.

836,153. SIGNALING SYSTEM FOR ELECTRIC RAILWAYS. Louis H. Thullen, Edgewood Park, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed June 9, 1906. A block-signaling system for alternating-current railways.

836,155. ELECTRICAL CONDUCTOR AND JOINT THEREFOR. Frank J. Tone, Niagara Falls, N. Y. Filed November 11, 1905. A layer of graphite is interposed between the surfaces of the joint.

836,177. ART OF PRODUCING PIGMENTS BY ELECTROLYSIS. Edwin D. Chaplin, Boston, Mass. Filed February 3, 1906. Consists in electrolyzing a soluble acid salt of lead.

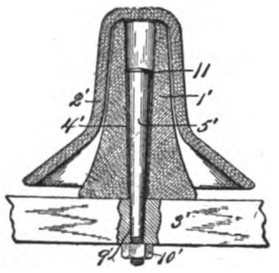
836,202. TELEPHONE-RECEIVER SWITCH. James McMahon, Oakdale, Cal. Filed July 24, 1905. A switch within the receiver controlled by a projecting lever.

836,204. TELEPHONE SYSTEM. Frederick R. Parker, La Fayette, Ind. Filed July 27, 1903. A modified central energy system.

Digitized by Google

836,243. ELECTRICALLY OPERATED RAILWAY SIGNAL AND GATE. James G. O. Combs and Isaac D. Combs, Harold, Mo. Filed April 20, 1906. The gate and signals are operated by electric motors.

836,261. MANUFACTURING ELECTRODES FOR ELECTRICAL ACCUMULATORS BY MEANS OF CONTINUALLY WORKING MACHINES. Ernst W. Jungner, Kneippbaden, Sweden, assignor to Nya Ackumulator-Aktiebolaget Jungner, Stockholm, a company. Filed September 11, 1905. Two metallic ribbons fed continuously toward each other are perforated and then receive an interposed layer of acting material.



836,122.—HIGH-POTENTIAL INSULATOR.

836,279. MEANS FOR CONTROLLING THE SUPPLY OF ELECTRIC CURRENTS. Friedrich W. Schneider, Frankfort-on-the-Main-Bockenheim, Germany, assignor to the firm of Voigt and Haeffner Aktiengesellschaft, Frankfort-on-the-Main-Bockenheim, Germany. Filed December 17, 1903. A regulator of the make-and-break type controlled by a "hot-wire."

836,280. SWITCH FOR ELECTRIC CIRCUITS. Burton G. Seavey and Walter G. Millen, Keene, N. H. Filed September 22, 1905. Terminal blocks with bridging members for making several connections.

836,282. ELECTRIC HEATING PAD. Luella W. Shellhamer, Los Angeles, Cal. Filed April 2, 1906. An insulated wire resistance surrounded by a flexible body.

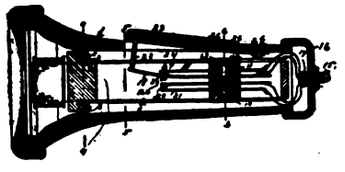
836,295. DEVICE FOR LIGHTING BY ELECTRICITY REVERSED GAS BURNERS. Paul Benard, Epernay, France. Filed November 21, 1905. An igniter for inverted gas mantles.

836,298. PROCESS OF MAKING GLASS INSULATORS OR OTHER GLASS ARTICLES. Henry M. Brookfield, New York, N. Y. Filed April 22, 1903. The molten glass is automatically divided into measured masses which are delivered to the molds.

836,307. CIRCUIT-CONTROLLING KEYBOARD APPARATUS. Patrick B. Delany, South Orange, N. J. Filed March 29, 1904. A controller for machine telegraphy.

836,314. CHARGING SYSTEM FOR STORAGE CELLS OR BATTERIES. Jacob De S. Freund, Edgewood Park, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed June 10, 1905. A system charging signaling batteries from a central source.

836,339. MAGNETIZABLE BODY FOR THE MAGNETIC RECORD OF SPEECH, ETC. Peder O. Pederson, Copenhagen, Denmark, assignor to American Telegraphone Company. Filed June 21, 1901. A blank for telegraphone records, coated electrolytically.



836,202.—TELEPHONE RECEIVER SWITCH.

836,352. SWITCH BOX. Charles E. Youmans, Yonkers, N. Y., assignor to Julia Hall Youmans, Yonkers, N. Y. Filed June 13, 1904. A water-tight switch box.

836,355. PRODUCTION OF GRAPHITE. Edward G. Acheson, Stamford Township, Ontario, Canada. Filed September 22, 1906. A method of making soft, unctuous and non-coalescing graphite by heating carbonaceous and carbide-forming materials.

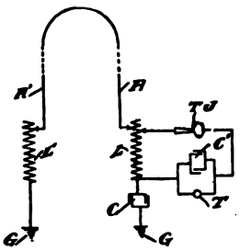
836,396. ELECTRIC OUTLET INSULATOR. John E. Moore, Davenport, Iowa. Filed October 27, 1902. A combination fixture for gas and electric outlets.

836,407. TELEPHONE ATTACHMENT. Joseph Silverman, San Francisco, Cal. Filed March 5, 1906. A spring attachment to the telephone hook for holding it in two positions.

836,427. MOTOR-STARTING SWITCH. Thorsten von Zweigbergk, Preston, England. Filed May 21, 1906. Two terminals are provided, one for determining the starting resistance and one for short-circuiting it.

836,454. TELEGRAPH KEY. Edward M. McConihay, Lewiston, W. Va. Filed December 29, 1905. A modified key.

836,480. DRY-BATTERY CELL. John W. Brown, Cleveland, Ohio, assignor to National Carbon Company, Cleveland, Ohio. Filed September 14, 1906. A battery in which the internal resistance is the same along any path.



836,531.—MEANS FOR RECEIVING INTELLIGENCE COMMUNICATED BY ELECTRIC WAVES.

836,489. TESTING SYSTEM FOR TELEPHONE LINES. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company, Chicago, Ill. Filed June 29, 1903. A testing device is normally connected with the tipstrand of the operator's cord.

836,490. DETACHABLE INCANDESCENT LAMP SHADE. Henry D'Olier, Jr., Philadelphia, Pa. Filed September 21, 1905. The shade is held to the end of the socket by clips.

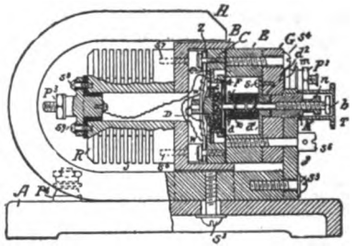
836,497. PROCESS OF IMPROVING THE MAGNETIC QUALITIES OF IRON-SILICON-ALUMINUM ALLOYS. Robert A. Hadfield, Sheffield, England. Filed August 21, 1906. The process consists in reducing the hysteresis action of an iron-silicon-aluminum alloy, low in carbon and manganese, by heating above the critical point and then cooling.

836,512. METHOD OF EXTRACTING GUTTA-PERCHA. Eulalie C. Larsen, Singapore, India, administratrix of Aime Arnaud, deceased. Filed August 23, 1905. A process for extracting gutta-percha from leaves.

836,514. TELEPHONE CORD-CIRCUIT. Albion D. T. Libby, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed September 3, 1904. A cord for a magneto system.

836,531. MEANS FOR RECEIVING INTELLIGENCE COMMUNICATED BY ELECTRIC WAVES. Greenleaf W. Pickard, Amesbury, Mass. Filed August 30, 1906. The receiver is formed of silicon.

836,581. MEANS FOR ELIMINATING OR REDUCING THE INFLUENCE OR DISTURBING CURRENTS ON TELEPHONE CIRCUITS. Charles M. Jacobs, Reading, England. Filed January 27, 1906. The receiver circuit is provided with a phonopore-winding.



836,611.—REGULATING DEVICE FOR TELEPHONE RELAYS AND TRANSMITTERS.

836,611. REGULATING DEVICE FOR TELEPHONE RELAYS AND TRANSMITTERS. Herbert E. Shreeve, Newton, Mass., assignor to American Telephone and Telegraph Company. Filed October 26, 1905. A thermal resistance is provided for regulating a variable-resistance telephone.

836,612. REGULATING DEVICE FOR TELEPHONE RELAYS AND TRANSMITTERS. Herbert E. Shreeve, Newton, Mass., assignor to American Telephone and Telegraph Company. Filed October 26, 1905. A finely divided variable-resistance material, the pressure on which is controlled electromagnetically.

836,639. CONTACT WHEEL. Edward L. Dunn, Washington, D. C., assignor of one-third to Jacob Gerke, Ballston, Va. Filed February 21, 1906. A ball-bearing trolley wheel.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 23. NEW YORK, SATURDAY, DECEMBER 8, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW
CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING
BOSTON
NEW ENGLAND OFFICE, ... 95 MILK STREET
LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE
TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS
One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING
CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
A Development in Radiotelegraphy . . . 917
Alternating Currents for Incandescent Lighting . . . 918
Electricity . . . 919
The Use of Storage Batteries in the Electric Lighting of Steam Passenger Equipment, by J. R. Sloan . . . 920
For the Preservation of Niagara Falls . . . 923
Transformation of Electric Power into Light, by Charles Proteus Steinmetz . . . 924
American Institute of Architects . . . 926
Polyphase Systems of Generation, Transmission and Distribution, by M. A. Sammett . . . 927
Production of Electrical Machinery in 1905 . . . 929
Erie Electrification . . . 930
The Electrical Trades Society of New York . . . 930
Convention of the Northwestern Telephone Exchange Company . . . 930
Units and Standards . . . 931
Cassier's Magazine . . . 932
Death of Arthur Vaughan Abbott . . . 932
Railway Generators Operated on a Three-Wire Lighting Service . . . 932
Two Exhibitions in Holland . . . 932
The Entraygues (France) Hydroelectric Plant, by C. L. Durand . . . 933
Capacity of a Battery of Accumulators Operating at Variable Output . . 937
New Types of Incandescent Lamps, by Clayton H. Sharp . . . 938
"Seeing Electrically" . . . 943
What Is an Engineer-Constructor? by George A. Damon . . . 944
Electrical Notes from Great Britain . . . 946
The Faraday Society . . . 948
Report on the New York Telephone Situation . . . 949
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 950
METHODS OF GETTING NEW BUSINESS—"Advertising Electricity," by Frank B. Rae, Jr . . . 952
American Institute of Electrical Engineers' Land and Building Fund . . 954
Technical Publicity Association . . . 954
Large Power Scheme for Paris . . . 954
Illuminating Engineering Society . . . 954
INDUSTRIAL SECTION:
Electric Motor Drive in the Packing Industry . . . 955
Allis-Chalmers Electric Hoists . . . 956
BOOK REVIEWS . . . 957
CURRENT ELECTRICAL NEWS . . . 958
DIRECTORY OF ELECTRICAL AND ALLIED ENGINEERING AND SCIENTIFIC SOCIETIES . . . 962
RECORD OF ELECTRICAL PATENTS . . . 963

Copyright, 1906, by Electrical Review Publishing Co.

A DEVELOPMENT IN RADIOTELEGRAPHY.

A result for which many have sought in radiotelegraphy is that of producing undamped electrical oscillations of fixed frequency. A successful method of doing this would reduce the problem of tuning to a simple matter and would at the same time greatly increase the power of a given system, since it would make possible the utilization of a train of waves to actuate the receiving device, whereas with the ordinary methods where damping occurs dependence must be placed upon the energy of the first wave. Many have attempted the solution of this important problem, with more or less success. The latest contribution to this work has been made by Valdemar Poulsen, who is well known as the inventor of the Telegraphone, that device which registers a telephone conversation on a steel disc or wire.

The line of attack adopted by Poulsen was begun by Duddell, who made an exhaustive study of the so-called singing arc. When the electric arc is shunted by a circuit containing capacity and inductance electrical oscillations may be set up around the circuit, the frequency depending upon the constants of the circuit and the conditions at the arc. Such a circuit becomes, then, a source of continued oscillations, which might be of value in wireless telegraphy, if the frequency of the oscillations can be carried high enough and if this frequency can be made sufficiently constant. Duddell succeeded in reaching from thirty to forty thousand oscillations per second, which was not sufficiently rapid. Poulsen, starting from this point, has, by making a careful study of the arc, carried the frequency to about 700,000 per second. He accomplishes this by surrounding the arc with hydrogen gas containing a small amount of hydrocarbon vapor. This frequency is sufficiently high for use in wireless telegraphy, so that the problem is thus partially solved. It remained to operate the arc under conditions which would give a constant frequency, which was finally done by holding the arc in a fixed position by means of a magnetic field, which, as is known, repels the arc; and by constructing the electrodes so as to maintain the length of the arc rigidly constant. To prevent changes in length due to the action of the arc on the electrodes the positive electrode is made of copper and kept cooled by circulating water through it; while the negative is made of carbon of larger size with a sharp edge, and is kept revolving at a slow speed so as to present constantly a new point of contact to the arc.

With this device it is possible, according to Poulsen, to obtain oscillations of any frequency desired, and at the same time to hold the frequency constant, so that tuning within one

Digitized by Google

per cent is easily obtained. The few practical tests which have been made public agree with this assertion, since communication was maintained over considerable distances with the expenditure of a small amount of power at the transmitting station. It would seem that the new method of generating electrical waves should be of the greatest importance in this comparatively new art.

There are several advantages with such a system. First, the use of undamped waves of fixed frequency makes accurate tuning possible and makes it possible also to operate a large number of stations within a given district without interference. This is a very important gain. The other gain, that of increasing the possible distance of transmission or decreasing the energy required for a given distance—which is the same thing—is likewise important, but to utilize this effect requires that advantage be taken of the prolonged train of waves sent out; in other words, the receiving devices must be such as to allow a comparatively long series of waves to set a comparatively large amount of energy into motion, which then actuates the recording apparatus. To accomplish this it is necessary that the receiving circuits be arranged so as to be set in oscillation without much damping, and since most of the recording devices now employed have a large damping effect when connected to the receiving circuit, it is desirable that these should not be connected permanently, and only after the receiving circuit has been set into oscillation. A method of accomplishing this has also been devised by Poulsen, which thus enables him to reap the benefits of his wave generator. The arrangement is simple enough, as it consists merely in making an intermittent connection between the signalling device, such as a telephone receiver, and the oscillating circuit. This can be done by a revolving star wheel or in a number of ways. The effect is to leave the oscillating circuit free to oscillate undamped, except during the periodic closing of the telephone circuit, at which time energy which has been set into oscillation by a comparatively long train of waves is turned into the telephone receiver to produce a click. These clicks succeed one another at a frequency which, of course, depends upon the number of contacts, and produce a note of corresponding pitch.

Poulsen thus seems to have contributed two important devices to the art of radiotelegraphy. He has developed a generator of undamped electrical waves and has devised a means of utilizing the energy of a train of waves. The results of a more extended experiment with this system will be awaited with considerable interest.

ALTERNATING CURRENTS FOR INCANDESCENT LIGHTING.

An interesting and suggestive section of the paper read by Dr. Clayton H. Sharp at the recent meeting of the American Institute of Electrical Engineers is that dealing with the flickering of incandescent lamps on alternating currents. Incandescent lamps, as is well known, can not be used indiscriminately on alternating-current circuits, since on low frequencies such as twenty-five cycles per second, the frequency most generally employed in this country for transmitting power, there is a perceptible and disagreeable flickering. The flickering depends upon the candle-power of the lamps and upon their so-called efficiency—that is to say, the watts per candle-power. The larger and thicker the filament, the less will it vary in temperature due to the pulsating character of the heat development. On the other hand, the higher the efficiency be—in other words, the higher the temperature—the greater will be the fluctuation of the light. But, combined with these effects, is the physiological effect. The behavior of the eye should always be borne in mind in any study of problems in illumination, and in this one it is the action upon the eye which really decides the question. The efficiency of the lamps as producers of light is apparently just as good at low frequencies as at high, so that it is resolved down to a question of the effect upon the eye. Thus, although the variation in luminosity of an incandescent lamp will be greater if the watt consumption per candle-power be low, if the intensity of illumination or the intrinsic brilliancy be carried high enough, the dazzling effect upon the eye may mask the flickering.

Low frequencies for incandescent lighting are employed in some instances. A notable one of these was the lighting at the St. Louis World's Fair, which was done at twenty-five cycles. Probably very few of those visiting the fair realized this—in fact, many could not detect a flicker even when their attention was called to it. This flickering, it may be mentioned, is in general not observable when the eye looks directly at the lamp, and is only seen when the line of vision is directed a little to one side, so that the image of the lamp does not fall upon the centre of the retina. In the latter case the eye is too dazzled to observe the variation. It is still a question, however, whether the variation which does take place but which is not observed under proper conditions tires the eye more than a uniform light or one at such a frequency that the variations can not be observed. It may be mentioned that two effects occur if the frequency be increased. Thus not only is less time allowed for a change in the temperature, but there is a similar effect upon the eye which renders it incapable of following the more rapid variations.

The development of the metallic-filament lamps naturally suggested that since the characteristics of the metals give the lamp a certain amount of inherent regulation, that it might be possible to use such filaments on alternating currents of frequencies lower than those found suitable for carbon-filament lamps. In other words, since the resistance of the filament increases with the temperature, the current, and hence the temperature of the filaments will vary less during the cycle than will those of a corresponding carbon filament. This is true, but unfortunately another characteristic of the metallic filament offsets these advantages. Since the metal has a lower resistance than carbon, the filaments are made much thinner and longer, and therefore, having a greater radiating surface for a given weight, will follow the energy changes more rapidly.

Digitized by Google

To determine just what will be the result, Dr. Sharp conducted a number of experiments with the idea of not only determining the performance of the metallic filaments at various frequencies, but of comparing such lamps with carbon lamps. The results were, it seems, rather unfavorable to the type of metallic-filament lamp employed—the tungsten lamp—but this may be explained by the fact that they were compared with thirty-two-candle-power carbon lamps. The comparison was entirely fair, since the tungsten lamps had a higher candle-power than the carbon lamps, but, of course, the thirty-two-candle-power carbon lamps would naturally show less variation than sixteen-candle-power lamps of the same efficiency. This comparison was made by direct observation. A further examination was, however, made stroboscopically to determine the actual variation in luminous intensity during the cycle, and a comparison was made in this way of a number of carbon-filament lamps. The result shows that in general the more efficient the filaments the greater the variation at low frequencies, but, as the frequency increases, the curves approach, and that for a high-efficiency filament may fall below the curve for one of lower efficiency. A very interesting feature of these curves, showing variations in luminous intensity, is the sharp bend which takes place between twenty-five and thirty cycles. The variation in luminous intensity was found to decrease rapidly with an increase in frequency up to twenty-five cycles. Beyond this point the decrease is much slower. This, as pointed out by Dr. Sharp, suggests that if thirty cycles or thereabouts should be adopted for power circuits that the conditions are very much more suitable for direct incandescent lighting.

It might be in some cases that a frequency of thirty cycles would, in the end, be more economical than transmission at lower frequency, and then conversion to a higher one or to direct currents; for while the alternating currents might require the use of less efficient lamps to produce equally satisfactory results, they would still save the losses due to transforming apparatus, besides giving a simpler system. For example, one of the curves given in Dr. Sharp's paper shows that a 3.1-watt lamp has a maximum variation of thirteen per cent on thirty cycles, while a metallized-filament lamp has a variation of about twenty-three per cent. However, the curves also show that the curve for the 3.5-watt lamp lies between the other two. In other words, a considerable gain in steadiness is secured by substituting for the metallized filament lamp a 3.1-watt lamp. But a change from 3.1 to 3.5 watts makes matters worse again. Curves for carbon lamps rated at eight candle-power had the same general characteristics as those for sixteen-candle-power lamps, but, as is to be expected, the variation of these thinner filaments is considerably greater for the lower-efficiency lamps. There seems to be little effect upon the high-efficiency lamps, such as the metallized filament. A similar curve for a tungsten lamp rated at thirty-five candles, one and one-quarter watts per candle, is much flatter. There is apparently a slight bend a little below twenty cycles per second, but the variation in luminous intensity is considerably greater than that of the carbon lamps, as it is thirty-seven per cent at twenty-five cycles, thirty-two per cent at thirty cycles, and even at forty cycles has only fallen to twenty-two per cent.

The study is of much interest and importance, since it calls attention to a phase of the lighting problem a further study of which may bring forth valuable results.

ELECTRICITY.

It is an interesting fact that the newer theories of electricity bid fair to restore that old and significant term to its original important position. For the past twenty years this word has been avoided by physicists and engineers who have made a study of the branch of physics designated by it, and left to the popular writer and the layman. This avoidance has been due to a feeling of the unsuitability of a term which implies an entity when referring to something which the initiated prefer to consider energy. The distinction is here made between matter and that which enables matter to do work, and the latter is called energy, though, of course, the mere designating by a distinctive term is not an explanation. But the newer ideas carry us back to the older ones. In the electron theory, electricity is really treated as though it were a form of matter, and we have been taken back to the old fluid theory, modified in important ways so as to agree with more recently acquired knowledge. The new school therefore feels no compunction in speaking about "electricity," for it actually thinks of it as small particles, very mobile and capable of exerting powerful forces. It feels no need of adding the saving clause, "a current of," an expression which is not intended to be taken literally by those who use it, but simply as implying a certain condition.

But, in acquiring this old word and all that it implies, the inheritance is not an unmixed blessing, for, unfortunately, the current of electricity as now thought of flows in the direction opposite to that indicated by all our symbols and terms. It is a negative current flowing from points of low to points of high potential—a current which goes uphill, as it were, against the direction of motion of what we call positive materials in the electrolytic bath. It is unfortunate that the early investigators found it more convenient to take glass as a positive generator, rather than sulphur, for their thoughtless choice has resulted in a condition which is very puzzling to students and others who attempt to adapt their notions to the new theories.

There is one point in the new theory which is not yet sufficiently clear. While it may be entirely proper to speak of particles of electricity or of "electrons," is this electrical particle believed to be indestructible? Is it conceivable that, to use the old phrase, they may be discharged? If so, then what? Are the effects they produce due simply to their motion, or would they be the same if the particles could be nailed down, so to speak? Is the new school simply carrying us back one step further, and is electricity simply finely divided matter in a peculiar condition which we do not as yet know how to change?

Digitized by Google

The Use of Storage Batteries in the Electric Lighting of Steam Passenger Equipment.

By J. R. Sloan.

IN a successful system of electric lighting of passenger cars in steam-railroad service, the storage battery is an essential portion of the equipment, regardless of the particular system of lighting which may be used, if a perfect service is to be rendered.

Perfect service implies that there shall be available at all times a sufficient volume of current to meet the demands that are made, and that this current be supplied at the predetermined voltage.

While it is true that there are electrically lighted trains on various railroads which do not include storage batteries as a portion of their electrical equipment, nevertheless, the above holds true, and should the train be broken up after nightfall to cut a car in or out, some other source of illumination, such as gas, must be depended upon if a battery be not used.

This situation also occurs at division points where the locomotive is changed, although the difficulty may in this case be overcome by connecting the train to the local electric plant and throwing a change over-switch.

With any system of so-called axle-generators, or generators which are driven by power transmitted from the car axle, a storage battery is necessary, as it provides the only means whereby power may be obtained while the car is at rest, or running below the "cutting-in" speed.

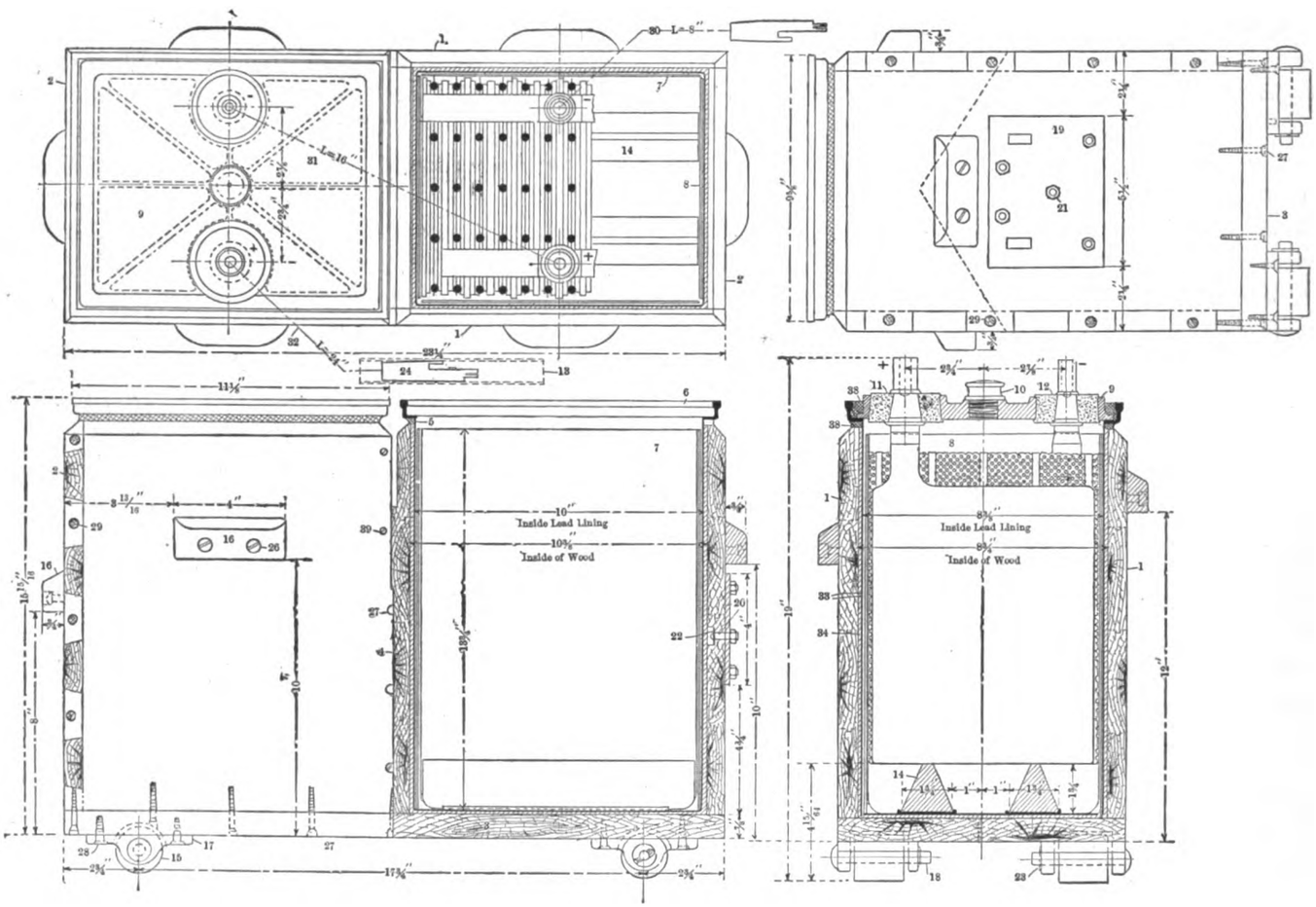
At the present writing, batteries are used in this service in the following ways: "straight storage," and in conjunction with axle and steam-driven generators.

"Straight storage," as the term would indicate, means that all the current used *en route* is obtained directly from the battery. The battery is charged at the terminal points of the car's run, either by charging while in place on the car, or by removing the exhausted set and replacing it with a fully charged set.

If charged while on the car, the lay-over must be sufficiently long to permit the batteries to be charged from the yard plant, and the yard master must also "spot" the car so that it may be connected to the yard outlets. If the batteries are exchanged it is necessary that the yard master leave openings so that the cars may be readily accessible. The labor involved in changing is considerable, while the continual handling results in a more rapid deterioration of the elements.

The necessity of "spotting" the cars or making the openings and then leaving them undisturbed is a cause of great inconvenience to the yard master, especially in a congested yard.

When batteries are used in conjunction with steam-driven generators, past practice has been to float them across the line in parallel with the lamps. As the lamps must be of such a voltage that they will burn normally when the battery dis-



THE USE OF STORAGE BATTERIES IN THE ELECTRIC LIGHTING OF STEAM PASSENGER EQUIPMENT. (SEE TABLE ON PAGE 921).

Digitized by Google

charges, it follows that during all the time lamps are burning the generator can not be operated at a voltage sufficient to fully charge the batteries, as this would result in blackening the lamps, thus decreasing their candle power and materially shortening their life, due to high voltage.

On the other hand, were the generator operated to produce normal voltage at the lamps, the output of the machine would be reduced to such an extent that it would not pay to run it, because the batteries, being electrically so much nearer the load, would assume it, and, if they were fully charged, might even drive the generator as a motor; or, if the line was provided with underload or reserve current-breakers, open the breaker in an attempt to do so.

On account of the above conditions, it is customary when lamps are burning to operate the generator at a voltage which is a compromise between the two extremes, so as to give about eight per cent excess voltage at the lamps, allowing the battery to carry a portion of the load. While this results in a more or less blackening of the lamps and shortening of their life, the principal objection from an operating view is that in case of failure of the generator or inability of the locomotive to supply steam, the batteries are not fully charged and, in consequence, a failure of lights may result.

The ideal system of electric train lighting would be one which would permit the generator to carry the full lamp load at normal voltage, and at the same time permit the batteries to be fully charged, thus ensuring an adequate reserve of power to carry the load, in case of failure of the generating apparatus or of the locomotive to furnish steam, and also obviating the necessity of expensive terminal plants.

When the writer first entered the field of electric train lighting, the batteries in use were much smaller in capacity than are now generally used, and were floated across the mains as above described. They were used in open-top hard-rubber jars, with hair-pin or ring separators, with bolted connections. These jars were placed in wooden crates, four or six to a crate, and adjacent cells were connected by means of flexible rubber-covered wire with lead ends which were bolted to the battery terminals.

On account of the open tops, the shock of coupling the cars and the vibration while *en route* would cause the electrolyte to splash over, soaking the wooden crates. This, and the electrolyte carried off by the evolution of gas while charging, would result in the batteries becoming heavily grounded, and the loss of electrolyte would necessitate frequent attention to maintain it at the proper height and of the correct specific gravity. In many cases this grounding was sufficient to cause a hole to be burned through the jar.

The many bolted connections were also a source of serious trouble, it being seemingly impossible to maintain a good connection, while the brass bolts and nuts, though lead-covered, were soon corroded by the acid. Also on account of having to scrape the battery terminals and connector lugs, so as to obtain clean and fresh contact surfaces, each time the battery was overhauled, the terminals soon became very weak and broken connections at these points were frequently found.

REFERENCE TABLE FOR TANK EQUIPMENT SHOWN ON PAGE 920.

No.	Piece.	Name.	Material.
1	2	Tank sides	Wood
2	2	Tank ends	Wood
3	1	Tank bottom	Wood
4	1	Tank partition	Wood
5	2	4 lbs. lead lining	Lead
6	2	Cover frame	Lead
7	4	Rubber side lining	Hard rubber
8	4	Rubber end lining	Hard rubber
9	2	Covers	Hard rubber
10	2	Vents	Hard rubber
11	2	Positive terminal bushing	Sponge rubber
12	2	Negative terminal bushing	Sponge rubber
13	1	Connector sleeve	Soft rubber
14	4	Bottom insulators	Porcelain
15	4	Rollers	Porcelain
16	6	Buffers	Porcelain
17	4	Roller bracket, Patent No. V., 5024	M. I.
18	4	Roller bracket spindles	Steel
19	1	Hook plate	Steel
20	5	¼-inch button-head bolts	W. I.
21	5	¼-inch nuts	W. I.
22	5	¼-inch washers	W. I.
23	4	⅛-inch cotter pin	W. I.
24	1	Westinghouse connector, male	Brass
25	1	Style No. 11,557, female	Brass
26	12	No. 10, 1-inch round-head wood screws.	Brass
27	26	No. 10, 1½-inch flat-head wood screws.	Brass
28	16	No. 14, 1-inch flat-head wood screws.	Brass
29	32	3-16-inch wood dowels	Wood
30	1	No. 6 flexible R. C. wire, L-8-inch	..
31	1	No. 6 flexible R. C. wire, L-16-inch	..
32	1	No. 6 flexible R. C. wire, L-24-inch	..
33	..	Petrolyte	..
34	..	Paraffine	..
35	..	Paint	..
36	..	Solder (hard)	..
37	..	Solder (special low melting)	..
38	..	Sealing compound	..
39	8	No. 6, 1½-inch flat-head wood screws.	Brass

On account of the separator used, dead cells were a common occurrence, due to the active material bridging the space between the plates.

The loss of active material on these early batteries was excessive and the mud space was entirely inadequate, so that it was found necessary to thoroughly clean the battery about every three months.

All of these conditions militated against the battery and as a consequence their life was short, the depreciation averaging about twenty-five per cent per annum.

The first improvement was the substituting of a ribbed, perforated, hard-rubber sheet separator for those of the hair-pin or ring type, and this materially decreased the number of short-circuited cells. As the breakage of the hard-rubber jars was excessive and the price was continually increasing and had reached a figure that was considered exorbitant, recourse was finally had to lead-lined wooden tanks. At first these tanks were constructed with an open top, and consequently soon developed grounds in the same manner as had the open-top rubber jars. The consequences, however, were more serious, as electrolytic action of the lead lining set in and much trouble was encountered by reason of leaky tanks. As otherwise the lead-lined tanks were giving good satisfaction, it was thought that if the tanks were to be fitted with tight covers and insulated by being placed on porcelain rollers, with porcelain buffers around the sides, the trouble would be overcome. Designs embodying this idea were accordingly prepared, a cover of indurated fibre, contained in a malleable iron frame, and provided with a hollow square rubber gasket, being used, the whole held in place by "U" shaped rods passing under the bottom of the tank and through holes in the cover frame, wing nuts being used to draw the cover down tightly in place.

Where the "U" rods passed underneath the tank they were supported either by the roller brackets or by shoes so as to prevent them cutting into the wooden tank.

A soft-rubber bushing was provided for the battery terminals where they passed through the cover for the double purpose of insulating them and making the tank acid-tight.

The bolted connection was also discarded, and instead the flexible rubber-covered wire was soldered directly into the terminal of the battery, a special low-melting solder being used for this purpose.

The mud space at the bottom and the free-acid space at the top were also greatly increased.

These tanks, constructed as above described and when new and carefully assembled, entirely overcome the "grounding" of the battery and the resultant electrolytic action on the lead linings.

However, after these tanks had been placed in service it was found that the indurated fibre would disintegrate under the action of the acid, and that the rubber

Digitized by Google

gasket was neither wide or thick enough to make a perfectly tight joint.

It was also found that the iron cover frames and "U" rods were being corroded, necessitating frequent renewals of these parts.

Accordingly a sheet-rubber gasket, with the soft-rubber bushings for the battery terminals forming a part of it, was designed and wood, boiled in paraffine, was substituted for the indurated fibre. This materially improved conditions and the trouble with the iron parts corroding was considerably reduced. It was still, however, serious enough to entail considerable expense of labor and material. It was, therefore, decided to abandon the use of iron on the tanks, with the exception of the roller brackets and pins and the hook-plate, at the same time preserving the tight-cover feature. An entirely new design was therefore prepared.

The lead lining, which heretofore had been of pure rolled lead, was made of antimony lead and burned at the top to an antimony-lead casting. This casting was so constructed as to act as a reenforcement of the top edges of the tank and at the same time form a rest for the cover.

The cover was made of a flexible hard-rubber compound of a special composition, capable of withstanding a great deal of misuse without breaking.

The battery-terminal bushings were made of sponge rubber, and extra large, so as to permit the effects of any shock to be absorbed without placing either the terminals or cover under stress.

The cover was sealed in the antimony-lead top casting with a compound of petrolyte, coal tar and lamp black, made of a consistency readily workable at ordinary temperatures, and which did not run at the higher or become brittle at the lower temperatures to which it would be subjected.

It had been the custom to paint the outsides of the linings and the insides of the tanks with petrolyte as a further precaution against electrolytic action, but when the first lot of the tanks built as above described were made, it was found that if this practice were followed that the petrolyte adhered so strongly to the lining that it was impossible to remove it. The design was therefore altered to allow a clear space on all sides of one-sixteenth-inch between the lining and the tank.

When assembling the tanks, molten paraffine was poured into the wood tank to a depth of about two and one-half inches and the lining plunged while the paraffine was still hot. This caused the paraffine to rise and fill this clear space, and the lining was readily removable by simply filling same with hot water, so as to again melt the paraffine.

Tanks constructed in this manner have been in service for approximately a year, and have been carefully watched, and as yet there has been no cause for complaint, they having all the good points of the first closed-cover tanks without their disadvantages.

Special attention to the design of batteries for electric lighting of passenger equipment has been given by several companies manufacturing batteries and the results have been very gratifying.

Where formerly short-circuits and broken connections were frequent they are now a rarity, and where it was necessary to clean the batteries every three months we now find it possible to defer the first cleaning for from fifteen to eighteen months, and make the subsequent cleaning about every twelve months.

Trouble is still occasionally encountered due to "growing" and "buckling," but in almost every instance this can be traced to improper treatment of the battery.

This improper treatment is, in many cases, impossible to avoid, on account of the conditions under which the batteries are operated, but if discovered in time and the proper precautions taken, its ill effects can be almost completely overcome.

It is believed that the improvements noticed in the operation of batteries are due to three causes: First, a decided improvement in the battery itself due to a better understanding of the conditions of service on the part of the manufacturers, and improved design of the elements due to better knowledge of the internal stresses undergone by the battery. Second, the use of improved separators, and third, the improvements in the tanks as exemplified in the increased mud and free-acid space, tight covers and better insulation.

Where formerly the average rate of depreciation per annum was about twenty-five per cent, authentic records are extant of batteries which have been in continuous service in excess of four and one-half years and are still above their normal capacity and in excellent condition.

It is the writer's belief that with the batteries now being furnished the average depreciation will not exceed fifteen per cent and may possibly be as low as twelve per cent.

The use of wood separators, except where the active material on the positive is in very bad condition and the negatives are low in capacity, is not considered to be good practice. Under these circumstances the wood separators may be used and will tend to hold the active material in place and will increase the capacity of the negative.

The following specifications for train-lighting batteries have been drawn up after consultation with prominent battery manufacturers, and thought to represent the type of cell which is best suited to this work.

SPECIFICATIONS FOR 280-AMPERE-HOUR CAR-LIGHTING BATTERIES.

These specifications, together with blue prints from tracings which are made a part of same, cover a 280-ampere-hour car-lighting battery.

BATTERY SET.

Each set of batteries shall consist of the following:

Thirty-two positive elements, each made up of six (6) positive plates, connecting strap and terminal post.

Thirty-two negative elements, each made up of seven (7) negative plates, connecting strap and terminal post.

Three hundred and eighty-four perforated hard-rubber-ribbed separators.

Note—All plates and terminal posts must be thoroughly and securely burned to their respective straps.

BATTERY ELEMENTS.

The plates composing the battery elements shall preferably be made from pure rolled lead, electrochemically formed.

Both positive and negative plates shall be ribbed in a uniform manner, and there must be sufficient reserve lead in the ribs to ensure a reasonable life without due loss of capacity. These batteries must be designed for use in the double-compartment lead-lined tanks with hard-rubber covers, as shown on prints from the tracings above mentioned.

CAPACITY.

Each complete element shall have a capacity of at least 280 ampere-hours, discharging at a thirty-five-ampere rate, with the cell at a temperature of seventy degrees Fahrenheit, and the time at which the voltage has fallen to 1.8 volts per cell being taken as the end of discharge.

CADMIUM READINGS.

The voltage in any one cell at end of discharge between cadmium and positive must not be lower than 1.98 volts. The voltage between cadmium and negative, at the same time, must not be higher than 0.20 volts.

ACTIVE MATERIAL.

The active material must be uniform in structure and it must be present in sufficient volume and with sufficient surface to give the desired capacity.

SEPARATORS.

Separators are to be made of hard perforated rubber, at least one-thirty-second-inch in thickness and provided with vertical ribs of the proper size to space the plates the correct distance apart.

TANKS.

When batteries are ordered with double-compartment lead-lined tanks, the tanks must be built in accordance with the prints from the company's tracings Nos. ——.

METHOD OF SHIPMENT.

The batteries shall be shipped in their respective tanks, the plates covered with acid and in a fully charged condition, both batteries and tanks being complete and ready for immediate service upon being removed from the crate in which they are shipped.

If positive or negative elements only are ordered they shall be shipped "knocked down," and in such condition that after being

Digitized by Google

"set up" they will be ready for service after having had one full charge.

Whether shipped in tanks or "knocked down" they must be securely crated that they may not be damaged during shipment, except that when shipment is made in carload lots, the crating may be omitted, provided that the tanks are so loaded that they will not shift while in transit.

CHARGE AND DISCHARGE RATES.

Normal charging rate	amperes	hours
Maximum safe charging rate	amp. start	amp. finish
Normal discharging rate	amperes	hours
Maximum discharging rate	amperes	hours

POSITIVE AND NEGATIVE PLATES.

	Positive.	Negative.
Thickness of finished plate	.....	.....
Number of plates per cell	6	7
Weight per square foot of plate	17	12
Weight of one plate with lug	.....	.....
Thickness of ribs or projections forming the support for active material	.....	.....
Number of ribs per inch	.....	.....
Size of cross-bar or bridge	1 3-4" × 7-16"	
Size of plate	.....	.....
Thickness of centre web	.....	.....
Ratio of active to superficial area of plate	.....	.....
Per cent of total weight of positive plate available for the electrolytic action to disintegrate before the plate loses fifty per cent capacity	.....	.....

ELECTROLYTE.

Pounds of acid required for one cell	.....	.....
Specific gravity at end of charge	.....	.....
Specific gravity at end of discharge	.....	.....

NOTE—Bidders will kindly fill in the space left blank above.

The advantages which electric light possesses over other forms of illumination which have been used heretofore in such service in the way of less heat and vitiation of the air, decreased fire hazard, more effective illumination and the possibility of designing more artistic fixtures, are patent to all.

For the Preservation of Niagara Falls.

On November 26 Secretary of War Taft entertained at Washington, D. C., representatives of American and Canadian water-power interests and representatives of the American Civic Association. Arguments were made for and against the admission into the United States of electric power generated in Canada from the waters of Niagara river. Under the Burton Act for the preservation of the scenic beauties of Niagara Falls, passed at the recent session of Congress, the secretary of war is vested with the right to grant rights, within certain limitations, for the importation of power and also for the diversion of water from the river from the American side of the stream.

J. Horace McFarland, president of the American Civic Association, contended that the Burton Act specifically charged the secretary of war with the duty of preserving the scenic features of the falls, and that it was passed solely in response to the insistence of the American people that the diminution of the waters of Niagara river for power purposes should cease. He pointed out that while the act limited the diversion and indicated the limitations as to the amount of power which may be transmitted from Canada, it expressly provided that these limitations should not be construed as a direction to the secretary of war to issue permits for the diversion of water or the importation of electricity. He urged that the paramount duty of the secretary of war under the act was to see that nothing was injured or interfered with the scenic beauty of the falls. He contended that the admission of any power generated on the Canadian side is fully equivalent in its effect upon the scenic advantages of Niagara Falls to an equal diversion in the United States.

Mr. McFarland opposed any importation of power in his opening statement, but later in the day said that it was possible that the present importation of power might not impair the falls, and that he might not oppose the bringing in of 157,500 horse-power, as recommended by Captain Charles W. Kutz, of the Army Engineer Corps, who made an investigation of the matter at the direction of Secretary Taft last summer, if there could be any positive assurance that there would be no demand for additional permits. He opposed the importation of 360,000 horsepower, the amount which is sought by the various Canadian companies interested.

Clinton H. Woodruff, secretary of the American Civic Association, closed the argument for the protesting party, contending that the complete preservation of the falls could only be accomplished by international agreement, and that to grant permits for the importation of power from Canada would be to so firmly entrench the power companies that it would be impracticable, if not impossible, ever to reach an international agreement upon the subject.

The opening argument for the industrial interests along the Canadian frontier was made by W. Caryl Ely, of Buffalo, N. Y. Mr. Ely said that the commercial interests, manufacturers and population had vastly increased since the beginning of the use of Niagara for power purposes, and that part of the state would be greatly handicapped by the withdrawal of this power. He declared that the refusal to grant permits for the importation of power from Canada would be construed as an affront to the Canadian government, from which the companies had obtained their right to utilize the waters of the river, and from which the Canadian government derived a revenue. Besides, he said, the companies which had spent from $20,000,000 to $25,000,000 in developing power in Canada would, if forbidden to import power into the United States, develop a market for the power in Canada, which would operate greatly to the detriment of interests in New York state.

Francis L. Stetson, representing the Canadian Niagara Power Company, made an emphatic argument in reply to Mr. McFarland. Mr. Stetson took Mr. McFarland to task for his "sentimentality," and characterized many of his statements as untrue. He stated that the subtraction of water sufficient for 360,000 horse-power would make no appreciable difference in the scenic beauty of the falls. Mr. Stetson denied Mr. McFarland's statement, that the Canadian companies were seeking to form a monopoly which would control all the power generated on the other side, and asserted that the companies were in considerable of a quandary as to their relative possibilities for distribution of power. With regard to the cost of power, he stated that electricity in the Niagara Falls radius costs about one-fourth as much as in Philadelphia or New York, and that there was a greater demand for power than could now be supplied. No international agreement for the preservation of the falls could be reached by an action indirectly seeking to control the Canadian side of the river by prohibiting the importation of power. Such an attempt would be resented by the Canadian government, which derives a revenue from the power companies for its grants.

General Francis V. Greene, representing the Ontario Power Company, made a brief statement urging the granting of the permits. Aside from the fight which the companies are having with the American Civic Association on the question of transmitting power across the river, the companies are in serious controversy among themselves as to the division of the power. The Canadian Niagara Power Company and the Schoolkopf Companies, the pioneer concerns to develop power in Canada, claim the right to import all the power permissible under the Burton Act.

Digitized by Google

TRANSFORMATION OF ELECTRIC POWER INTO LIGHT.[1]

BY CHARLES PROTEUS STEINMETZ.

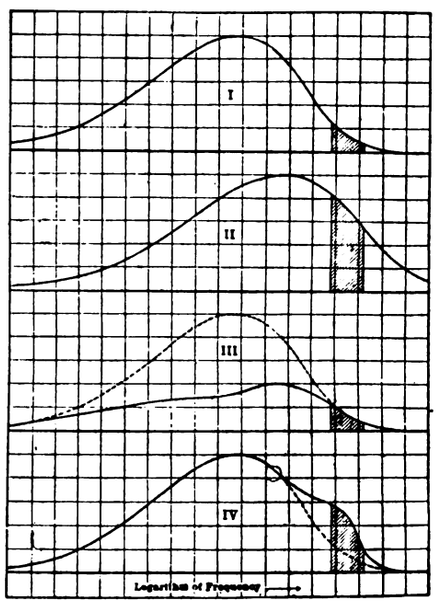
If energy is impressed upon a solid or a liquid, as by passing an electric current through a carbon filament, and no other work done, the body is heated. This energy must be given off again; it is given off partly by conduction, but largely by being radiated from the incandescent body. By increasing the power, the amount of radiation increases; and there are changes in the quality of the radiation, too: first appear radiations of very great wave-length or very low frequency, then, with the increasing power, higher frequencies appear; that is, the wave-length of radiation becomes shorter.

Of the infinite variety of waves radiated by a heated body—from the long heat waves given by liquid air to the shortest ultraviolet waves, many octaves of wave-length in all—somewhat less than one octave is visible to the eye. These wave-lengths are useful as light; the rest is wasted energy.

Of these useful rays, the visible three-quarters of an octave, none appears until the temperature is fairly high. Below that only the long waves appear. That means the average wave-length of radiation decreases with the temperature. Or, with increase of temperature, not only the existing waves become intense, but shorter and shorter waves appear, and the intensity maximum moves toward a shorter wave-length. With increase of temperature the percentage of visible radiation thereby becomes greater and ultimately reaches a maximum, or the efficiency would be the highest when the maximum intensity lies just within the visible octave. Where this maximum may be is unknown, but it is beyond the temperature of the crater of the arc, possibly somewhere between 4,000 degrees and 5,000 degrees centigrade. At that temperature the efficiency of the incandescent light is a maximum, and probably from one-quarter to one-half watt per candle-power. But even then the efficiency is not high, five to ten per cent, or thereabouts. It follows, however, that even if we could raise the incandescent body to the temperature of maximum efficiency, we would still get only about five to ten per cent of all the energy as light. The other ninety per cent would be ultra-violet, chemical or actinic rays, X-rays or long heat-waves. There is thus an absolute limit to efficiency of lighting by incandescence.

The higher the temperature the greater the light efficiency of an incandescent body. Carbon is apparently the most refractory of all substances—its boiling point being somewhere near 3,500 degrees centigrade, so an incandescent body, at the highest possible temperature, and the incandescent crater of the carbon arc are the most efficient sources of light by incandescence. They are still somewhat below the temperature of the efficiency maximum.

Incandescent lighting is effected by the electric current, either by raising the temperature of the light-giving solid body, a lamp filament, by passing a current through it or by passing the current from it into another body. In the latter case



VARIATION OF RADIATION WITH CHANGE IN FREQUENCY.

the temperature of the boiling point of the material is reached, and the crater of the carbon arc lamp is at the highest temperature which can be reached; gives it an incandescent light of maximum efficiency probably not very far from half a watt per candle-power. But the large amount of energy which is conducted away by air currents, etc., greatly reduces the actual efficiency of the carbon arc below this value.

When producing light by passing an electric current through the conductor, as in the incandescent lamp, no such efficiency can be reached. Here carbon is also chiefly used. The higher the temperature of the incandescent-lamp filament, the greater is the efficiency; but the limit of the temperature is not the boiling point of carbon, 3,500 degrees centigrade, but far below that; it is the temperature where evaporation of the filament becomes so rapid as to limit its life below economical requirements. This is probably not very far from 1,800 degrees centigrade. Far below the boiling point, evaporation takes place: water evaporates at ordinary temperatures; even below the freezing point snow and ice evaporate very noticeably. An incandescent carbon filament evaporates, thereby decreasing in cross-section, and increasing in resistance; the current decreases, therefore the temperature decreases and with the temperature the efficiency decreases. As the condensed carbon vapor blackens the globe and obstructs the light, another decrease of light results from absorption. Thus efficiency has to be sacrificed in the incandescent lamp to get good life, and the specific consumption of electric power, instead of being one watt per candle-power (as in the case of the arc lamp) becomes as high as four watts per candle-power.

The arc, then, is the more efficient illuminant. But its efficiency is still low, and here there has been a similar result; to increase the life, the efficiency has been decreased by enclosing the carbon arc, in the present long-burning lamp. Increasing the efficiency of the arc by reducing the conduction of heat by a decrease of the diameter of the carbon has also been tried, with the same result—exchanging efficiency for life.

In the incandescent lamp the problem of increasing the efficiency can be attacked in two ways. One way is to replace the carbon by a material which has a lower vapor-tension at high temperature. While carbon has the highest boiling point, it is not the boiling point which is of importance in a lamp filament, provided that this point is sufficiently high—it is the vapor-tension, far below this point.

The efficiency of the incandescent lamp can be improved by replacing the carbon filament with a material which has a lower vapor-tension and a sufficiently high melting point. Tantalum, osmium, wolfram or tungsten as materials for incandescent lamp filaments promise to revolutionize the incandescent lamp by holding out fair promise of an ultimate efficiency of about two watts per mean spherical candle-power for tantalum, 1.5 watts for osmium and one watt per mean spherical candle-power for wolfram—compared with about four watts per mean spherical candle-power for the carbon-filament lamp. The objection to these metal filaments obviously is the low resistivity inherent to metals which restricts their use to rela-

[1] A paper presented at the two hundred and fourteenth meeting of the American Institute of Electrical Engineers, New York, November 23. Slightly condensed.

Digitized by Google

tively larger units, or at least makes difficult the production of low-candle-power sizes.

Another way of improving the efficiency of the incandescent lamp is by improving the carbon. The vapor-tension depends not only on the chemical constitution, but also on the physical structure. At the boiling point of carbon the carbon deposited from hydrocarbons converts, under the influence of atoms which can enter and leave the carbon chain, into an allotropic modification having pronounced metallic characteristics, as elasticity, a positive temperature coefficient of resistance, etc., and very great stability, so that as a lamp filament this form of carbon can be run up to a considerably higher efficiency, in the so-called "metallized filament."

Most incandescent bodies give the same, or approximately the same, law of radiation, that of the so-called "black body"; that is, at the same temperature the intensity of radiation varies with the wave-length or frequency in the same manner, somewhat similar to that shown by Curve I, Fig. 1[1], with a maximum at a certain wave-length. At higher temperature, Curve II, a similar intensity curve exists, with the maximum at shorter wave-length, or higher frequency, so that the intensity within the visible range, shown shaded in Fig. 1, is a higher percentage of the total radiation—that is, the efficiency of light production is higher.

If, however, a body could be found which at the temperature corresponding to Curve I gives an abnormally low radiation outside of the visible range, as illustrated by Curve III, or which with normal radiation in the invisible range gives an abnormally high radiation in the visible range, as illustrated by Curve IV, then in either case the visible radiation would be a greater percentage of the total radiation than corresponds to the temperature, that is, the efficiency of light production would be higher than that of a black body at the same temperature. Theoretically such a body with selective radiation might give an efficiency higher than the absolute maximum of light efficiency of black-body radiation.

Either of the two cases, abnormally high radiation in the visible and abnormally low radiation in the invisible range, may give the same shape of intensity curve, the only difference being that in the first case the total radiation per unit-surface is higher, in the last case lower than that of a black body at the same temperature. That is, with the same amount of light radiation and the same efficiency, in the last case the radiating surface is greater than in the first case, and this may give a criterion to decide between the two alternatives.

With such selective radiation there is a distribution of intensity throughout the visible range, and so the color of the light may differ from that of an incandescent body. With abnormally high radiation in the visible range, the increase of intensity is probably greatest in the middle of the visible spectrum; with abnormally low radiation in the invisible, the decrease of intensity is least in the centre of the visible spectrum. In either case the tendency is towards preponderance of the wave-lengths in the middle of the visible spectrum; that is, the greenish-yellow, as characteristic of such selective radiation, and apparent in the Welsbach mantle. Typical of such selective radiation is the lime cylinder of the calcium light, and possibly the flame of burning magnesium.

With gas as illuminant, a very great increase of efficiency has resulted from the use of selective radiation, as found in the Welsbach mantle.

In electric lighting, the Nernst lamp probably represents the first attempt on a large scale of improving the efficiency of light production by selective radiation. It has not been as successful as in gas lighting, since the efficiency of the Nernst lamp does not differ much from that of the carbon incandescent lamp, while the efficiency of the Welsbach mantle is many times higher than that of the ordinary gas flame. The reason probably is that with a very inefficient illuminant, as the gas flame, the additional light given by selective radiation may increase the total light several fold, while the same amount of additional selective radiation with a relatively far more efficient illuminant, as the incandescent lamp, is a far lower percentage of the total visible radiation. Or, to illustrate, the additional shaded area between the dotted and the drawn line in Curve IV, Fig. 1, increases the efficiency threefold, while the same additional area added to the shaded area of Curve II would not materially increase the efficiency. That is, the increase of efficiency by selective radiation of an incandescent body becomes less with a more efficient illuminant, and selective radiation may greatly increase the efficiency of inefficient illuminants, but not so much that of efficient illuminants, so that the hope of very greatly increasing the efficiency of light production by selective radiation of solids does not appear very strong. However, some of the recent very efficient incandescent lamp filaments, as tungsten and osmium, may owe their high efficiency partly to selective radiation; that is, they give light not only by incandescence but also by luminescence.

The problem of efficient light production consists of producing radiations; that is, vibrations of the molecules or atoms of the light-giving body, of frequencies within a limited narrow range, that of a visible radiation, and as few vibrations as possible outside of this range. When heating a solid body, the energy put into it as heat sets the molecules or atoms in motion, in vibration. Where they are close together, as in a solid or liquid, they can not vibrate freely; each can not have a period of its own, just as all the different grains in a sand heap can not vibrate simultaneous as do the molecules of a tuning fork, and the vibration is irregular. All you can get is a mixture of all kinds of vibrations, not a tune, but a noise. To get a tune requires a body which can vibrate freely without restraint; that means a gas; as the gas molecules are free they can execute free vibration. A vibration of a definite pitch, definite frequency, that is, definite color of light, can be produced only in a gas or vapor. But when heating a gas or vapor, the energy put into it appears not as vibration of the molecules, except perhaps indirectly at extremely high temperature, but as rectilinear motion or pressure. The molecules move faster in their rectilinear paths, and so strike the boundary at higher velocity; the pressure of the gas rises by increasing molecular velocity; that is, increasing temperature, but the vibration of the light radiation does not appear. So heat, while making a solid or liquid incandescent, does not make a gas incandescent or luminous but merely increases its pressure.

There are methods, however, of setting the gas molecules in vibration. By chemical reaction or electric stress, gases become luminescent; that is, the molecules of the gas are set in vibration. For instance, if the gas is used as a conductor of electric current, then the molecules of the gas are set in vibration, and we find a definite period of vibration, or a number of periods or frequencies, in which the gas molecules or atoms can vibrate; that is, gases give line spectra. Here results a definite rate of vibration, practically independent of the temperature. For in-

[1] These curves, drawn with the logarithm of the frequency of radiation as abscissas, are only illustrative, and not quantitative nor based on experiment, but merely illustrating the statements made above.

Digitized by Google

stance, in mercury vapor the lowest frequency is that giving the greenish-yellow line, but no appreciable amount of vibration is so slow as to give red light at ordinary temperature. When you raise the temperature very high (but still below the temperature of the incandescent lamp filament) then the mercury molecule begins to execute a slow vibration, which gives an intense red light, and red lines appear in the mercury arc; with increasing temperature it gradually changes its color from green to white to red. Here we have a particularly interesting illustration that for luminescent vapors or gases the law of the black-body radiation does not apply.

As a rule, then, it can be said that such an arc or a luminescent gas or vapor is more efficient as a producer of light the lower the temperature. This is just the reverse of the solid incandescent body.

Theoretically, there is no limit to the efficiency of a luminescent vapor. A vapor may be imagined which vibrates only with one particular wave-length, say a yellow line. That means all the energy put into it must be radiated at that particular wave-length, as yellow light, and therefore the conversion of electric energy into light would be 100 per cent., not counting the energy lost by heat convection or conduction. The latter can be made very small by enclosure in a vacuum. Complete conversion of electric power into light would so result, if all the spectrum lines were within the visible range. That is never the case. There is no definite law giving the percentage of energy which appears as radiation in the visible spectrum, and which appears outside of the visible range as ultrared and ultraviolet lines; but the position of the lines in the spectrum is an individual characteristic of the gas or vapor. The problem of efficient light production is to find a material having most lines in the visible range of the spectrum.

With mercury vapor which is set in vibration by the current, a very high percentage of the total energy is radiated in the visible range. With carbon vapor, the percentage of energy radiated in the visible range is extremely small. The carbon arc is extremely low in efficiency, practically non-luminous. Silicon also gives a practically non-luminous arc. Others, like calcium, titanium, etc., give a very high percentage of light within the visible range and so a high efficiency of light production.

The color of light produced by incandescence varies from reddish-yellow at low temperature to yellow, and approaches yellowish-white at higher temperature. Selective radiation of solids tends to superpose hereon a preponderance of greenish-yellow rays, without, however, greatly changing the color. With electroluminescence of vapors and gases, however, the color of the light depends on which of the spectrum lines happen to be most prominent.

Electroluminescence makes it possible to produce light of any color. This, however, greatly complicates the question of efficiency. As efficiency can no longer be considered the ratio of the power radiated within the visible range to the total power input, since the different parts of the visible spectrum have entirely different energy-equivalents: one candle-power of red light or of violet light represents many times more power, which issues as radiation, than one candle-power of green or of yellow light. That is, the light-equivalent of power is a function of the wave-length. It is obviously zero in the ultrared, it is very low in the dark red, and gradually rises to a maximum in the yellow and green, and then decreases again, becoming very low in the violet and zero in the ultraviolet. One candle-power per watt as red light or as violet light may therefore represent a fairly high efficiency, while ten candle-power per watt, with green or yellow light, would be a far lower efficiency. That is, the energy radiated in a beam of one candle-power red light probably is greater than the energy of a beam of ten candle-power of green light.

This feature explains the impossibility of determining efficiencies of light by the measurement of physical quantities. Light is the physiological conception of some wave-lengths of radiation, but no physical quantity.

Where high economy of light production is the only or the foremost consideration, spectra in which green or yellow preponderates are therefore selected; for instance, as mercury, bluish-green in the mercury arc lamp, or calcium, yellow in the flame-carbon lamp. These two illuminants give high efficiency, but they give it by sacrificing the inefficient colors at the end of the visible range. But, unfortunately, the sun, as an incandescent body, gives the light of solids or liquids, and therefore gives all the radiations, with the red end of the spectrum specially prominent; and, since we call the sun white, the light from the mercury arc appears green, that of the flame carbon arc yellow, not the yellow of the incandescent lamp, but a pronounced monochromatic hue.

The mercury arc and the flame carbon arc are useful for cheap lighting, regardless of color. They also find an application for special effects due to their color. So the mercury arc is eminently suited for outdoor lighting in suburban districts where its effect on foliage and snow makes it superior to illuminants containing red rays, and so intensifying the appearance of incipient death in the vegetation, and where the intrinsic brilliancy of illumination can be kept sufficiently low as not to show the objectionable effect of monochromatic light. The flame carbon arc finds its field in advertising, where its intense glare makes it especially suitable.

For general illumination, at least in this country, people have become educated to require as close an approach to daylight as possible; that is, to require white light. The problem, then, is to find a vapor which gives spectrum lines over the whole visible range, distributed approximately in the same manner as the intensity in the solar spectrum, and giving as few lines as possible outside of the visible spectrum.

A substance giving spectrum lines uniformly distributed in their intensity over the whole visible range should not give white, but a pronounced green light, due to the higher physiological effect of the radiations in the middle of the spectrum. By the law of probability, amongst the spectra of the chemical elements, the predominant intensity of radiation should be found just as often in one wave-length as in any other. Physiologically, therefore, green should predominate in the colors of metal spectra. To a certain extent this is true. Red metal spectra are rare, green most prominent. Bluish metal spectra, however, are much more frequent than should be expected by probability, and it therefore seems that in molecular vibrations of vapors, shorter wave-lengths or higher frequencies predominate. This may be due to the size and mass of the molecules being such as to have a mean frequency of oscillation higher than the average frequency of visible light.

(To be concluded.)

American Institute of Architects.

The next convention of the American Institute of Architects will be held in Washington, D. C., January 7, 8 and 9, 1907. This will commemorate the fiftieth anniversary of the institute, which was founded in 1857. A bronze memorial tablet containing the names of the founders will be unveiled in the Octagon, commemorating the occasion. During this meeting the institute will inaugurate the custom of presenting a gold medal for distinguished merit in architecture. The first medal will be presented to Sir Aston Webb, the architect of the Victoria Memorial, London, who received the gold medal of the Royal Institute of British Architects and knighthood during the past year. A formal banquet will be held, at which will gather those distinguished in the fine arts, prominent government officials, representatives of educational institutions and men of literary fame.

Digitized by Google

POLYPHASE SYSTEMS OF GENERATION, TRANSMISSION AND DISTRIBUTION.[1]

BY M. A. SAMMETT.

Every electrical development possesses some typical peculiarities which should be the determining factors in the selection of the frequency of the system as a whole, as well as the selection of the generating and distributing systems as to phases, that is, whether it should be two or three-phase.

Whatever the generation and distribution, the transmission of power is always accomplished by three-phase. This arrangement allows of most economical transmission of power with a given drop in the line. While the transmission of power is invariably accomplished by three-phase, the generation and distribution is often by two-phase. A two-phase system for distribution purposes is somewhat simpler to operate than a three-phase system. The two phases may be controlled independently for single-phase lighting circuits without any appreciable effect of one phase on the other. In the case of motor connections on two-phase circuits, all that is necessary is to connect the two transformers with the primary coils to the line, and the secondary coils to the motor. No special attention is required as to polarities of transformers. The impedance of transformers need not be the same for proper division of load, as is essential in connections of three-phase installations.

Power-House—Taking up the generating plant first. For a given capacity, speed and voltage, at a given frequency, the three-phase generator will prove the more efficient machine.

At the switchboard the only advantage the two-phase board has in comparison with the three-phase, is the saving of one ammeter. It is standard practice to use an ammeter in each leg, therefore the three-phase board will require three ammeters. It is also maintained that the figuring of the kilo-volt-amperes load from the instruments is a more difficult matter with a three-phase than with a two-phase installation. The above objections have very little weight when compared with the advantages of a three-phase board.

All bus-bars, oil-switch contacts and switch compartments, all cables from generators to switchboard and from the board to the transformers are reduced, in the three-phase system, in the ratio of four to three, but a 15.6 per cent larger cross-section of copper is required.

[1] A paper read before the electrical section of the Canadian Society of Civil Engineers, November 15. Condensed.

The use of but two transformers for a given load allows a greater individual transformer capacity, and therefore a more efficient transformer. This would have been a decided advantage, favoring the two-phase system, were it not for the fact that the transmission of power is to be by three-phase. To accomplish this phase transformation by the well-known Scott connections, unless all transformers are provided with a heavier high-tension winding, the transformer capacity would of necessity be reduced, due to a higher current in the three-phase winding, namely than of 115.6 per cent of the normal current. Should, however, the transformers be designed with provision made for this higher current, it would necessitate larger transformers, or in other words, a more expensive installation. Beside this increased transformer capacity, another disadvantage must be added, that of a possible resonance, with T-connected transformers for two-phase-three-phase transformers. Whenever one of the phases is open, due to a failure of making proper contact of various switches or any of the auxiliary connections, the high reactance of the high-voltage transformer will be in series with the capacity of the transmission line and a resonance is likely to take place.

The advantages of using a three-phase generator are further augmented by the possibility of using transformer connections, with which the danger of resonance is eliminated. Of the transformer connections in vogue, there are two which are free from the danger of resonance, namely delta to delta for step-up and delta to delta for step-down, or delta to Y and Y to delta. While the delta to Y and Y to delta is selected for transmissions where highest voltages are made use of, the delta to delta and delta to delta gives the most reliable service. With the latter style of connections, should one of the transformers fail, as soon as this transformer is cut out the service may be restored. This latter connection, namely delta to delta and delta to delta, which insures both continuity of service and freedom from resonance, is introduced now on one of the 60,000-volt transmission lines and is destined to become the standard, inasmuch as high-tension transformers for 60,000 volts as well as the insulators, especially if the latter are carefully selected and tested, have the requisite factor of safety.

Distributing System—The considerations which hold true in the discussion of the transmission line will also hold true in the distributing system. The three-phase delta connections should be made use of, since on motor service a complete shutdown due to a failure of one transformer must be carefully guarded against. Again, the three-wire, three-phase distribution will result in a saving of twenty-five per cent of copper and insulators. It will reduce the maintenance expense by the same percentage.

The advantages thus enumerated show clearly the desirability of three-phase distribution from the purely commercial standpoint and still more so from the point of view of reliability and permanency of supply. Some engineers object to the three-phase distribution on the ground of the difficulty of balancing loads. With a mixed load of lighting and power, the power load has an equalizing tendency on the balancing of the system and with some attention given to the proper division of the connected lighting load, no difficulty will be encountered.

The comparative losses of two and three-phase motors of the same rating are as follows:

A two-phase machine should have twenty-two per cent more conductors per slot than the corresponding three-phase Y-connected machine, designed for the same voltage and flux per pole.

The magnetizing current is the same in both the two and three-phase machines when expressed in percentage of the current, which corresponds to the full-load output.

The copper loss of the two-phase machine is twelve per cent higher than that of the three-phase.

The leakage factor of the two-phase machine averages twenty-five per cent greater than that of a three-phase machine, therefore the power factor is lower. Actual results show from one to three per cent lower power factors.

These considerations show that the two-phase machine will have a higher temperature rise as a result of a higher copper loss. For the same reason the efficiency of the two-phase motor will be lower. The slip of the two-phase machine will also be greater. Tests and theoretical calculations show twenty per cent greater slip.

Thus the two-phase induction motor is a poorer motor for the central station company, due to a poorer power factor. It is also less advantageous to the power user, due to the lower efficiency. The higher temperature rise will result in a shorter life and larger slip will mean a greater fluctuation between synchronous, partial and full-load speeds.

While the three-phase service should be made standard, two-phase motors may be

Digitized by Google

used by the aid of three-phase-two-phase transformers. This, however, should be discouraged, as such transformers require special taps, which make them more expensive, especially so when core-type transformers are used. It also means the carrying of a stock of these special transformers as spare units.

Frequency—The frequencies most widely used on this continent are those of sixty and twenty-five cycles. As far as the transmission line is concerned, the lower the frequency, the less the inductive drop, the smaller the charging current and the better the regulation. As a purely transmission problem the twenty-five-cycle frequency would be adopted. The problem, however, is more complicated. The transmission line is only a chain in the link, and important as it is, it should not overrule the advantages of a higher frequency as applied to the distributing end of the system.

The table of speeds of generators at sixty and twenty-five cycles shows a wider range of speeds, hence a greater flexibility when laying out a sixty-cycle hydroelectric power-house. The speeds of turbine-generator units are limited by the number of wheels, type, head and output. Therefore the wider range of speeds permissible with a sixty-cycle system will enable the selection of the most efficient generator-wheel combination. Inasmuch as increased peripheral velocities will result in a decrease in active material, the selection of higher speeds will enable one to choose cheaper hydroelectric sets. The above conclusions hold true except when higher speeds call for special construction, which will rapidly increase the cost.

The switchboard under the two frequencies is unaffected. All meters and potential and current transformers are designed for satisfactory operation on frequencies from twenty-five to 125 cycles.

Transformers built for twenty-five cycles are much more expensive, as well as less efficient, than when built for sixty cycles. Considering that there is with a generation, transmission and distribution of power a total transformer capacity equivalent to from three to four times the capacity of the generating apparatus, one will readily see the advantage of the higher frequency.

With incandescent lighting thirty cycles is the limiting frequency, and forty cycles is unsatisfactory when moving objects are viewed. On this continent sixty cycles is the standard frequency for such a service, while fifty cycles is European practice. For arc lighting forty cycles is the limiting frequency. Lower frequencies may be made use of in the application of the recently developed mercury vapor converter and magnetite lamps.

Analyzed from the standpoint of frequency, induction motors show characteristics which make it difficult to decide as to the best motor. Both motors under careful design can be made of equal performance as to power-factor, efficiency, etc. But the motors will be of radically different designs. From the commercial standpoint the sixty-cycle motors have a decided advantage, namely, a somewhat higher speed. Speed and cost are inversely proportional, hence the sixty-cycle motor will prove the cheaper of the two. Another point which favors the sixty-cycle motor is the greater demand for it, and the manufacturing companies have developed a finer design of this frequency. As a rule lower-frequency motors are adaptations of standard sixty-cycle frames and punchings, hence their performance does not show characteristics of the same high standard. Of course the low-frequency motors have advantages of their own, such as better starting torque, higher instantaneous but not continuous overload capacity and lower speeds. As stated before, unless the motors of the lower frequency are standardized for best and most efficient design the high-frequency motors are more satisfactory.

The principal factors in favor of the sixty-cycle motors are better continuous overload capacity and also a cheaper product commercially as a result of higher speeds. Therefore, with equally good performance as to efficiency and heating, the sixty-cycle motor will still be ahead of the twenty-five-cycle motor.

The suitability of low-frequency synchronous converters for railway work is a well-established fact. While sixty-cycle synchronous converters are used for such purposes, they are rather an exception and their operation is less satisfactory. What should then, under the circumstances, be a desirable way of supplying street railway loads without resort to frequency changers? The latter are out of the question, due to excessive cost, beside the great reduction in the efficiency of the systems, resultant from their use.

Motor generator sets may be and are advantageously used in this connection, and while not possessing the advantages of twenty-five-cycle synchronous converters, have features which make them particularly suitable for use on long-distance transmission systems, as they permit of a partial or complete control of the power-factor of the system. Wherever large capacity is present, due to long transmission lines, induction motor generator sets of large size can be used to great advantage. For perfect control of the power-factor of the transmitted power, synchronous motors should be employed, as in this case the regulating of the field excitation allows of a close control of the power-factor of the transmitted energy.

While the synchronous converter is the most efficient of the three means of supplying railway loads, whenever this load constitutes only the minor portion of the total output of the plant, the interests of the lighting and power load can not be sacrificed.

The preceding discussion leads to the conclusion that for a mixed load of lighting and power with a railway load not exceeding one-third of the total power generated, sixty cycles will be the frequency to select.

Charging Current and Line Regulation—The charging current and the regulation of the line, under adverse conditions, will limit certain developments, making them impossible, commercially considered, at sixty cycles. The same development at twenty-five cycles may present a very attractive proposition using power for a different application. As an example, what will be the relative magnitude of the charging current and the regulation for the line given below at the two frequencies? The values are obtainable from any table of line constants.

Line 100 miles long.

Load 10,000 horse-power for each transmission circuit.

Conductor, 4.0.

Voltage at receiving end, 50,000.

Space between conductors, sixty inches.

Charging current at sixty cycles, twenty-three amperes.

Charging current at twenty-five cycles, 9.6 amperes.

Regulation at sixty cycles, 100 per cent power-factor, full load, nine per cent; eighty per cent power-factor, full-load current, twenty-three per cent.

(Step-up and step-down transformers included in this calculation.)

Regulation at twenty-five cycles (including transformers), 100 per cent power-factor, full load, 5.5 per cent; eighty per cent power-factor, full-load current, ten per cent.

The regulation and capacity or charging current are decidedly in favor of the twenty-five-cycle transmission. The results for the sixty-cycle system, while considerably in excess of those at twenty-five cycles, are considered quite normal for com-

Digitized by Google

mercial purposes and inasmuch as the increase and decrease in the load is gradual the regulation is well within control of the central station operators or automatic devices.

As to the railway load, this had better be carried on a separate circuit, whenever a multiplicity of circuits is used in transmitting the power.

Considering the successful operation of one of the long-distance transmission lines of 150 miles in California where the charging current forms forty per cent of full-load current, and where the regulation is forty per cent at full load, eighty per cent power-factor, one need not hesitate to operate a line with a regulation of twenty-three per cent, eighty per cent power-factor.

The power-factor of the system, however, is to a large extent within the control of the operating company, as it may recommend to power users such apparatus as will best answer the purposes of the system as a whole. Beside this, by employing synchronous motors running as rotary condensers, it will be enabled to regulate the power-factor of the system and keep it if necessary at unity. These synchronous motors running idle, used supplementary to the synchronous motor generator sets, will allow of a perfect control of the power-factor of the system, reducing the regulation to nine per cent under full-load condition.

The author concludes that under the conditions as stated, for a mixed lighting and power load, with a railway load not exceeding thirty-three per cent of the total output, a three-phase, sixty-cycle system should be employed throughout and all transformation should be accomplished by delta to delta connections.

Production of Electrical Machinery in 1905.

A bulletin (No. 57) just issued by the Bureau of the Census, of the Department of the Interior, Washington, D. C., gives the accompanying statistics showing the production of electrical machinery during 1905.

The following figures show the extent and character of the power used by the manufacturing industries.

Mechanical power of some variety was used in 134,520, or 62.2 per cent, of the establishments included in the census of manufactures in 1905. The inclusion of the neighborhood and mechanical industries at prior censuses greatly reduced the proportion of establishments reporting the use of power. Of the 512,254 establishments reported at the census of 1900, only

ELECTRICAL MACHINERY, APPARATUS AND SUPPLIES—PRODUCTS, BY KIND, QUANTITY AND VALUE: 1905 AND 1900.

	1905.	1900.
Products, total value	*$159,551,402	†$105,831,865
Dynamos:		
Number	15,080	10,527
Value	$11,084,234	$10,472,576
Horse-power	1,328,243	770,832
Dynamotors, etc.	$1,740,534	$379,747
Transformers	$4,468,567	$2,962,871
Switchboards, etc.	$3,766,044	$1,846,624
Motors, all kinds	$22,370,626	$19,505,504
Direct and alternating:		
Number	79,877	35,604
Value	$13,120,948	$7,551,480
Horse-power	678,910	515,705
For railways:		
Number	12,298	15,284
Value	$4,949,795	$7,568,841
Horse-power	713,181	666,669
For automobiles:		
Number	1,819	3,017
Value	$152,685	$192,030
Horse-power	19,907	8,220
For fans:		
Number	102,535	97,577
Value	$1,168,254	$1,055,369
Horse-power	30,796	12,766
For electric elevators:		
Number	1,333	(‡)
Value	$638,473	$2,523,901
Horse-power	13,398	(‡)
Miscellaneous:		
Number	8,481	7,913
Value	$2,340,471	$613,883
Horse-power	36,820	11,392
Batteries, including parts and supplies	$4,243,893	$3,679,045
Storage	$2,645,749	$2,559,601
Primary	$1,598,144	$1,119,444
Carbons	$2,710,935	$1,731,248
Lighting	$1,050,971	$1,263,732
Furnace	$172,454	$10,974
Miscellaneous	$1,487,510	$456,542
Arc lamps	$1,574,422	$1,827,771
Open—		
Number	1,748	23,656
Value	$29,989	$276,481
Closed—		
Number	193,409	134,531
Value	$1,544,433	$1,551,290
Searchlights, etc.:		
Number	1,924	8,283
Value	$114,795	$225,635
Incandescent lamps	$6,953,205	$3,515,118
16 candle-power:		
Number	83,333,285	21,191,131
Value	$4,608,084	$2,910,023
Below 16 candle-power:		
Number	19,779,834	2,906,817
Value	$1,132,011	$308,626
Above 16 candle-power:		
Number	9,598,439	1,222,250
Value	$568,204	$223,534
Decorative and miniature lamps:		
Number	1,584,495	397,432
Value	$644,906	$72,935
Electric light fixtures	$5,305,466	$4,344,599
Telephone apparatus	$15,863,698	$10,512,412
Telegraph apparatus	$1,111,195	$1,642,266
Insulated wires and cables	$34,519,699	$21,292,001
Electric conduits	$2,416,245	$1,066,163
Annunciators	$185,870	$224,885
Electric clocks, etc.	$373,926	$132,149
Fuses and lightning arresters	$1,455,203	$595,497
Rheostats and resistances	$1,328,752	$1,186,878
Electric measuring instruments	$5,004,763	$860,265
Circuit fittings	$3,525,446	(‡)
All other products	§$26,634,963	$15,764,875
Amount received for custom work and repairing	$2,798,922	$2,063,736

* Includes electrical machinery, apparatus and supplies, valued at $18,742,033, made by establishments engaged primarily in the manufacture of other products.

† Includes electrical machinery, apparatus and supplies, valued at $13,397,430, made by establishments engaged primarily in the manufacture of other products.

‡ Not reported separately.

§ Includes $1,451,337 for electric switches, signals and attachments; $678,077 for magneto ignition apparatus, and $1,036,962 for electrical therapeutic apparatus, including spark coils.

Digitized by Google

169,409, or 33.1 per cent, reported power. The census of 1890, with 355,415 establishments, showed 100,735, or 28.3 per cent, using power, while the census of 1880, with 253,852 establishments, had 85,923, or 33.8 per cent, using power.

Comparatively little motive power is employed in the neighborhood and mechanical industries, and their exclusion from the census of 1905 has but slight effect on comparisons with the statistics for prior censuses in which they are included. The horse-power, by kind, as reported at each census since 1870, is summarized in Table 81. This table gives the total horse-power reported at each census, except the amount returned for custom grist and sawmills and cotton-ginning establishments at the census of 1900.

HORSE-POWER EMPLOYED IN MANUFACTURES, WITH PER CENT OF INCREASE: 1870 TO 1905.

	DATE OF CENSUS.					PER CENT OF INCREASE.			
	1905.	1900.	1890.	1880.	1870.	1900 to 1905.	1890 to 1900.	1880 to 1890.	1870 to 1880.
Total horse-power	14,464,940	10,409,625	5,954,655	3,410,837	2,346,142	39.0	74.8	74.6	45.4
Owned:									
Steam	10,664,560	8,140,533	4,581,595	2,185,458	1,215,711	31.0	77.7	109.6	79.8
Gas	289,514	134,742	8,930	.....	.....	114.9	1,408.9	....	....
Water	1,647,969	1,454,229	1,255,206	1,225,379	1,130,431	13.3	15.9	2.4	8.4
Electric	1,138,208	310,661	15,569	.....	.....	266.4	1,895.4	....	....
All other	91,784	49,985	4,784	.....	.....	83.6	944.8	....	....
Rented	632,905	319,475	88,571	.....	.....	98.1	260.7	....	....

Each variety of power has increased during each census period since 1870. The greatest actual and relative increase occurred between 1890 and 1900. Notwithstanding the great increase in other kinds of power, steam continued to be the motive power of greatest importance.

The use of electric current for the transmission of power has been one of the most notable features of the development of machinery in manufactures. The first census to show electric power was that of 1890, when 15,569 horse-power was reported. At the census of 1905 this class of power owned amounted to 1,138,208 horse-power. When the electric power is generated by the manufacturer the combination of the horse-power of the engines and the motors results in a duplication, but since in some cases the steam engines are used for purposes other than the generation of electric current it is impracticable to avoid this duplication.

Erie Electrification.

Last summer Westinghouse, Church, Kerr & Company were retained by the Erie Railroad to furnish and install upon the Rochester (N. Y.) division a complete equipment of electric motive power covering the passenger service of that portion of the main line of the Rochester division between Rochester and Avon, and the branch between Avon and Mount Morris, a total distance of thirty-four miles of single track, besides sidings. This work has been brought very near to completion. The equipment will represent the most modern type of single-phase, alternating-current system of train propulsion, and will consist of motor-cars of the inter-urban type.

The supply of power for operating the system will be derived from the lines of the Niagara, Lockport & Ontario Power Company, which receives the current generated at the new station of the Ontario Power Company at Niagara Falls. This power is now being transmitted at 60,000 volts as far east as Syracuse. The power company's transmission line crosses the Erie Railroad at Mortimer, about five miles south of Rochester, and from that point the power company is constructing a branch line about fourteen miles long, which is to supply the substation at Avon.

The substation building is of brick and reenforced concrete, and is now practically completed. The electrical apparatus is being rapidly installed.

The electrical equipment of the cars comprises four 100-horse-power motors, one on each axle, besides the transformer equipment which forms part of the single-phase outfit. Each car will be equipped with the Westinghouse electropneumatic system of multiple-unit train control. The cars will be capable of a maximum speed of from forty-five to fifty miles an hour, and will be able to haul one trailer under any of the conditions of service that are likely to prevail.

The collectors on the car will be of the so-called "pantagraph" type. These are controlled by air pressure and designed to instantaneously adapt themselves to any change in the height of the trolley wire, as when passing under low bridges.

The Electrical Trades Society of New York.

The tenth annual meeting of the Electrical Trades Society of New York will be held on Tuesday evening, December 11, at the Imperial Hotel, Broadway and Thirty-first street, New York city, at 5.30 o'clock. Reports will be read, addresses made and directors will be elected. In addition to the usual proceedings action will be taken on an amendment to the by-laws.

An informal dinner (business dress) will follow the annual meeting at 7.30 o'clock. The dinner tickets will be $3.50 each.

Convention of the Northwestern Telephone Exchange Company.

The second annual convention of the managers of the Northwestern Telephone Exchange Company was held at the general offices of the company in Minneapolis, Minn., November 22, 23 and 24. The opening address was made by H. J. Pettingill, president of the company.

The following papers were read: "Operating Methods," R. F. Estabrook, superintendent of traffic; "Farm Lines," A. von Schlegell, general contract agent; "Requisition and Material Reports," J. L. Barney, supply clerk; "Collections," J. W. Christie, treasurer; "Reports," W. R. Overmire, auditor; "Equipment," J. Houghtaling, superintendent of equipment; "Maintenance," B. Waller, engineer; "Construction," Thomas Dwyer, superintendent of construction; "Connecting Companies," J. L. W. Zietlow.

There were also addresses by C. P. Wainman, vice-president and general manager; C. M. Mauseau, assistant general manager; E. A. Prendergast, attorney; B. L. Freedy, superintendent, and W. A. Stanton, district manager.

A complimentary luncheon was served at the National Hotel on Thursday and Friday; a theatre party was given on Friday evening, and a banquet was held at the Nicollet Hotel on Saturday evening.

Among those present were E. B. Baker, general superintendent; A. Williams, superintendent, and E. C. Short, superintendent of construction, of the Minnesota Central Telephone Company; George A. French, superintendent, and F. E. Lister, district manager, of the Duluth and Mesaba Telephone Companies.

Digitized by Google

Units and Standards.[1]

As soon as electricity became a science a need was felt for new units—for those quantities which could not be immediately or conveniently expressed in terms of the C.G.S. units of length, mass and time. Resistance, current and electrical pressure had to be measured, and for scientific reasons it appeared advisable to base the new units on the centimetre, gramme and second. There are two ways of doing this, according to whether one started from electrostatic or magnetic phenomena; and we have therefore both electrostatic and electromagnetic units. These two sets of units are, of course, definitely related to one another, but the relation has no practical value, and the individual units of either system are either too large or too small to be of commercial use. Hence the British Association defined what are known as the commercial units, the chief among which are the ohm, equal to 10^9 absolute C.G.S. electromagnetic units; the volt, equal to 10^8 absolute units, and the ampere, 10^{-1} of an absolute unit, and these have been accepted by the civilized world. After definition came the task of making standards, and this is where the real difficulty began. The British Association committee made a standard ohm of German silver wire, but this was subsequently found to be about two per cent less in resistance than the definition required. Siemens had previously used as a "practical ohm" a column of mercury one metre long and one square millimetre in cross-section. This was about four and one-half per cent less than the true value, but the mercury column constituted such a convenient and easily reproducible standard that in revising the value of the ohm, a mercury column was returned to. The Paris congress in 1884 suggested that the international legal value should be the resistance of a mercury column 106 centimetres in length and one square millimetre in area at zero degree centimetre; but this was never acceded to either by England or America, as it was known not to be correct. In 1882 Lord Rayleigh, using the method which had been employed by the British Association committee, of rotating a coil in the earth's field, found the length of the mercury column to be 106.27 centimetres; Dr. Glazebrook, in the same year, arrived at a length of 106.28 centimetres by a different method. In 1891 Professor Viriamu Jones found the value to be 106.3 centimetres, and in the next year the British Association agreed to recognize this value, though defining the mercury as having a mass of 14.4521 grammes and of a uniform cross-section, instead of stating what the cross-section had to be. In 1893 this definition was endorsed by the congress of Chicago, and is now recognized as constituting the international legal ohm.

The standard ohm being decided upon, at any rate, for the present, there remain the ampere and the volt, the determination of either of which, now that the unit of resistance has been settled, will fix the value of the other. At the Berlin congress last year it was resolved that, besides the ohm, the other independent unit should be the ampere, the volt therefore being the pressure which will drive a standard ampere through a standard ohm. The legal standard ampere is at present that current which will deposit silver from silver nitrate at the rate of 0.001118 gramme per second. How nearly such a current approaches the theoretical unit of 10^{-1} C.G.S. is not known; but the difference is probably not great. The volt is, as we have pointed out, dependent on the standard values assigned to the ohm and the ampere; but for convenience an independent legal standard was decided on. The standard volt is such that the pressure across the terminals of a Clark cell at fifteen degrees centigrade is 1.434 volts. This value is certainly not the equivalent of 10^8 C.G.S. units, and it is probable that it would be much more in accordance with the definition of the C.G.S. value of the volt to rate the Clark cell at something like 1.433 volts at standard temperature. This difference, though not much to look at, is of real practical importance. Besides, it is the general opinion that, apart from the inaccuracy of the legal voltage of a Clark cell, this form of cell is unreliable, and the Weston cadmium cell should be adopted as the standard cell.

The state of affairs, then, is something like this: We have the C.G.S. definitions of the ohm, ampere and volt, which are absolute and immutable. They are, however, but abstractions, and there must be physical embodiments of them of the highest attainable accuracy kept as national possessions. These, which may be called primary standards, correspond to the standards of the metre, pound, etc., and must be capable of being copied and compared so exactly that there shall be no observable difference between the primary standards of different nations. When once these primary standards are specified, they must be looked upon as unalterable, and if any discrepancy between them and the C.G.S. units can be detected at any future time, this must be allowed for in exact calculations. The primary standards must be as arbitrary, in that sense, as the metre or the kilogramme, for otherwise there would arise the same confusion as would occur were the standard metre to be altered to conform more closely with the dimensions of the earth. The best primary standard for the ohm is the mercury column, 106.3 centimetres in length. The standard ampere can probably be best defined by the deposition of silver, and the standard volt follows from these two by Ohm's law. As far as primary standards are concerned, there is no need for a standard volt, for the standard ampere can be passed through the standard ohm, and the electromotive force absorbed gives the standard volt.

Every standardizing laboratory in the various countries will, however, require apparatus for verifying or calibrating commercial instruments. Copies of the primary standards will be too inconvenient and costly for this purpose, and secondary standards are needed, suitable for rapid and accurate work. The most convenient resistance standard is a coil of special wire of negligible, or accurately known and constant, temperature coefficient. Again, as the measurement of current by electrodeposition is an extremely delicate and slow process, a more practical instrument than an electrolytic vat is wanted for a secondary standard. Such a standard should probably be some form of the Kelvin ampere-balance, in which the magnetic effect of the current being measured is balanced against the gravitational effect of known masses. Again, a tester can not very well refer to the pressure across the terminals of a standard resistance when a standard current is passing through it every time he requires to compare voltages. He needs some portable cell, such as the Clark or Weston cell, as a secondary standard of pressure, and, of course, one or other of these cells is always used as a volt standard in potentiometer measurements. If a more constant and reliable source of voltage can be found, so much the better.

Now that all nations are agreed as to both the names and definitions of the ideal units of electrical measurement, it is of the utmost importance that some attempt should be made to get an international and permanent agreement concerning the specifications and dimensions of the standards by which the ideals are represented.

[1] Abstracted from *Engineering*, London, November 23.

Digitized by Google

When once agreement has been arrived at, permanency is, above all things, to be desired. Since the Berlin congress last October experiments have been going on in various countries to determine the best way to define the standards, both primary and secondary. Professor Glazebrook, whose presidential address the other day to the Institution of Electrical Engineers dealt with many aspects of the work of standardization, is responsible for some most exhaustive experiments on the absolute value of the electrical units. The results have not yet been made public, but it is hoped that this work of the National Physical Laboratory will enable both the international ampere and the electromotive force of the Weston cell to be stated with a most extraordinary degree of accuracy. An international conference is to be held in London next October, when we trust that the work of the National Physical Laboratory and kindred institutions abroad will culminate in a universal agreement as to the electrical standards which shall be legalized by the governments of all civilized countries.

Cassier's Magazine.

Cassier's Magazine has been sold by the estate of the late Louis Cassier to Henry Harrison Suplee, for many years technical editor of the *Engineering Magazine,* and James Van Vorst Colwell, recently works manager for the C. W. Hunt Company, and the publication will be continued as heretofore by the Cassier Magazine Company at No. 3 West Twenty-ninth street, New York city. The editorial conduct of the magazine will be in the hands of Mr. Suplee, who brings to this work a wide experience both in the practice of mechanical engineering and of technical journalism, while the business department will be directed by Mr. Colwell. The first issue of the new magazine under the new management will be the January number.

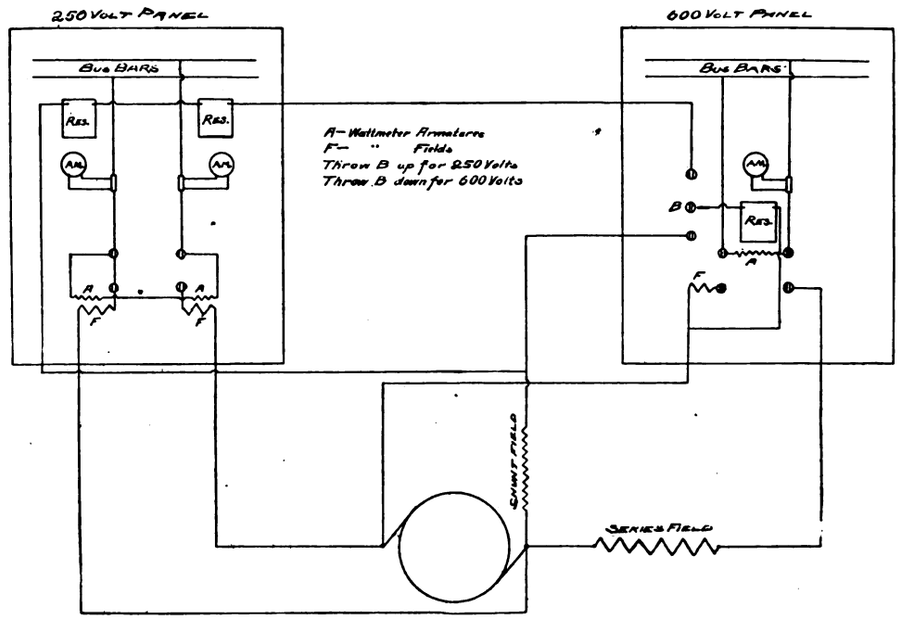
Death of Arthur Vaughan Abbott.

Arthur Vaughan Abbott, one of the most prominently known and esteemed engineers of this country, died from pneumonia, December 1, at St. Luke's Hospital, New York city, after a short illness. Mr. Abbott, who was a son of the late Benjamin Abbott, was born in New York city in 1854. He had been a member of the American Institute of Mining Engineers since 1882, vice-president of the American Institute of Electrical Engineers, and chief engineer of the Chicago Telephone Company and engineer of Westinghouse, Church, Kerr & Company since 1902. He wrote several books. Among his works are "Electrical Transmission of Energy," "The Evolution of a Switchboard," "History and Use of Testing Machines," "Treatise on Fuel" and "Telephony."

Railway Generators Operated on a Three-Wire Lighting Service.

Interesting and valuable results have been obtained by the Topeka Edison Company, Topeka, Kas., in operating a 600-volt railway generator at 250 volts on an Edison three-wire system.

The company has one of the most modern and well-equipped plants in the West. In addition to its regular lighting business it supplies current at 600 volts to the Topeka Railway Company, and for this purpose has installed three 500-kilowatt, 600-volt generators. This number of generators affords a considerable reserve capacity, which is increased by the use of a storage battery which operates on the railway service.



Plan Showing Operation of Generator on Either 250 or 600 Volts.

Anticipating an extra heavy demand on the three-wire lighting system during the present winter season, Superintendent J. T. Huntington and Chief Engineer J. L. Chase made the experiment of connecting one of the railway generators to the two outside wires of the three-wire system. To do this the generator was connected to the 250-volt panel in the manner shown in the accompanying diagram. To operate at 250 volts the compounding feature is cut out as indicated, and the field rheostat on the 600-volt panel about one-half cut out; the field resistance is then controlled by rheostats on the 250-volt panel. The engine speed was reduced five revolutions per minute by adding weights to the governor which gave a speed of 120 revolutions per minute. On the day the test was made the generator had operated ten hours at 600 volts and 900 amperes in railway service. In changing over the extra governor weights were added, switch thrown, and the generator connected to the three-wire system at 250 volts, being operated at 850 amperes for over three hours in parallel with regular lighting units. There was no sparking at the brushes and no heating of commutator above normal, and there was no trouble with regulation, which indicates that the amperage could be carried higher. The generator used was a General Electric, type M.P., Class 10, 500 kilowatt, 570 volts, no load; 600 volts full load; 900 to 1,000 amperes, direct-connected to a Buckeye vertical, cross-compound engine with cylinder twenty-three inches by forty-two inches by thirty inches, normal speed 125 revolutions per minute.

The generator can be changed from either service to the other in a few moments by the adding governor weights, and throwing switch marked "B" in diagram.

Two Exhibitions in Holland.

It is announced by the Maatschappy van Nyverheid, Department Arnheim, Holland, that an exhibition will be held in that city during the month of July, 1907. All letters should be addressed to J. G. van Gelder, 52 Amsterdamsche weg, Arnheim, Holland.

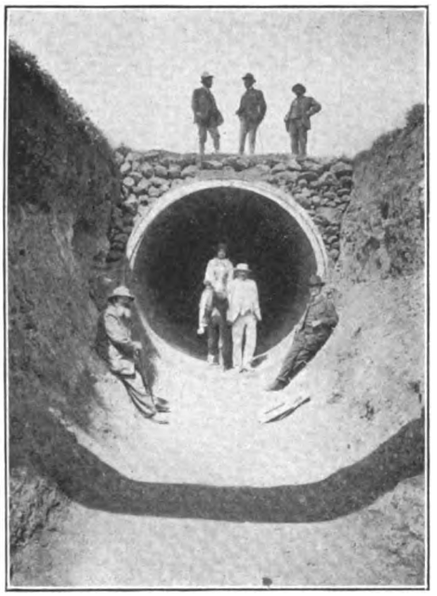
An international exhibition of motors and machines for professions and trades will be held at Amsterdam, Holland, during the months of August and September, 1907. The secretary-general, to whom all correspondence should be addressed, is Dr. Th. Muller Massis, Heerengracht 357, Amsterdam, Holland.

Digitized by Google

The Entraygues (France) Hydroelectric Plant.

By C. L. Durand.

THE mountain streams in the Alpine region of France which lies near the Mediterranean coast have already been utilized for running a number of hydraulic plants of large capacity, so as to secure a considerable amount of current for the cities and towns along the coast, such as Nice, Monte Carlo, Cannes and others. The whole system is connected together, and forms an extensive network of overhead lines working at high voltage. Operated by the company known as the Energie Electrique du Littoral Méditerranéen, these plants form one of the largest hydraulic supplies of the Continent. The electric outfit is supplied by the Thomson-Houston Company, from its Paris shops. Not long ago a new

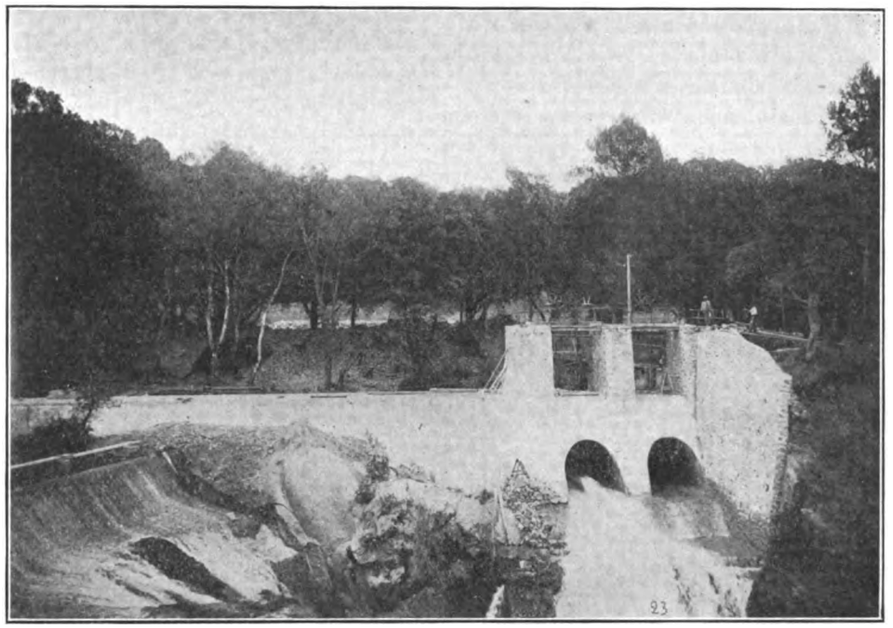


ENTRAYGUES (FRANCE) HYDROELECTRIC PLANT —A VIEW OF THE MAIN CANAL.

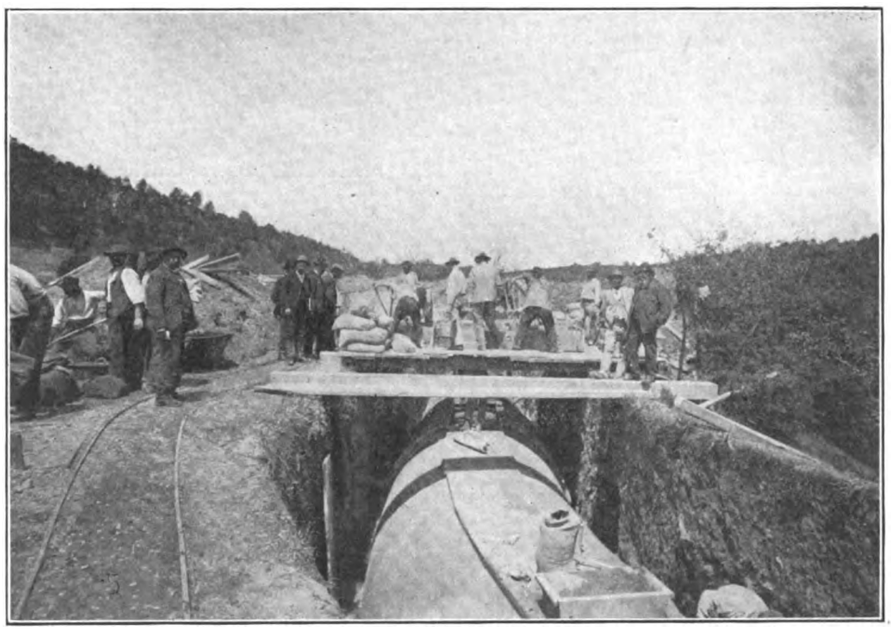
hydroelectric station was erected in the region, and it is one of the most important of the series. The voltage of the overhead line is among the highest which has yet been used in Europe, as it now runs at 28,000 volts. Current is delivered over a thirty-seven-mile overhead line to the city of Toulon, where most of the energy is used at present.

The Entraygues plant has been installed mainly with the object of providing a good supply of current for the lighting circuits and the tramway lines of Toulon, but aside from this, it furnishes a good amount of energy for lighting or motors to numerous villages in the Mediterranean coast region which lie along the path of the high-tension line. It is expected that several large industries in the region of Toulon will also make arrangements to use current from the lines.

Power is obtained from the Argens river, a mountain stream giving a considerable flow, and the hydraulic plant is located at Entraygues, near Vidauban. It utilizes a natural fall in the river followed by a succession of rapids. Between the intake canal at the dam, and the offtake canal at the station the difference of level varies from fifty to seventy feet. The main dam and the hydraulic work in connection with it have been laid out so as to allow of storing up enough water so as to give a good reserve, this being used at times of the day when the lighting current is added to the motor current. The hydraulic work has been carried out by one of the largest Paris construction companies, A. Giros & Loucheur, to whom the writer is indebted for the photographs



ENTRAYGUES (FRANCE) HYDROELECTRIC PLANT—DAM AND HEADGATES.



ENTRAYGUES (FRANCE) HYDROELECTRIC PLANT—MAIN CANAL UNDER CONSTRUCTION.

Digitized by Google

showing the various parts of the plant. The present views show different portions of the dam, intake canal, piping and penstocks. In the main dam are placed two openings provided with gates, which allow of supplying the canals for irrigation and for water-mills. There are also three outlet gates and the main offtake canal of ten feet diameter. The latter is provided with a gate which is operated by a rack movement, and is protected by an iron grating formed of parallel bars.

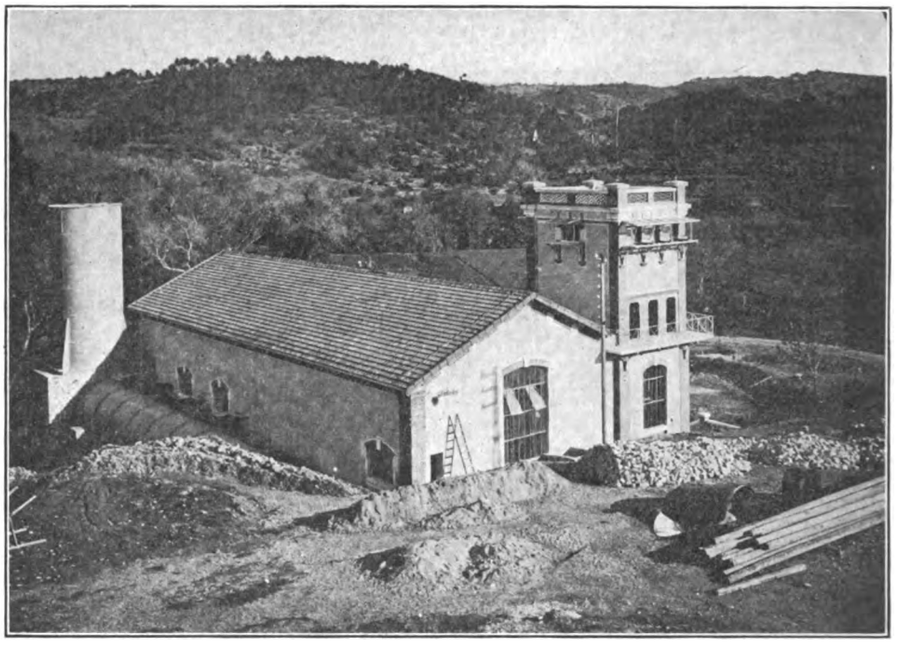
The main canal which passes from the dam to the station is laid underground for the most part, and consists of an eight-inch-thick tube of reenforced cement about ten feet in diameter, working under a water-head which varies from forty feet in times of low water to fifty feet during the freshets. The cement conduit is about 1,600 feet long, and is laid upon a foundation of beton. Its metallic framework consists of soft steel hoops and a set of straight steel bars running parallel to the conduit, these bars being well connected together. A settling basin lies on the path of the canal, and good arrangements are provided for washing it out. When near the station building, the conduit is joined to a steel collector by means of a steel T-piece. This collector has a somewhat larger diameter than the conduit, and is terminated by a vertical stack, held in masonry, which is designed to lessen the pounding in the collector and the conduit at the moment of a quick change in the flow of the turbines, caused by the action of the speed regulators. This vertical stack is about eight feet in diameter, and is surrounded by a second circular stack of sheet steel of about fifteen feet in diameter. When the turbine regulators cut off the water feed suddenly, the water rises in the inner stack and overflows in the outer space, going from thence to the offtake canal by means of steel piping.

In the station there are installed three principal turbine and alternator groups, each of these being composed of a double turbine with horizontal shaft, on the Francis system, coupled to a three-phase alternator. The turbines are designed for 1,000 horse-power, and the alternators for 700 kilowatts. The main turbines utilize a net water-head varying between fifty and sixty-six feet, according to the season, with an aspiration height maximum of twenty-one feet from the level of the dynamo-room to the water level in the offtake canal. The normal running speed of the turbines is 300 revolutions per minute. By means of a belt transmission, the turbine shaft operates an automatic speed governor, and the latter acts through the medium of an oil-pressure hydraulic piston motor upon the water-feed inlets of the turbine, so as to reduce the section of the inflow without causing an interior disturbance. The degree of opening of the inlet and consequently the power given by the turbine, is indicated in a very apparent manner by an index which is connected with the hydraulic piston and is displaced on a graduated scale. The oil which is needed for the working of the hydraulic motors of the station is supplied, at a pressure of fifteen atmospheres, by two triple-action pumps (one of which serves as a standby) worked by electric motors. A special device is used with the turbine which allows of varying their speed within five per cent. This is operated either by hand, or at a distance by means of a small electric motor of special form, worked from the main switchboard.

Each of the main groups is provided with a cast-steel flywheel placed between the turbine and the alternator. The rim of the wheel weighs about six tons and is ten feet in outer diameter. The gate-valves, which are placed under the water inlet of the main turbines, are located outside of the building, but they can be operated from the interior of the station.

Coupled to the turbines by a rigid connection, the alternators are of the revolving-field type. They have ten poles and when running at 300 revolutions per minute, can deliver three-phase current at 3,500 volts, which is the regular working voltage. Should the turbines race and in such case run up as high as 550 revolutions per minute, the alternators are strong enough to support the latter speed without danger.

Separate turbines are used for the exciters. Two sixty-volt direct-current generators (of which one serves as a standby) having a capacity of thirty kilowatts each, run with seventy-five horse-power turbines at a speed of 600 revolutions per minute. Each of these generators is coupled direct to another machine which stands upon the same base-plate and will furnish at least twenty kilowatts at the above speed. These machines are provided with a compound winding which allows the terminal voltage to be kept constant at 110 volts, and are used for the auxiliary service of the plant, and especially for the lighting, independent of the exciter lines, the latter can be operated at a variable voltage, seeing that the simultaneous change of the exciting current for all the alternators is obtained by changing the voltage of the exciter.



ENTRAYGUES (FRANCE) HYDROELECTRIC PLANT—POWER STATION

The three-phase current furnished by the alternators is sent into the circuits of a bank of three-phase, air-cooled, 650-kilowatt, twenty-five cycle transformers which raise the voltage to 26,000 or 28,000 volts. There are three large transformers used for this purpose, and in fact the station is formed of three units, each consisting of an alternator and the transformer which is connected with it. Such an arrangement allows of a great simplicity in the wiring and the switchboards. An extensive switchboard system

Digitized by Google

is provided, including a main switchboard containing three alternator panels and one panel each for exciters, auxiliary lines, and station. A second switchboard contains three panels for the low-tension ends of the transformers. There is also a third single-panel board for the switches of the 3,500-volt line.

Each of the main alternator panels has the following apparatus: A three-pole 30,000-volt, oil switch provided with a slow-working relay for an automatic release in case of overload; four knife switches, mounted on porcelain, used for cutting off the main switch from the neutral point of the transformer; a field rheostat; a field switch with shunt resistance for discharge; an ammeter, voltmeter, current meter, power-factor indicator, with their small transformers; one synchronizing plug; a double-throw switch controlling the motor circuit for the regulation of the turbine speed at a distance. The panels for the exciters and the auxiliary circuits each carry the switches, field rheostats and measuring instruments which are needed for handling the corresponding dynamos. The station panel contains one three-pole 30,000-volt, oil switch, four knife switches mounted on porcelain which allow of disconnecting the above and to give an earth connection for the bus-bar, joined to the neutral points; three ammeters, one for each phase; one voltmeter, a Lincoln synchronizer, and a recording voltmeter.

On the auxiliary switchboard, each of the three panels carries three fuse blocks for 3,500 volts, separated by marble partitions; two oil switches of the three-pole type worked by hand and combined so as to form a two-direction switch. They allow of connecting each of the alternators, simultaneously or separately, to the corresponding transformer and to the 3,500-volt bus-bars. The single panel for the switches of the 3,500-volt line leaving the station is provided with a three-pole oil switch with automatic overload break and an ammeter. This line is to supply the region lying near the station. The main switchboard and its appliances are mounted on a metallic platform at one end of the dynamo hall. All the apparatus carried on the outside of the marble panels and which are to be handled by the personnel, are of low tension.

In the Entraygues plant the use of this system of switching has given very good results since starting up the station. The switches have been placed side by side upon a bridge lying near the switchboard. At the bottom the wires enter to the switch by openings in the floor of the bridge. Each of the oil switches is completed by three section switches which allow of cutting it off the bus-bars.

For each phase the bus-bars are formed of a rubber-insulated wire carried upon insulators of the same type as the line insulators, and are separated from the neighboring phase by a horizontal slab of cement. The connecting wires between the three-pole switches and the bus-bars are separated from each other by vertical par-

ENTRAYGUES (FRANCE) HYDROELECTRIC PLANT—PIPE LINE AND HEADER AT STATION.

Digitized by Google

titions of cement, between which are fixed the knife switches mounted on porcelain which are used for cutting off the bus-bar switches. A gallery running along the end of the station allows of approaching the bars and using an insulated pole for working the above-mentioned knife switches.

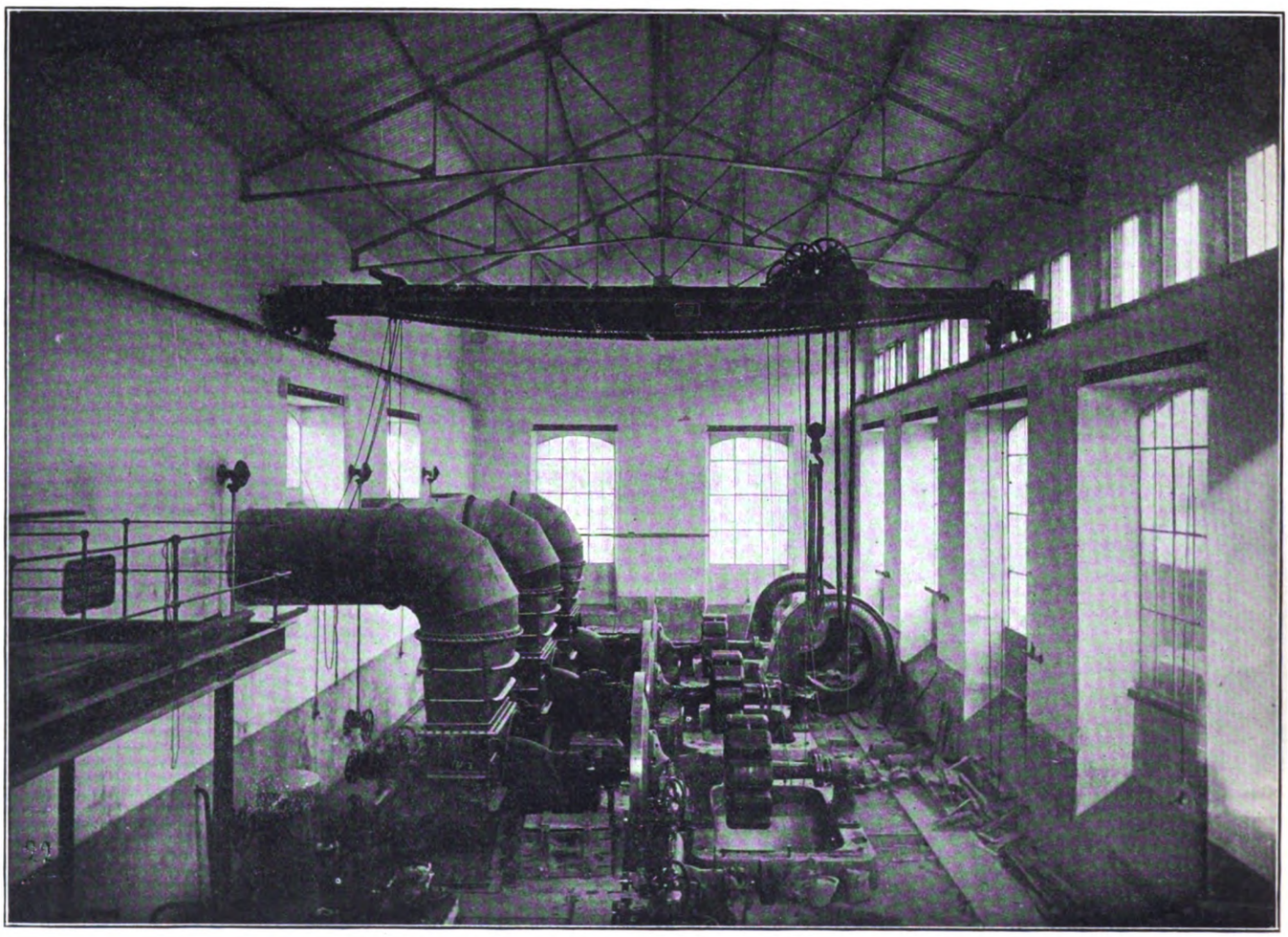
Coming from the main three-pole switch corresponding to a line panel, rubber-covered wires lead the current to the windows from which the lines start out to the poles. These windows are placed in a rectangular tower adjoining the main building, which has been laid out for two main overhead lines using six wires each, and an overhead line of three wires working at 3,500 or 10,000 volts.

The overhead line is formed of twenty-eight-millimetre bare copper wire, held upon porcelain insulators of nine-inch largest diameter and weighing 5.8 pounds exclusive of the supports. All the insulators were tested at 100,000 volts during thirty seconds. Straight metal arms fix the insulators to the cross-arms of the poles, the former being spaced about thirty inches apart.

For the local use of the current, a number of substations have been erected at various points on the line, some of these being located at Toulon, and the others between Entraygues and the city. Where the overhead line comes to Toulon, it ends in the transformer post of Brunet, where the voltage is lowered from 26,000 to 3,250 volts by means of two three-phase 650-kilowatt transformers. These transformers are used at the same time for the converting groups of the lighting station of Loubière, belonging to the Société d'Eclairage of Toulon, and for the machines of the tramway substation of Toulon. Two air fans driven by four horse-power, 110-volt motors are used for cooling the transformers, and the motors take current from two ten-kilowatt transformers which lower the current from 3,250 to 110 volts, supplying also the lighting current for the station. The distributing switchboard is made up of two panels for the 650-kilowatt transformers, two panels for the three-phase circuits at 3,250 volts, and one panel for the interior service of the station. Each transformer panel carries three single-pole oil switches for 30,000 volts, with an overload cut-out relay; also four single-pole switches for cutting off the former switches and connecting the neutral point of the transformers to ground, an ammeter, voltmeter, a three-pole oil switch, and a power-factor indicator. Each panel for the 3,250-volt, three-phase line leaving the station contains a three-pole oil switch and an ammeter. One of the panels carries a polyphase meter.

The main oil switches for 30,000 volts are placed separately in brickwork chambers, and are worked together by a mechanism from a single shaft. The latter is operated from the switchboard. An overload solenoid, fed by a relay, allows of making an automatic break for the switches.

Current is distributed from the transformer post just described to the substation of Loubière which supplies the lighting mains of Toulon. The overhead line reaching this point starts from one of the 3,250-volt panels of the Brunet station. In the Loubière substation are placed three motor-generator sets, each containing a synchronous motor of 300



ENTRAYGUES (FRANCE) HYDROELECTRIC PLANT—DYNAMO ROOM UNDER CONSTRUCTION.

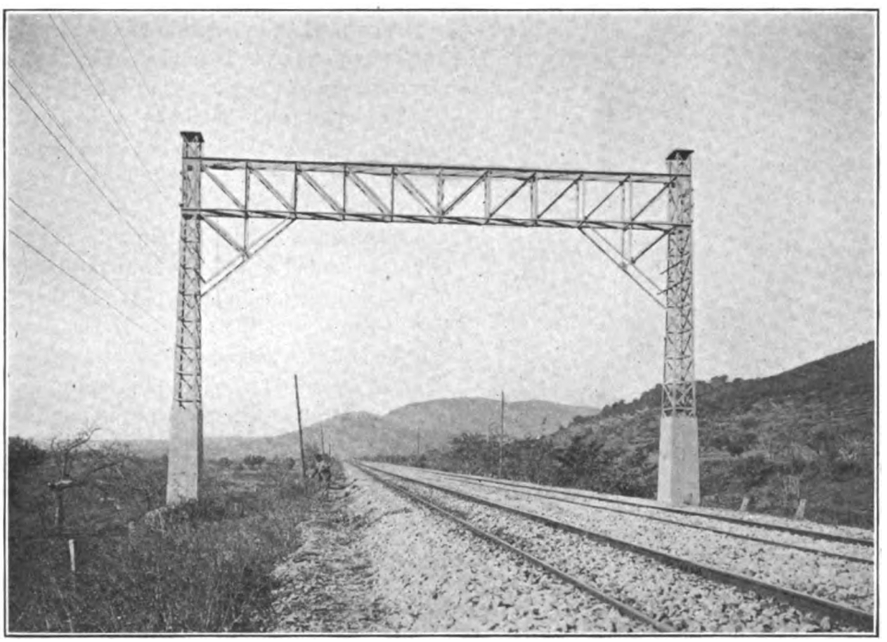
Digitized by Google

horse-power. These motors are of the six-pole revolving field pattern, running at 500 revolutions per minute at twenty-five cycles and wound for 3,250 volts. Direct coupled to the motor is a lighting generator. Each of the three generators is of the six-pole 225-kilowatt pattern, and designed to give 260 volts under full load. Current from the lighting generator is used to excite the synchronous motors. The former are provided with a shunt exciting circuit calculated so that the machine runs regularly for all voltages between a minimum of 240 and a maximum of 300 volts.

A large amount of power is also taken by the tramway substation, which is located at another point. It is supplied from the Brunet transformer post at 3,250 volts, by means of an insulated and armored cable, which supplies two motor-generator groups, each formed by a synchronous motor and a railway generator. The synchronous motor, having fixed field and rotating armature, is of the six-pole type, running at 500 revolutions per minute at twenty-five cycles and 3,250 volts. It is direct coupled to a 225-kilowatt generator, delivering current at 600 volts for the tramway lines. Current for exciting the synchronous motor is obtained from the tramway generator. The latter has a compound winding, and the shunt winding is sufficient in itself to supply the field for obtaining 600 volts at full load. The series winding can be short-circuited when the group works in parallel with a storage battery, and is sufficient to furnish a constant value of 600 volts from the machine. The switchboard of this plant comprises two panels for the synchronous motors, two panels for the direct-current machines and one direct-current feeder panel.

Besides the transformer post of Brunet the Entraygues system operates two posts of less importance, these being placed upon the main 30,000-volt overhead line between the turbine station and Toulon. These posts are near the localities of Gonfaron and Cuers. Both of them are used for supplying light and power to the villages near by. The transformer post located at Gonfaron contains two three-phase, 110-kilowatt, oil-cooled transformers, lowering the line voltage from 28,000 to 3,500 volts. The main high-tension line runs to the inside of the building, and can be sectioned by means of knife-switches placed at two points, between which is taken the circuit of the transformer post. In this way the station can be supplied either from the hydraulic plant or by the line coming from Toulon, in the latter case by means of the reversible groups of the substations which receive direct current from steam-driven generators. These latter groups form part of an old plant, and are retained as a standby.

The Cuers transformer post is equipped with three 250-kilowatt, three-phase transformers, each lowering the tension from 28,000 to 3,500 volts, also three monophase transformers of seventy-five kilowatts which raise the voltage from 3,500 to 10,000. In general, the post is laid out on the same plan as the Brunet and the Gonfaron posts. The high-tension oil switches of the Thomson-Houston pattern are separated by fireproof partitions, being placed on a bridge above the transformers and operated mechanically at a distance. The panels are installed on the main floor beside the transformers. The main high-tension line passes into the station and can be sectioned by an oil switch with hand or automatic action. By means of a set of switches the main line can be short-circuited outside of the station and the latter is thus cut out of the circuit, and means are provided, as in the above-mentioned plant, for supplying it either from the hydraulic station or from Toulon.



ENTRAYGUES (FRANCE) HYDROELECTRIC PLANT—TRANSMISSION LINE.

Capacity of a Battery of Accumulators Operating at Variable Output.

An analytical study has been made by F. Loppé of the proper method of rating storage batteries when operating under a variable output. Peukert has given the following formulæ for rating cells for various outputs: $i^n t = k$, i being the current of the discharge, t the time, n a coefficient depending upon the type of the element, and k a constant depending upon the capacity of the elements employed. This applies to a constant output, but if the load be variable the equation may be written as giving the output for a short time and then integrated over the entire time of discharge. A convenient way consists in plotting the discharge curve, dividing it into triangles, and summing up the areas of all of these. Knowing the value of k it is easy in this way to deduce the proper rating for a battery under any given conditions. The application of this method is shown to a battery having a constant discharge current of 336.5 amperes for ten hours. When the battery is discharged to the same point in the same time, but by varying the currents, the rating is reduced from 3,365 ampere-hours to 2,606 ampere-hours. The same method enables one to determine the charge contained in a battery at any epoch of the discharge.—*L'Industrie Électrique (Paris), November* 10.

Digitized by Google

NEW TYPES OF INCANDESCENT LAMPS.[1]

BY CLAYTON H. SHARP.

For a number of years the standard of electric lighting has been set by the carbon-filament lamp consuming initially 3.1 watts per candle-power. Progress there has been; but it has been chiefly in the way of minor improvements in the process of manufacture, rating of lamps, and in the way of a more general adoption by electric lighting companies of the 3.1-watts-per-candle lamp. This watt-per-candle consumption has been recognized as the minimum practicable under good operating conditions. Any considerable improvement in the lamp itself has seemed improbable of attainment.

Within the last two years the situation has altered materially. A marked improvement in the process of manufacture of carbon-filament lamps which has been announced and described by Mr. John W. Howell before this Institute[2] has resulted in the commercial production of lamps which operate on a 2.5-watts-per-candle basis instead of a 3.1-watts-per-candle basis.

A German firm, going back to the class of materials employed in the earliest attempt at the manufacture of incandescent electric lamps, has produced a lamp with a wire of tantalum as the glowing body and with an efficiency greatly in advance of that of the established carbon filament. More recently still, various experimenters have succeeded in producing lamps with a filament of metallic tungsten which carry the standard of efficiency to a point far beyond that obtainable with either carbon or tantalum. Since the graphitized or "metallized" carbon filament has in this country become a regular commercial product, the properties of which are moderately well known, it is deemed best in this paper to take up more in detail the peculiarities or the properties of the tantalum and the tungsten lamps.

It is not necessary in this place to go into a discussion of the processes of manufacture of the filaments of the metallized carbon and of the tantalum lamp, nor of the appearance of the lamps themselves, since these have become quite well known. In the case of the tungsten lamp, certain peculiarities of the construction are made necessary by the properties of the tungsten filament itself. The metal tungsten (German "wolfram"), while ordinarily reckoned as one of the rare elements, yet is, from the point of view of lamp manufacture, quite plentiful enough for all practical purposes. While its price per pound is high, yet considering the weight of the metal entering into an incandescent lamp, it is not especially expensive. The metal is infusible by any ordinary process. The melting point of tungsten filaments has recently been given by Waidner and Burgess[1] at 3,200° cent. The metal is commercially obtainable in the form of a fine powder. Tungsten does not seem to be ductile, so it is impossible to draw it directly into a fine wire. It unites readily with oxygen and with carbon at high temperatures. These peculiarities have made the problem of the production of

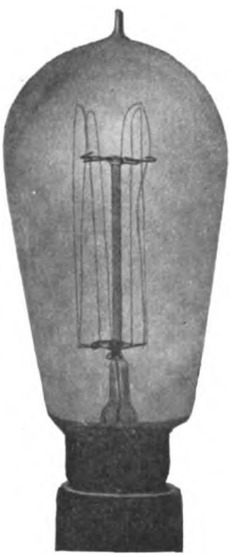


FIG. 1.—110-VOLT OSRAM LAMP.

tungsten filaments a rather difficult one. It has been attacked from several sides, and different processes for the manufacture of tungsten filaments have resulted therefrom.

The earliest process to be brought to public attention was that of Dr. Kuzel. Kuzel's process consists in the production of a colloidal solution of tungsten by forming an arc between terminals of the metal under the surface of water. The colloidal solution, when it has been brought to the proper consistency, is squirted through a die into filaments, which after being dried are converted to the crystalline condition by the passage of an electric current through them. In this way the filament is produced without introducing any carbon, which would unite with the tungsten to form tungsten carbide, a compound which is readily formed and which is very detrimental to the quality of tungsten filaments.

Another process is the substitution process of Dr. Just and Hanaman. This process seems to be very similar to one patented by Lodyguine some ten years ago. In this process a very fine carbon filament is heated in an atmosphere of a chloride of tungsten and hydrogen. Under proper conditions of the experiment, tungsten is deposited upon the carbon filament, the hydrogen acting as a reducing agent. By heating the filaments by means of a current the whole filament is converted into tungsten carbide. The carbon made is then removed from the filament by heating the same in an atmosphere of steam and hydrogen. The steam is decomposed, its oxygen uniting chiefly with the carbon of the carbide. Whatever tungsten is oxidized in this process is reduced again by the hydrogen which is present. It is impossible to say exactly whether this process is actually used in the manufacture of these lamps or not, though the statement may be made with a reasonable degree of certainty that some substitution process is used by Dr. Just and Hanaman.

The manufacture of filaments of osmium presented a problem similar to that of the tungsten filament. It is, therefore, natural that the process of Dr. Auer von Welsbach should by proper modification be adapted to the manufacture of tungsten lamps. Experiments along this line have been carried on by the companies in Germany and Austria which have been engaged in producing osmium lamps. To the tungsten lamp manufactured by the Osmium Lamp Company of Vienna has been given the name of the Osmin lamp. The tungsten lamp of the Auer Company of Berlin is called the Osram lamp. While it is reasonably certain that the details of the processes of manufacture of these two lamps differ from each other, yet they are probably alike in their general features. The method consists in forming a paste of finely divided tungsten with a binder of organic material such as, for instance, sugar solution, and squirting the same into filaments through a die. The carbon is then removed from the filaments by heating the latter in an atmosphere of steam and hydrogen or by the use of some similar process.

Still another tungsten lamp is known as the "Z" lamp. The process by which it is manufactured involves also a squirting of a paste consisting of finely divided tungsten with an organic binder, but differs from the other in the method employed to remove the carbon.

Tungsten lamp filaments manifest all

[1] A paper presented at the 211th meeting of the American Institute of Electrical Engineers, New York, November 23, 1906. Slightly condensed.

[2] Asheville convention paper, 1905.

[1] *Electrical World*, 1906, vol. xlviii, p. 915.

Digitized by Google

the ordinary properties of wires of pure metals. They have high conductivity and a large positive temperature coefficient. The high conductivity of the material requires that the filaments shall be very fine and quite long if they are to be used in producing lamps giving a reasonably low candle-power on 110-volt circuits. The degree of fineness to which it has been possible to reduce these filaments is indicated by the following table:

	Diameter.
Tantalum, 110 volt, 22 c-p	0.052 mm.
Osmium, 16 volt	0.103 "
Z New	0.1 "
Z After burning	0.055 "
Osram, after burning	0.044 "

A fine hair may have a diameter of about 0.06 mm. In view of the extraordinary degree of fineness which has already been attained in the manufacture of these filaments it does not seem probable that very much more can be looked for in this direction.

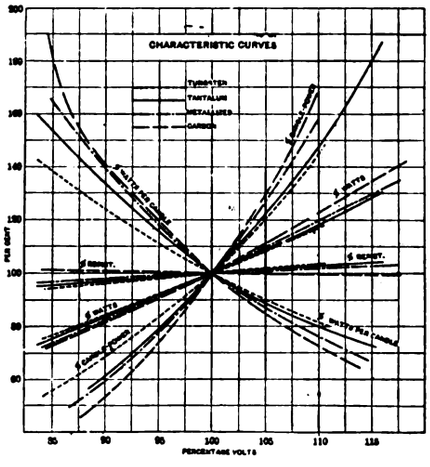


FIG. 2.—CHARACTERISTIC CURVES.

Tungsten filaments, when at the temperature of full incandescence, are quite soft. It is, therefore, not feasible to produce them and mount them in lamps in any other form than in loops. The result is that the tungsten lamp takes on the appearance shown in Fig. 1, which illustrates a 110-volt Osram lamp. In this lamp it will be seen that the filament consists of four loops. The ends of each loop are attached by means of a paste or by actually fusing them fast by the use of an electric arc to wires brought out from the stem of the lamp. The stem of the lamp is prolonged and carries at its lower extremity wires which serve as guides and supports for the loops of the filament. All the lamps which have been exhibited up to the present time have been intended for burning only in a pendant position. It can be stated, however, that by certain modifications in the details of construction lamps are now being made which can be burned in any position. The first tungsten lamps produced were designed for low voltages. In consideration of the high conductivity of the material, the production of a low-voltage lamp is a more simple problem than the production of one of higher voltage, since for low voltages a shorter length of the filament may be employed. It would seem also that it is easier to produce a lamp of high candle-power than of low candle-power, since a stouter filament may be employed in the high candle-power lamp.

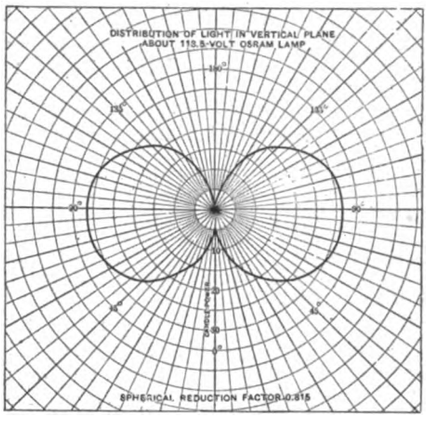


FIG. 3.—DISTRIBUTION OF LIGHT IN A VERTICAL PLANE ABOUT 113.5-VOLT OSRAM LAMP.

As far as the writer knows, no 110-volt lamps have been produced as yet for lower candle-powers than 25 and no lamps have been produced for higher voltages than 220. The fineness of the 110-volt, 125 candle-power filament is such that it would seem to be difficult to produce such a lamp as a regular commercial article. The 220-volt lamps are probably only experimental as yet. The properties of the tungsten filament are such that it would seem to lend itself very readily to the production of most excellent lamps for street lighting by the series incandescent system. Lamps for 110 volts are likely to have when commercially produced a watt consumption of 50 watts or more. If tungsten lamps are to be made for small candle-powers, such as are commonly employed in domestic lighting, they would probably need to be made for fifty volts or under, and consequently either burned in series or connected to low-voltage mains.

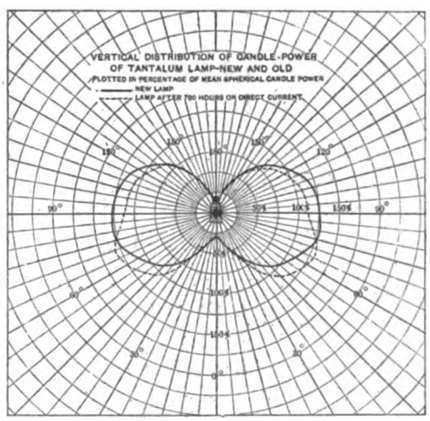

VERTICAL DISTRIBUTION OF CANDLE-POWER
OF TANTALUM LAMP—NEW AND OLD
PLOTTED IN PERCENTAGE OF MEAN SPHERICAL CANDLE POWER
NEW LAMP
LAMP AFTER 700 HOURS ON DIRECT CURRENT

FIG. 4.—VERTICAL DISTRIBUTION OF CANDLE-POWER OF TANTALUM LAMP—NEW AND OLD.

One of the chief disadvantages of the tungsten lamp lies in the extreme fragility of its filament. Blows or shocks given to the lamp are quite likely to cause a rupture of the filament. A ruptured filament may, however, mend itself by the parts welding together once more, but where the filament has become welded it is quite likely to break loose again.

The tungsten and tantalum filaments have positive coefficients which are, moreover, much larger than the positive coefficient of the "metallized" carbon. The temperature coefficients of tantalum, osmium, and tungsten filaments have been determined by measuring the resistance of these filaments at room temperature and again at 100 degrees centigrade. They were as follows:

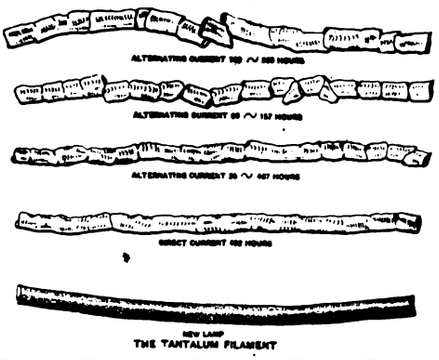


FIG. 5.—TANTALUM FILAMENT UNDER VARIOUS CONDITIONS.

Tantalum	0.234 per cent per degree.
Osmium	0.872 " " " "
Tungsten (Osram lamp)	0.438 " " " "

The effect of the positive coefficient is to give the metal-filament lamps considerable inherent regulation. That is, the change of current through the lamp is no longer proportional to the change in voltage, but is smaller proportionally than the change in voltage. Consequently in watts, candle-power, and watts per candle, these lamps undergo smaller changes with the change in the line voltage than in the case of the carbon-filament lamp. These characteristics are brought out in the curves of Fig. 2.

The distribution of luminous intensity in the horizontal plane for both tantalum and tungsten lamps must be on the average a circle, due to the method of construction of the lamps. This circle contains in each case a number of narrow maxima which are due to reflections from

Digitized by Google

the opposite side of the bulb. Curves of vertical distribution of a tungsten lamp and of a new and an old tantalum lamp are shown in Figs. 3 and 4. The difference between the curves of the old tantalum lamp and the new tantalum lamp brings out a marked peculiarity of the tantalum lamp when constructed with a straight-sided bulb. It points to a change in the spherical reduction factor or ratio of the mean spherical to the mean horizontal candle-power of the lamp during its life. Such a change is actually shown by the lamp. The change in vertical distribution may be traced to two causes: first, to the deposit of black material left on the bulb in a zone of a width substantially the same as the length of the spires of filament stretched between their support, and to an increased roughness of the filament.

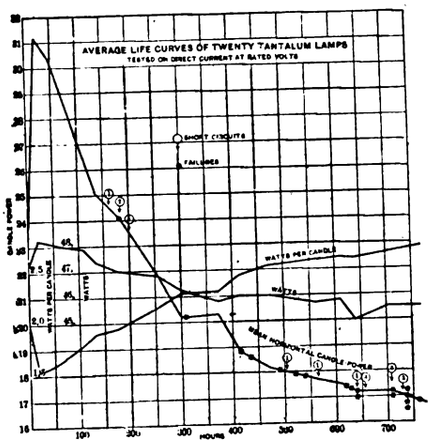


FIG. 6.—AVERAGE LIFE CURVES OF TWENTY TANTALUM LAMPS.

It has been customary to consider as the useful life of a carbon-filament lamp its life up to the time when its candle-power has fallen to eighty per cent of its initial value. Beyond this point it has been considered cheaper to discard the old lamp and replace it with a new one; in other words, this has been taken to be the proper "smashing point" of the lamp. It should be pointed out that this relation does not hold with the metallic-filament lamps. The smashing point of a lamp is determined by considerations of initial cost of the lamp, the cost of electrical energy, and the rate of decline of the candle-power of the lamp. In the metallic-filament lamps we have lamps of much higher economy, not only initially, but throughout their life; they are lamps of higher candle-power and necessarily of higher initial cost. It would seem that the data at present available regarding such lamps are not sufficient to permit of the proper determination of the smashing point. Certain it is, however, that where such lamps are used they are likely to be burned until they fail.

Some of the earliest tests of tantalum lamps made in this country showed a much poorer behavior than was claimed for the lamp by its makers. In these tests the lamps were burned on alternating-current circuits. Since there was no reason to suspect that the lamps were suffering on account of incorrect voltage or rough handling, the conclusion was almost inevitable that the nature of the current might be influencing their life. On trial it was found that tests made on direct current instead of alternating gave results which were in general agreement with those which had been published abroad. Since that time the effect of alternating current in shortening the life of a tantalum lamp has become well recognized.

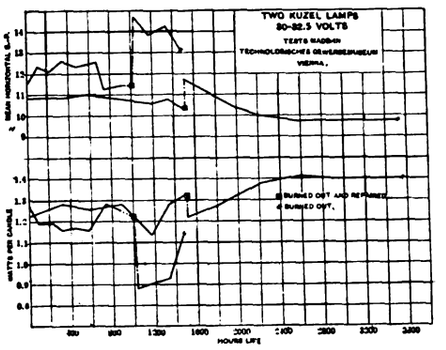


FIG. 7.—TESTS OF TWO KUZEL LAMPS.

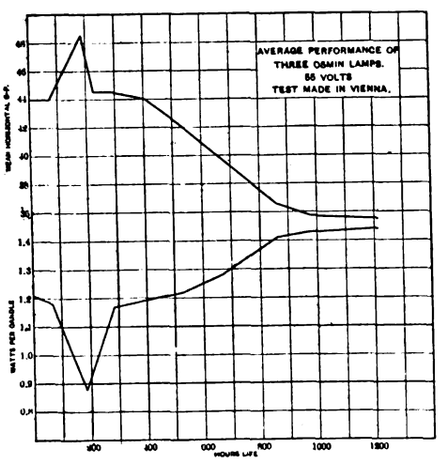


FIG. 8.—AVERAGE PERFORMANCE OF THREE OSMIN LAMPS.

A microscopic examination of the tantalum filaments, new and burned on direct current and alternating current of different frequencies, is extremely interesting. A free-hand drawing of such filaments as seen under the microscope is given in Fig. 5. It will be seen in this figure that the unused filament is smooth and polished with only slight pittings on the surface. The filament which has been burned on direct current is much less regular; its surface shows deeper pittings and, in places, it is cut and notched as if with a knife blade. Some parts of the filament are much more irregular than others. The filament on twenty-five cycles shows still stronger markings of the same character as shown on the direct current, but shows also, in places, a jointed structure looking like the jointed structure observable sometimes in basaltic rocks. This latter effect is even more marked in the case of the filament which has been run on sixty cycles. Here, parts of the filament look as if they were made up of blocks which had been irregularly piled one on the other. The length of these jointed sections in the filament is about equal to the diameter of the filament itself. It looks, in some places, as if one of these sections had been almost expelled from the row. The appearance, too, is very much as if where these joints occur, the filament had actually separated and had welded itself together instantly. The filament which had been operated on 130 cycles had the same appearance, perhaps somewhat exaggerated. In short, the increased wear and tear of the filament, due to the use of the alternating current, is very apparent. The reason for it, however, is obscure. The conclusion is inevitable that this lamp at the present time is essentially a direct-current lamp.

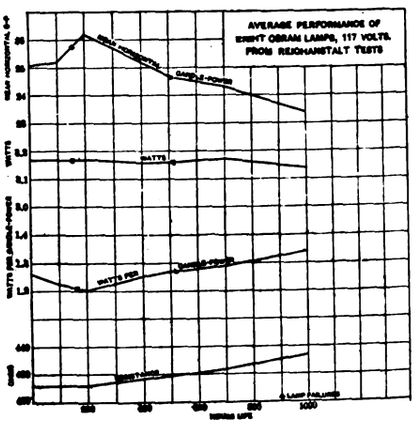


FIG. 9.—AVERAGE PERFORMANCE OF EIGHT OSRAM LAMPS.

No such effect is observable with the tungsten lamps. Tests of the Electrical Testing Laboratories show quite definitely that their life on direct current and alter-

Digitized by Google

nating current is the same. This has also been proved by elaborate experiments to be true of carbon filaments.

The average results of tests of twenty tantalum lamps of German manufacture on direct current are given in Fig. 6.

The life-history of tantalum lamps is characterized by a large initial increase in candle-power and a corresponding decrease in watts per candle, the extreme values being reached at the end of about

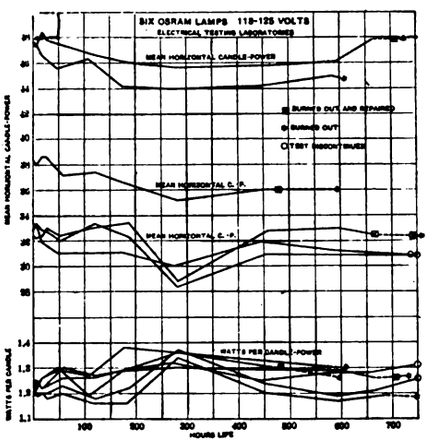


FIG. 10.—TESTS OF SIX OSRAM LAMPS.

twenty-five hours. From this point on, the candle-power decreases at a moderately rapid rate and the watts per candle increase. The result of the relatively slow decrease of mean spherical candle-power with a large initial increase, is that in some cases the final mean spherical candle-power of a lamp is actually greater

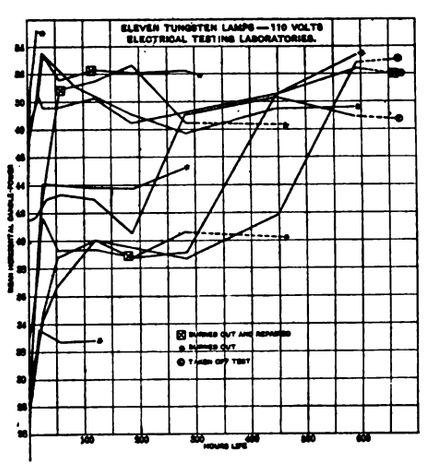


FIG. 11.—TESTS OF ELEVEN TUNGSTEN LAMPS.

than its initial mean spherical candle-power.

Results of tests of tungsten lamps made in various laboratories are given below. The data on some of the makes of tungsten lamps are extremely meagre; a circumstance which in some cases is believed to correspond to a backward state of their commercial development. Fig. 7 gives the results of tests[1] of two Kuzel lamps of approximately 30 volts and 11.5 candle-power, made at the Technologisches Gewerbe-Museum in Vienna. These lamps consumed approximately 1.25 watts per candle initially. One of them reached the extraordinary life of 3,537 hours, with a decrease in candle-power of about ten per cent. The filaments in both the lamps were burnt through and repaired once in the course of their life. The result of the repair was an increased candle-power, which is shown clearly on the curve.

The average result of tests of three Osmin lamps of fifty-five volts and forty-four candle-power are shown in Fig. 8. These tests were made in the laboratory of an electrical company in Vienna. The lamps showed a life of 1,200 hours and a decrease in candle-power of fourteen per cent in that time. The results of a test of three Osmin lamps of fifty-five volts made at the Municipal Electricity Works, Vienna, showed an initial candle-power of 27.3 and initial watts of candle-power of 1.25. After 2,239 hours of burning the candle-power was 23.4 and the watts per candle 1.45. Six fifty-four-volt Osmin lamps tested at the Technologisches Gewerbe-Museum consumed initially 1.17 watts per candle. After 1,776 hours the watts per candle were 1.24. The candle-power of these lamps is not given in the report. It should be noticed that all the above lamps are low-voltage lamps, from which a better result is to be expected than from 110-volt lamps.

Fig. 9 shows average values of candle-power, watts, and watts per candle of eight 117-volt lamps from among those given in the above tests.

In Fig. 10 are shown the individual curves of six Osram lamps of thirty-two, thirty-five, and forty-five candle-power, tested at the Electrical Testing Laboratories. The results of these tests differ from the results of the Reichsanstalt test in that they show practically no initial rise in candle-power. The decrease in candle-power of the lamps throughout life, however, is very slow. The watts per candle are also almost constant. The life of the lamps was on the average considerably shorter than the life of those tested at the Reichsanstalt.

Candle-power curves of eleven tungsten lamps of quite another foreign make as tested at the Electrical Testing Laboratories are shown in Fig. 11. These lamps exhibit a very large initial increase in candle-power, followed by a practically constant condition. The average life is also much shorter than in the case of the Osram lamp.

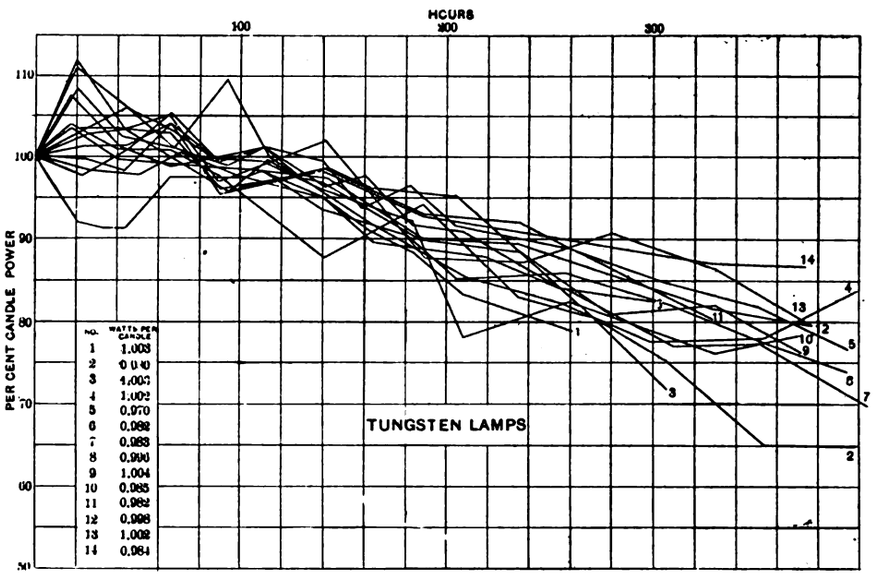


FIG. 12.—LIFE-EFFICIENCY CURVES OF TUNGSTEN LAMPS.

The curves of Fig. 12 are of particular interest since they show the performance of lamps made in this country. These lamps were tested at an average initial consumption of 0.99 watt per candle. Their average life was 363 hours even at this high initial efficiency, and the average decrease in candle-power was 17.7 per cent. These curves demonstrate that incandescent lamps can be produced which will operate successfully at one watt per candle and will give a satisfactory life. The candle-power of these averaged about forty.

The color of the light from the tantalum lamp is whiter than that of the carbon

[1] Kremenezky "Elektrotechnik und Maschinenbau", 1906, No. 6.

Digitized by Google

lamp, and the color of the tungsten lamp is still whiter than that of the tantalum lamp. The light of the tungsten lamp resembles quite closely that of the acetylene flame. The increased whiteness of the light, which is produced evidently largely as a temperature effect and which does not involve a preponderance of certain colors, such as green or violet, constitutes a point of real superiority in the tungsten lamp. Time has been lacking to make a regular spectro-photometric study of these lamps. A simple experiment, however, has been made which gives some idea of the increased radiation of the shorter wave lengths, both of tungsten and tantalum lamps, as compared with the carbon lamp at 3.1 watts per candle.

The metal-filament lamps were photometered against the 3.1 carbon lamp directly and then with a red, green and blue glass interposed between the eye and the eye-piece of the photometer. The intensities so measured, expressed in percentages of the intensities measured without colored glasses, are given in the following table:

	Tantalum Lamp. Per Cent.	Tungsten Lamp. Per Cent.
Total light.....	100	100
Red light.....	90.5	88.0
Green light.....	100.3	101.8
Blue light.....	109.2	126.5

The increased whiteness of these lamps may theoretically be due either to higher temperature of the filament or to selective radiation by the filament. Recent work of Waidner and Burgess indicates that while the increase in the efficiency of tantalum and tungsten lamps, as compared with the carbon lamp, is to some extent due to the selective character of their radiating power, yet the chief cause of the increase is the higher temperature at which it is practicable to operate them. The higher temperature causes the maximum of the spectral energy curve to be shifted toward the shorter wave-lengths, and consequently a higher percentage of the total radiation is emitted in wave-lengths which are capable of exciting vision.

It has been established as a result of practice that in general it is not possible to operate incandescent lamps on 25-cycle current with satisfactory results. This statement is made with a knowledge of the fact that in certain cities a large amount of lighting is actually being done on twenty-five-cycle circuits. Yet under some circumstances twenty-five-cycle current produces such marked flickering of incandescent lamps that its use is absolutely impossible. It is an interesting question whether the tungsten lamp presents any advantages over the carbon lamp for use on low-frequency circuits. Its positive temperature coefficient and the relatively low radiating power of its surface would tend to reduce the flickering, while the extreme fineness of the filaments which results in a smaller thermal capacity and the high thermal conductivity which, as a metal it probably possesses, would tend to increase the flickering. A few preliminary tests have been made in an attempt to gain some information on this question. It was very quickly discovered, however, that the question is so very complicated that a considerable research will be required to ascertain definitely the facts of the case. Eleven tungsten lamps were attached to the ceiling of a small room, producing a brilliant illumination in the room. Three observers attempted to determine the presence or absence of flickering. With the lamps at their normal voltage of 115 and with a frequency of 25.5 cycles per second, L. found the flickering marked; M. found the flickering marked; S. could see a flickering intermittently, as when his head was moved suddenly. With the same lamps, but with the voltage reduced to 100, the flickering was imperceptible to all the observers.

As the voltage was raised successively to 105 and 110 volts the flickering became perceptible. When five of the lamps were removed, leaving only six lamps in position, it was the consensus of opinion of the three observers that the flickering was less marked than when all the lamps were in. In other words, the intensity of the sensation of flickering seems to be a function of the illumination. The flickering was imperceptible when looking directly at the lamps, but could be observed only through light which is not focused directly on the fovea of the eye. To institute a comparison between the flickering of the tungsten lamps and of carbon-filament lamps a sufficient number of carbon-filament lamps of candle-power comparable to the candle-power of the tungsten lamps, lamp for lamp may be taken. That is to say, twelve thirty-two-candle-power carbon lamps were substituted for the eleven tungsten lamps. These were operated at 3.1 watts per candle. At the same frequency as was used for the tungsten lamps, no flickering could be observed. This is not a surprising result, since the diameter of carbon filaments is much greater than the diameter of the tungsten filaments, and consequently their thermal sluggishness is a much more important factor.

In view of the very considerable advantages which would be gained if it could be shown that it is feasible to operate incandescent lamps on alternating-current circuits of frequency low enough to permit of the easy operation of synchronous converters, that is to say, a frequency of twenty-five cycles or slightly greater, the question of the variation of the light of incandescent lamps during a half cycle of the alternating current has also been subjected to an experimental investigation by the use of a stroboscope. The curves so obtained, while exhibiting certain irregularities due to experimental difficulties, are fairly concordant and exhibit to a common character. The percentage variation seems from these curves to be expressible by two linear relations, with a point of sharp curvature occurring between twenty-five and thirty cycles per second. That is, as the frequency is increased from fifteen to twenty-five cycles the diminution in flicker is very rapid. Above thirty cycles the diminution in flicker is very slow. Since it has been found possible in some places to operate incandescent lamps on twenty-five cycles, it would seem probable that a comparatively small increase in the frequency, which would carry the lamps beyond this apparently critical point in the curve, might make feasible the general operation of incandescent lamps from alternating-current power circuits.

Similar tests to the above have been carried out on a forty-watt, thirty-five-candle-power, 115-volt Osram lamp. The results of this test indicate that the stroboscopic variations of a tungsten lamp of this size are not much different from those of an ordinary lamp rated as on eight-candle-power lamp when forced to 2.5 watts per candle. The stroboscopic measurements, however, may be subject to certain ones of the difficulties which affect the detection of flicker by the eye. In other words, the degree of intensity of the light upon the photometer disc may have an influence on the results obtained. However, if the results of this preliminary test, which has been made in a very limited time for the purposes of this paper, can be confirmed by later and more careful experiments, the tungsten lamp will be found to be less adapted to use on alternating circuits of low frequency than the standard lamp of to-day.

From the data given above it seems certain that the electric lighting industry is face to face with a change of almost revolutionary character. The standard of incandescent lighting efficiency will be brought by the tungsten lamp to a point about three times as high as it is at present. The efficiencies of all other incandescent lamps and of enclosed arc lamps are exceeded by that of the tungsten lamp. In other words, with the possible exception of some forms of vacuum-tube lighting and of the magnetite and flaming arc lamps, the tungsten lamp is the most efficient electric illuminant. Combined with its virtue of high efficiency it has the other advantages of incandescent lamps in being perfectly simple in its character and construction and in being capable of subdivision into small units.

Digitized by Google

"Seeing Electrically."

To the Editor of the Electrical Review:

The interesting communication on "Seeing Electrically," from A. W. Storm, which was published in your issue of November 17, goes to show that there are a good many men at the present studying this problem. It is too bad that he did not in that article give us some inkling of the ideas that he has been storing away for these many years of his study of the subject. Equally unfortunate is it that the two men mentioned as having solved the problem, have also seen fit to withhold the details of their methods. It is much to be hoped that there is good foundation for their claims, and I shall watch eagerly for the descriptions of their apparatus.

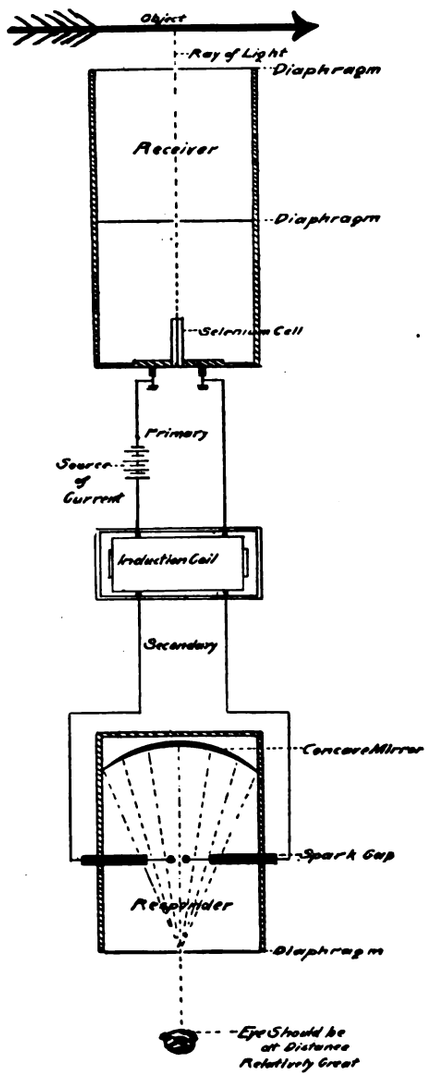
If all those engaged in the study of this intricate and difficult problem could pool their ideas we might have an actual working, though perhaps crude "optigraph" much sooner than most of us think. Why not let each one who has any idea bearing on this matter publish it, and thus help to an early solution of this most interesting problem? In accord with these views, may I submit what has seemed to me a possible solution? Having carried out as yet no experiments, the plan, of course, is purely theoretical.

In the first place, the plan is to do away with the necessity of throwing the shadow of a negative upon a selenium screen and instead to look, as it were, upon the object itself, any changes or motions in the object to be recorded as faithfully as those parts which remain motionless.

A sensitive selenium cell is made by clamping together two strips of copper between which is placed a very thin slice of mica only a few thousandths of an inch in thickness; after clamping the ends are dressed off to give a smooth surface for the delicate coating of selenium, which is crystallized, so as to be most sensitive to light.

This cell is placed in the bottom end of a hard-rubber or other suitable tube an inch or less in diameter, and perhaps three inches long. The sensitive end of the cell is located in the centre of the tube and pointing toward the open end. Midway of the tube a diaphragm of some very thin opaque material is placed and near or at the open end another like it is located. A pinhole is drilled in the exact centre of each of these partitions in such a way that a ray of light passing through both pinholes strikes the selenium cell exactly in the centre between the copper plates or at a point exactly over the edge of the mica. In this way light from but a small point at a time can be reflected into the tube and strike the sensitive cell.

The tube is so mounted on a movable mechanism that it will be made to pass over or in front of a small square of perhaps three or four inches to the side.



Arrangement of Apparatus.

It must move so rapidly as to pass before every portion of this square within the space of one-tenth of a second, which is the recognized time for the persistency of vision, and must repeat it over and over at the same speed.

The object to be seen can not exceed in size the square over which the tube moves, and must be placed directly in front and within the limits of the square. Having a good light thrown upon the object, it will be evident that a ray of reflected light will be cast upon the selenium cell from every point of the object in its turn, but light can enter but from a single point at one time. This causes the cell to be more or less conductive, according to the particular shade of the point on the object before which it happens to be at any instant. The inside of the tube, of course, should be blackened to prevent reflections.

A current of electricity is caused to flow in a circuit which includes the selenium cell, the current varying with the fluctuations of the resistance of the cell. The wires of this circuit pass to a reproducing station and cause fluctuations in a light. To successfully reproduce the image being transmitted would seem to be a particularly difficult task, from the fact that the amount of light represented by the varying current in the circuit must change so rapidly from maximum to minimum that there is no known source of light capable of following it without considerable lag, which, of course, means failure.

The possible exception may be the induction-coil spark, which is free from solid filaments and substances to be heated and cooled.

The induction coil may be capable of being interrupted sufficiently fast to produce sparks of varying brightness to obtain the desired results. On this supposition let us proceed. At the reproducing end of our circuit a tube similar to the one already described, only somewhat shorter and possessing but one diaphragm, is mounted on a moving mechanism exactly like the one already described.

In the bottom or back end of the tube is mounted a concave mirror of such focus as to reflect all rays to a small pinhole in the diaphragm of the tube, located in this case at the outer end.

Between the reflector and the diaphragm is a spark-gap, so located as to give the best results with the reflector and condensing all the light possible at the pinhole of the diaphragm. The wires from the selenium cell are brought as primaries to an induction coil, the secondaries of which connect to the opposite sides of the spark-gap in the tube. The tube-carrying mechanisms are driven synchronously, so that they are always in the same position with relation to the squares they are each describing or covering.

As the current varies with the action of the selenium, the brightness of the spark in the reproducing tube is increased or diminished accordingly, thus making the pinhole as seen from directly in front grow bright or dark as the case may be. This point of varying light exactly repeating itself over the same space once every tenth of a second produces a view of the object at the receiving end which persists as long as the apparatus is kept in motion, and should changes or motions take place in the object, they will also be seen.

W. L. Chamberlain.

West Hartford, Ct., November 22.

Digitized by Google

WHAT IS AN ENGINEER-CONSTRUCTOR?[1]

BY GEORGE A. DAMON.

One prominent element of modern industrial life is bigness. We have large business corporations, combined railway systems, extensive manufacturing concerns and comprehensive enterprises in all lines of commercial activity.

Another dominant element is efficiency, which may be taken as the key word of modern business life and engineering practice. The constant aim is not cheapness in construction or equipment, but effectiveness, the greatest return for the outlay.

These two elements chiefly have brought about a condition in which we have the necessity for a technical organization ready to produce large results in an effective way. Between the desire for bigness and efficiency and its fulfillment is the field of operation for the creative and constructive abilities of the "engineer-constructor."

An "engineer-constructor" is an organization, and not an individual. It makes possible the most effective combination of technical theory with practical experience, and provides for the use of "team work" in connection with the designing and building of properties. Its aim is to attain the greatest economy in effort, time and money—its province is to "do" things in the most effective way.

In its broadest development such an organization need not be confined to any one class of enterprise. Here is something to be built which requires for its completion a combination of conception, technical knowledge, construction experience and executive ability. Whatever it is, the "engineer-constructor" should be prepared to carry the proposition through from beginning to end without technical assistance from outside the organization. To be most effective, such an organization should have at its command the technical knowledge and experience of the past; the ability to analyze situations, and discover the truth from conflicting testimony; the imagination to conceive unprecedented results and courage to overcome obstacles; the ambition to improve existing systems, and the honesty to spend money without favor or graft; and finally loyalty to itself and to its client, which will protect in every way the interests of all concerned.

An "engineer-constructor," therefore, is nothing less than an ideal employé who has the best possible preparation, the widest experience and the natural aptitude to do in a large way the big things which the development of this country is constantly requiring. Such an organization substitutes for the isolated efforts of one or more individuals an effective combination of the aggregate abilities of a number of experts and adds the enthusiasm and inspiration which come from the contact of fellow workers.

It is an organization in which men of various training in engineering and industrial work of all kinds are fitted together as a mechanic would build a machine, and the efficiency of such an organization for the purpose for which it is created depends upon, first, the perfection of its individual parts; second, upon the skill with which these parts have been brought together; and, third, upon the absence of any unnecessary friction during operation.

Such an organization should not be the maker or manufacturer of any equipment, nor be connected with the exploitation of any system of apparatus, nor interested in the introduction of any patented devices. In its highest stage of development it will not be connected except in a technical way with the financial interests which control the enterprise.

To show the possibilities of such an organization, let us pick out a staff for the design and construction of a steam railroad locomotive repair shop, involving the expenditure of from two to three million dollars. The selection of men with their chief duties will be as follows:

Industrial Expert	Designing Layout of Shops. Planning Method of Handling Work. Arrangement of Tool and Transportation Equipment.
Electrical Engineer	Providing Power and Lighting Equipment. Laying Out Transmission Systems. Planning Telephone and Signal Systems.
Mechanical Engineer	Design of Power Plant. Plan of Heating and Ventilating. Laying Out Air, Gas and Steam Systems.
Structural Engineer	Building Foundations. Designing Steel Structures. In Charge of Reenforced Concrete Construction.
Architect	Designing Building Superstructure. Choice of Fixtures. Laying Out Landscape Work.
Civil Engineer	Directing Grading. Testing of Soil. Construction of Track.
Sanitary Engineer	Design of Sewage System. Construction of Water Works. Choice of Plumbing.
Purchasing Agent	Selecting Markets for Material. Checking Bills of Material. Arranging for Delivery of Material.
Constructing Superintendent	Organization of Construction Force. Consideration of Time Element in Construction. Settling Labor Difficulties Arising in Connection with Construction Work.
Operating Engineer	Consideration of Economics in Operation. Securing Reliability in Operation. Insuring Effectiveness in Operation.
Accounting Department	Keeping Pay Rolls. Making Record of Costs. Preparing Progress Reports.

The first work will be a number of preliminary studies, showing the proposed sizes, designs and relative arrangements of the buildings. There will next be forthcoming a carefully prepared report, showing the advantage of the finally selected arrangement, and the suggested construction of each of the buildings, together with a description of the equipment required. An important part of this preliminary report is an approximate estimate of cost, based upon a careful consideration of all the items involved in the construction.

With the general layout and the preliminary report and estimate approved, the next move is to prepare the plans and specifications.

The plans should preferably be drawn upon one size of paper and every drawing should be numbered to correspond to the

[1] A paper presented to the Electrical Section, Western Society of Engineers, November 16, 1908.

Digitized by Google

classification. A border and a standard title printed by a draughting-room outfit gives a finished appearance to each drawing.

Specifications can now be printed very quickly, and when at least twenty copies are required, they can be produced in this way as cheaply as by carbon copies, or the better method of blue-printing from a typewritten record.

In purchasing, the "engineer-constructor" should find some advantage over an occasional buyer. He is in the market constantly, is favorably known by the manufacturers of standard equipment, and buys apparatus delivered f.o.b. cars, doing all erection work as far as possible with his own experts, and calling on the factory for assistance only when necessary.

Throughout the entire progress of the work, systems are in use to keep all concerned informed as to each move. The construction office is advised by the home office as to the material ordered and as to the probable delivery of this material. The home office is advised as to the receipt of material on the job, as well as to the progress of the construction work, and any reports and advices as to the labor situation. To accomplish the former copies of contracts for apparatus and orders for material are sent to the superintendent in charge of construction. Such reports and orders contain exact information as to the material covered by them, as well as to the time at which this material is expected to arrive on the work. A card system in which are entered all orders and contracts is used in the home office, and is designed to follow up and secure prompt delivery of all material and apparatus. In case of any changes in time of delivery of material, the construction superintendent is advised in advance, and is thus in position to make any alterations necessary in his program. The importance of promptly delivering the material on the job can not be overestimated, and the value of a system that will provide for the delivery of the materials in accordance with an approximate schedule previously arranged for will appeal to all interested in construction work.

Practically all of the material is ordered by the home office. In case, however, it is more advantageous to order small quantities at the seat of the work, such orders are issued by the superintendent, a copy of all such orders being sent to the home office, after which they are recorded and handled in all respects similar to orders issued from the office.

Records of all material received on the job are kept by the superintendent in the form of a material report. These reports are written out in a duplicate book as each shipment is received, and one copy is sent without delay to the main office. This serves to keep the home office very closely in touch with the field work, so far as the receipt of material is concerned.

In construction work consisting of a great many items, such as will be found in railroad shops, it is very desirable to know with a fair degree of accuracy the exact progress of the work. Certain lines of the work, such as the delivery and installation of machinery, are dependent upon the progress of other work, such as the completion of the buildings and foundations. In order that this information may be always at hand, progress reports from the work are received at stated intervals, usually two weeks apart, giving in detail the progress of the work under each classification head. This information is kept in form for convenient reference, and is useful in a variety of ways. Not only do these reports keep the engineering force in touch with the progress of the work, making it possible to more efficiently insure the work coming in proper sequence, but they also provide the information necessary to make decisions as to changes in detail, in case such are found necessary after the work has been begun. These progress reports, together with a record of moneys expended for material and labor at any date, give timely information as to the actual cost of the work as compared to the estimated cost. As such reports are made on the work under each classification heading, any variation of the cost from the estimate is at once detected. This is of importance to the constructor who proposes to complete a certain improvement within a definite estimated cost, and to the client's official who may be charged with the responsibility of protecting a definite appropriation.

Wherever it is possible, curves or diagrams are used to represent the condition of affairs of which record is to be kept. A chart showing the progress of the work on building construction is easily made, and shows very clearly at a glance the exact condition of the work at any time.

Although every facility is provided for keeping the main office and the construction office in close touch, it should not be understood that the engineering is done at arm's length, and that all plans and specifications are devised and completed by an engineering force in the office to be sent down to the construction superintendent on the job for his execution. A competent engineer is in charge of all construction work, and spends a certain amount of time in the field, thus putting him in close touch with the situation, and enabling him to more efficiently direct the detailed engineering work that is done in the main office.

It would be a big mistake to think that such an organization as we are outlining could be got together and perfected in its work in a short time. It will probably take years, and it is evidently for this reason that this very inviting field is occupied by so few organizations who are really prepared to do the work justice.

Ten years ago the president of the Arnold Company was a consulting electrical engineer—an expert on electrical questions, and in a consulting capacity only. Then came the natural addition of mechanical problems—still in a consulting capacity. The introduction of the system of rotary converters for electric railway work, and of an improved system of power plant construction, made it necessary to take two contracts in which the results of these two systems, which were advised by the consulting engineer, were guaranteed. Thus a contracting company was formed and a construction department organized. This move developed the fact that the same brains which made the plans for an installation could be mixed with some enterprise and business ability, and thus actually bring about a complete result.

This worked so well that other contracts for complete electric systems were sought and secured—sometimes as engineers, sometimes as constructors, occasionally as both. Civil, structural, architectural, industrial and hydroelectric departments were added as the business grew. Systems of carrying on the work were perfected as experience dictated, and weak parts were made stronger. To-day this company has on its payrolls a technical force of over eighty men, and often employs on its construction enterprises thousands of skilled mechanics, experienced foremen, and unskilled laborers.

Most of the work of this company is done on the basis of "cost plus a percentage," that is, the work is done at actual cost, and then the "engineer-constructor" gets a percentage fee for his services. By such an arrangement the client or purchaser is relieved of the necessity of organizing a technical force of his own, or of employing a number of individual specialists. If the actual construction work is turned over to the "engineer-constructor," then the client is relieved of the inconvenience of obtaining proposals and awarding contracts to a large number of separate contractors, with the attendant delays, conflicts and "extras," which even the closest supervision will hardly avoid.

Digitized by Google

Electrical Notes from Great Britain.

(From Our British Correspondent.)

SO FAR as London is concerned the electrical topic of the hour is that of power supply. This revival of interest in the subject is due to the publication of the new proposal of the London County Council, which has been drawn up at the suggestion of its Highways Committee with the combined assistance of such experts as H. F. Parshall, Robert Hammond, J. F. C. Snell, Mr. Fell, the council's tramway engineer and manager, and J. H. Rider, the tramway's electrical engineer. Briefly stated the scheme is: To purchase five years hence the electricity supply undertakings of fourteen municipal corporations (in London) which have cost close upon $30,000,000, reserving the right to control capital expenditure until the purchase takes effect; to make agreements with many similar authorities outside London either for purchase or with provisions that they may continue to act as local distributors; to provide for buying the London companies (which have spent about $65,000,000) at the time they become purchasable by existing municipal corporations (roughly speaking, the year 1931), or earlier in particular cases by special agreement; the erection of a big generating station at Barking or Erith to cost $7,000,000 or more, including land, with an additional outlay of some $13,000,000 for the transmission and distribution system. Railways, tramways and other large consumers are reckoned among the prospective purchasers of current. The first two sections of the station would be completed by 1910. The total area which the council wants to supply, or to control the supply of, is 451 square miles, but only 117 square miles are in London. The remaining 334 are in the surrounding districts in Essex, Kent, Surrey and Middlesex. The scheme has been met with storms of criticism and opposition in many quarters, chiefly on financial grounds, and those who are against London's piling up municipal indebtedness are getting their plans into shape for throwing out the reckless "progressive party" which is responsible for the proposal, at the public elections next March. That would be a death-blow to the scheme, but it would still leave open the way for a new undertaking as originally fought for by C. H. Merz, or for combined action on the part of the existing supply companies. But it would be quite premature to discuss the subject further at this stage, for the air is full of proposals.

The new tube railway known as the Great Northern, Piccadilly & Brompton line, is practically finished. A trial run was recently made, and early in 1907 the system will be open for public traffic. This is a similar undertaking to the other tube lines of London. It runs between Finsbury Park in the north to Hammersmith, the length of the twin tunnels being seven and three-quarter miles. Energy is obtained from the great power-station at Lot's Road, Chelsea, from which the district and several other tubes are served. The 11,000-volt, three-phase current (33.3 periods), is reduced to a 600-volt, direct-current. The cars (Brush steel construction, externally finished in scarlet and white) measure forty-nine feet nine inches over platform, eight feet nine inches extreme width, and seven feet six inches from floor to roof. Each car has a seating capacity for fifty-four passengers, and weighs fifteen tons seventeen hundredweight, which represents a saving of twenty per cent when compared with the normal wooden railway coach. G. C. Cuningham, the general manager of the Central London tube line, designed these cars for the new line.

On November 13 C. F. Jenkin spoke on the subject of electric railway traction at the meeting of the Institution of Civil Engineers in London, and the discussion is to be continued at the next meeting. The single-phase system was the main theme, and naturally the author covered a good deal of the ground traversed in his paper read in the summer at the meeting of the British Association. Four years ago Mr. Jenkin, in conjunction with W. M. Mordey, read a paper before the Civil Engineers on railway electrification, and the present object was to bring that account of the different systems right up to date, showing how far the conclusions then expressed must be modified in the light of subsequent experience. A description of the single-phase system was given and some of the problems arising in connection with its working were discussed. Much historical and descriptive matter concerning the single-phase motor in its compensated series and compensated repulsion forms found a place in the paper, and it was contended that the conclusion of four years ago, that the single-phase was the only system to satisfy all the requirements of a general system, had been amply confirmed. The limits of voltage at which flickering is visible with glow lamps on a low periodicity supply were indicated in a table, and Mr. Jenkin also set out a method of calculation for finding the drop of voltage in any part of the circuit. Actual railway tests were shown to have confirmed such calculations.

So far the only actual example of single-phase traction in England is that at the Westinghouse works at Trafford Park. Equipment operations are, however, begun in connection with the South London line of the London, Brighton & South Coast Company, which will consist of about nine miles of double track, equipped on the Aktien Elektricitäts Gesellschaft system. For this there are to be some sixteen motor cars, each having four 115-horse-power motors. The pressure is 6,000 volts, with a frequency of twenty-five.

The other English system for which the single-phase system has been actually adopted is the Heysham, Morecambe & Lancaster section of the Midland Railway, and part of the contract has been placed within the last month. There will be eight miles of double track, with 6,000 volts on the line and step-down transformers on the motor coaches. Energy will probably be obtained from the railway's existing gas-driven power station at Heysham. The rolling stock will at first comprise three motor coaches and four trailers. The Siemens & Halske Company has been ordered to supply one motor coach (and two trailers) equipped with two 180-horse-power compensated-series motors. The main transformer on the motor coach will deliver 320 volts to the motor terminals. The motors will be mounted on the bogie by centre of gravity suspension, the Midland Company suitably modifying the standard bogie. The motors are to be connected to the car axles through single-reduction gearing (ratio 40:18). Each track will have a single trolley wire with catenary suspension.

The condition of British electric manufacturing, so far as profit-earning is concerned, continues to be very unhealthy.

Digitized by Google

Foreign competition is less severe because other countries are more fully occupied with their home trade, but the serious under-cutting which prevails between British makers and suppliers has given rise to much serious discussion. This under-cutting has been proceeding for several years, and its effect has been very evident in nearly all the reports of electrical manufacturing concerns. The output capacity of the works is, for the time being at any rate, in excess of the requirements, and the successful future seems to lie in developing electrical enterprise in foreign markets. Much is proceeding in this direction at this moment. The profit obtainable upon municipal electrical contracts has been so greatly reduced by the competition in price-cutting, that some firms have expressed the intention of not wasting time and energy in trying to secure such business. But there is a movement on foot among a number of manufacturers to adopt concerted action for protecting their interests by raising prices. Whether this movement will be more successful than some that have preceded it is hard to say, but it certainly at the moment gives promise in that direction.

America has given us a good lead by the organization of its Illuminating Engineering Society. The attempts to form a similar society in London have apparently not yet been successful, but the need for illuminating experts to guide consumers in securing better lighting efficiency is very real and is becoming more and more recognized. The difficulty of educating the consumer was interestingly dealt with by James Swinburne, F.R.S., on November 14, in a valuable communication to the Association of Engineers-in-Charge, in London. "Indoor Illuminants" was the title, gas and electricity mainly being considered. Though the modern central station is a marvellous study of economical production all questions of economy end at the consumer's meter. "He uses blackened lamps, which are marked incorrectly to begin with, and he covers every light with useless and dirty shades, and has his lamps in the wrong places." "But," said Mr. Swinburne, "the average man is busy all day, and you can not expect him to spend his evenings puzzling out questions of photometry or luminous efficiency." The engineer-in-charge who has to look after the lighting of a big building was advised to become a specialist to some extent in illumination. Though we may some day have illuminating engineers who will be tied to no particular system but will deal with each on its merits without partiality, the matter to-day is left mainly to chance, with some assistance from architects and house decorators. From the physiological point of view, the speaker said, the sources of light should not be intense, but should be small and numerous, or out of sight. As to color, it should be as near sunlight (as it reaches the earth) as possible, which view was supported by the experience of the users of the mercury arc, which, though it made things look "very ugly" as far as color went, was very restful to the eye, and was specially useful in drawing offices and similar places. The illumination of buildings was dealt with in two classes: (1) general; (2) special; and something was said regarding cost comparison of gas with electricity. Gas lighting with mantles was stated to be very much cheaper than any other form of indoor lighting except the mercury lamp. Mr. Swinburne's comments on the metallic filament lamps may be quoted: "We might almost put the carbon lamp on one side, because it appears to be doomed, as the metal wire lamps seem bound to push it out of existence as soon as they can be made in large enough quantities, and, what is more important, as soon as the public gets into the habit of asking for them. They are far more efficient than the carbon lamps, but they have some special drawbacks of their own. Some do not work well on alternating circuits. This is a difficulty that exists in some lamps only and will most likely soon be overcome. The other and very serious difficulty is that it is apparently impossible to make small lamps for reasonably high pressures."

The Institution of Electrical Engineers (London) on November 8 listened to the presidential address of Dr. R. T. Glazebrook, of the National Physical Laboratory. Electrical standardization and units were the chief subjects touched upon. At the Leeds section the chairman, George Wilkinson, in his opening address put forward some of the problems that had crossed his path as a supply station engineer, and discussed some suggestions for their economical solution. The president of the Birmingham section, R. A. Chattock, delivered his address on November 21, devoting it to considerations which had governed the development of electricity supply. Among other things he congratulated Birmingham upon having delayed such development until now, because it had thus been able to watch how it proceeded in other large centres of commerce. It was thus able to adopt the most modern and efficient plant and design. On November 13 at the Glasgow section a joint contribution by Professor F. G. Baily and W. S. H. Cleghorne on "Some Phenomena of Commutation" was read. A description was given of experiments on the phenomena occurring in the process of the commutation of armature currents in direct-current dynamos and motors. Some of the work so described was substantially a repetition of earlier work, but amplified to more exact determinations, or carried out in a different manner. The points discussed in the paper were: The contact resistance of the brush, the value of the brush current, the currents in the short-circuited coils, and the electromotive force between the segment and the trailing edge of the brush. The Leeds section, already mentioned, has been considering the question of overhead equipment for tramways. R. H. Campion, who introduced the subject, gave figures relating to cost of maintenance of overhead lines at a number of places. He thought trolley wheel grooves should be made wider than was customary and slightly V-shaped at the bottom; and pointed out various advantages of the bow collector as compared to the trolley wheel. These advantages included diminished wear on the wire when rounding curves, simplification of overhead construction, freedom from jumping the line, and ability to run in either direction. He wanted to see some engineer adopt the bow collector on a new line, for he felt that these good points had been overlooked.

For some time past good progress has been made with the erection of the new magnetic observatory at Eskdale Muir, in Dumfriesshire, but it is now reported that work has had to be stopped for the present. The building is under ground, and it is thought that there is iron in the blue whinstone that is being used. The erection of the other buildings is proceeding. ALBERT H. BRIDGE.

London, November 24, 1906.

The Pennsylvania and the Baltimore & Ohio Railroads have informed the District Commissioners that they can not substitute electric motors for steam locomotives within the District of Columbia. The Commissioners requested that this be done from the time the new union station is in use.

Digitized by Google

The Faraday Society.

The twenty-third ordinary meeting of the Faraday Society was held on Tuesday, November 13, at the Institution of Electrical Engineers, London, England. Dr. F. Mollwo Perkin, treasurer, was in the chair.

W. Pollard Digby read a paper entitled "Some Investigations Relative to the Depreciation of Electrolytically Produced Solutions of Sodium Hypochlorite."

This deals in the first place with depreciation taking place in bottles of various colors in which dark amber bottles gave the best results, the loss in 1,817 days being about forty per cent for a solution containing 4.216 grammes of available chlorine per litre. The corrosive action of hypochlorite solutions upon various metals is then discussed, and the depreciations due to graphite, copper, zinc, lead and iron plates immersed in such solutions are set forth for a period of 480 hours. A much greater depreciation takes place, due to galvanic action, when two dissimilar metals immersed in the liquid are connected by an insulated wire: the paper gives records in the case of twenty-one different couples. When iron is present as one metal in such a couple, the depreciations are generally greater than for any two other metals.

As regards the area of the exposed surface in the cases of single metals immersed in hypochlorite solutions, it was found that doubling or trebling the surface doubled or trebled the rate of depreciation.

Brief reference is made to the value of protective coatings as applied to metal-couples, but no conclusive results were obtained.

As it is a matter of difficulty to paint evenly the inside of small plates, and, still more, of pipes, the writer deprecates reliance upon insulating materials for the protection of any vessel in which hypochlorite liquids are stored, or of any metallic piping in contact with hypochlorite liquids. When once the paint breaks down, corrosion of the metal will follow at a rapid rate.

Accounts are also given of the value of bitumen as a protective agent for wood exposed to hypochlorite solutions.

In conclusion the author urges that storage, transport, and methods of conveyance from place to place, or even from one part of a factory to another, are details meriting attention. Certain conditions of storage may clearly be regarded as fatal to stability, particularly those in which the galvanic action of dissimilar metals is likely to arise.

Chas. V. Biggs read a paper describing "The Hermite Electrolytic Process at Poplar."

This paper is a contribution to the data at present available on the subject of the electrolytic productions of hypochlorites. It consists of a description of the plant in use at Poplar for the preparation of a solution containing about 4.5 grammes of available chlorine per litre, for use as a disinfectant in the borough.

The system adopted is to mix a certain quantity of fluid in an elevated tank, and then to allow this fluid to flow through four double troughs or cells, placed one above the other so that the liquid descends, continuously by gravity. Each trough is divided laterally by a partition, and in each of the two divisions five distinct "elements" are suspended. The positive plates are of thin platinum wire wound upon slate slabs and the negative plates are of zinc. There are thus four troughs each containing ten "elements," or forty cells in all. After passing through the successive cells, the liquid discharges into a carboy. Sodium hydroxide is used as a preservative; it flows drop by drop into the carboy as it is filling and serves to neutralize free hypochlorous acid. As the liquid passes through the troughs it is subjected to the action of a current of fifteen amperes at 230 volts, being 5.6 volts per cell.

The tank is charged by placing in it 100 litres of a saturated solution of sodium chloride and twenty litres of a saturated solution of magnesium chloride. To this is added as much water as will bring the whole up to 840 litres. The rate of flow through the apparatus is three-and-one-third pints per minute.

Curves are appended showing (1) the rise in value of the solution as it passes through the cells, amounting to about one gramme per litre for ten cells; (2) efficiency in grammes per British thermal units for this plant, which is highest at a current of sixteen amperes. Above this amperage energy is wasted in heat, and below it the flow becomes too high.

A number of tests of samples of the liquid made are given. Liquid made during the warm weather of the exceptional summer of 1906, at a temperature of 104 degrees Fahrenheit, was found to have lost only 0.1 gramme available chlorine per litre in six weeks. Several samples of liquid made before the conditions of the plant (as to mixing, rate of flow, etc.) were very fully determined, showed losses of 0.1 and 0.2 grammes per litre in six months; the higher strengths (4.8 to 5.3 grammes per litre) losing 0.5 grammes in six months.

The author concludes that the magnesium hypochlorite, as made at Poplar, is sufficiently stable for practical purposes, and that it could be made in a warm climate without necessarily rapid deterioration. The warm weather specimens quoted had been kept in ordinary dark glass bottles, merely corked.

J. B. C. Kershaw considered that electrolytic hypochrolite was unlikely to replace bleaching powder at present prices. He criticized the efficiency of the Hermite plant at Poplar.

Dr. R. S. Hutton hoped that further information regarding the electrodes and other important details of the Poplar plant, and also further data regarding cost and efficiency would be forthcoming. He drew attention to the theoretical work that had been done on the Continent. Replying to Mr. Kershaw's strictures, efficiency depended on concentration. At Poplar high concentrations were used, so the efficiency was relatively low.

Dr. F. W. Alexander gave complete details regarding the cost of running the Poplar plant. The plant has been producing an average of 200 gallons a day of 0.4 grammes solution since January last at a total cost for current and material of under £33. Two laborers sufficed to watch the plant and bottle the solution. The defects of the original Hermite process had been successfully overcome. They had no trouble with non-conducting films on the zinc cathodes. Non-stability was caused by the presence of undecomposed salt in solution.

Dr. S. Rideal was of the opinion that the convenience of being able to make hypochlorite on the spot as required for disinfecting purposes rendered it far more suitable than bleaching powder. The dust nuisance caused by motors rendered the use of a sterilizing fluid for street watering a necessity.

L. A. Smart remarked on the value of such electrochemical processes to borough engineers if they could be arranged to run so as to increase the load-factor of the power station.

W. Defries pointed out that although the price of raw materials would probably not decrease, that of power tended to diminish, so electrolytic hypochlorite would in time compete favorably, even as regards price, with chloride of lime.

The authors' replies were reserved for the transactions. The paper by Dr. Alex. C. C. Cumming "On the Electrochemistry of Lead," was taken as read, and the discussion postponed until the December meeting.

Digitized by Google

Report on the New York Telephone Situation.

Harry P. Nichols, assistant engineer of the Bureau of Franchises of the city of New York, has filed his report with the secretary of the Board of Estimate and Apportionment on the result of the investigation which he has made of telephone conditions throughout the country in cities where two telephone systems are in operation.

This investigation was made under the direction of the Board of Estimate in view of the application of the Atlantic Telephone Company for a franchise to operate in this city.

After covering in a general way telephone conditions in the various sections of the country where investigations were made, Mr. Nichols takes up under separate headings the subjects which he thinks should be taken into account when considering a franchise for a second telephone company to operate in New York city.

Mr. Nichols defines the two methods of charging for telephone service, the flat rate being a fixed charge per month or per year for the use of the telephone, regardless of the number of messages sent; the measured rate, a charge based upon the number of messages used. Concerning the flat-rate plan, he says "that this system is unfair to many subscribers is universally conceded."

Mr. Nichols states it is his belief that the matter of rates and their effect upon the financial prosperity of the company offering them demands the most careful consideration by the city in fixing the terms of a franchise.

Referring to the proposed rate schedules of the Atlantic Telephone Company Mr. Nichols says: "I believe the rates offered have not been carefully prepared, which would seem to indicate that the company has not made an exhaustive study of the cost of equipment and operation upon which to base such rates. No rates are given for private branch exchanges and extension stations, which I believe should be specified in the contract."

Mr. Nichols states that from information received in other places, he believes the charges for suburban and long-distance service in New York to be too high.

Mr. Nichols states that while two telephone systems where tried have resulted in an increase in the number of telephones, with a general improvement of service and lowering of rates by the old company, this has been attended by inconvenience to subscribers and by additional expense to those who have felt that they must have both telephones in order to get a full service.

Mr. Nichols feels that the effect of competition on the Bell companies has been to create a new ambition on their part to enlarge and develop their system. He states that in 1899 the total number of Bell telephones in operation in this country was less than 500,000, while on January 1, 1906, there were more than 2,530,000 Bell telephones in operation.

Mr. Nichols states that many contradictory statements were made in regard to the effect of independent telephone companies on the Bell companies' rates, the independent companies claiming that the effect was to force a general reduction in the Bell rates, and the Bell companies claiming that no reductions were made on account of competition, the rates having been reduced from time to time as the companies' earnings warranted. Mr. Nichols thinks that the independent companies have been in the main responsible for these rate reductions.

Mr. Nichols thinks that competition has raised the standard of efficiency of telephone service generally.

The report takes up in detail the subject of automatic telephones. Regarding the application of this information to New York conditions, however, he says as follows:

"Several exchanges were visited where the automatic system is in operation. However, no exchange examined is of much use in determining how such a system would apply in New York, in which a number of exchanges will presumably be necessary within each borough. In none of the cities visited was there more than one exchange in operation."

Mr. Nichols points out the danger of overcapitalization of telephone companies, and compares the capitalization of the Bell Telephone Company, of Buffalo, and the independent companies operating in that territory, *i. e.*, the Frontier Telephone Company and the Rochester Telephone Company, showing that the first is capitalized at $124 per telephone, while the independent companies are capitalized at $288 per telephone.

In his conclusions Mr. Nichols states that in his opinion the telephone companies in New York are doing everything in their power to increase the telephone development of the city; that the service is equal to, if not better than, that of any other manually operated system; and although reductions in rates have been made from time to time, he believes that the board should undertake an investigation to ascertain whether the present rates are as fair and as low as they should be. He states that the officers of the New York Telephone Company and the New York & New Jersey Telephone Company have expressed their willingness to cooperate with the board in such an investigation.

CONCLUSIONS.

In closing his report, Mr. Nichols makes the following recommendations:

First: That the board consider the offer of the New York Telephone Company and the New York & New Jersey Telephone Company, as contained in their communication of July 13, 1906, and direct that an examination be made of the property and financial affairs of the companies to ascertain if the amounts offered to the city for the exclusive right to a telephone business are adequate, and if the rates now charged are fair, such examination to include the relations of these companies with the American Telephone and Telegraph Company, a New York state corporation, known as the parent company, and under whose license the New York and the New York & New Jersey companies are now operating.

Second: That the matter of the Empire City Subway Company (Limited) as contained in the communication from the telephone companies be referred to the corporation counsel with a request to take up the matter immediately and confer with the representatives of the telephone companies, and advise the board as soon as possible if, in his opinion, a settlement of this case can be obtained which will in all respects protect the interests of the city.

Third: That the Atlantic Telephone Company be requested to present a study for an automatic telephone system in the city of New York of a capacity such as it proposes to install, together with detailed plans of mode of construction and operation. Further, that a detailed statement showing the estimated cost of the proposed installation, operation, maintenance and expected depreciation be submitted. Such statement to show the amount of capital, in the opinion of the Atlantic company, necessary to successfully finance the operation, and the extent to which it is proposed to bond the company should a franchise be secured. That the system of rates for toll business and subscribers' stations, as contained in the proposed form, be revised, and that rates for private branch exchanges and extension stations be added.

If such an investigation be made of the Bell companies it would show the cost of plant, the operating expenses and earnings of the manual system in the city of New York, and it would seem that the board should then be in a position to more intelligently decide upon an application from an independent company which offers rates far below the existing tariffs. If such an independent company desires to use the manual system a direct comparison could be made, and the board would be enabled to determine if an independent company entering the field could live under the rates offered and the terms proposed in the forms of franchise now before the board.

It should be remembered that in the statements made in favor of the automatic system the cost of installation and of operation would have a direct effect upon the cost of service of that system, if the municipal authorities retain the power to fix the rates by the terms of the franchise. Such provision has been proposed and accepted by the Atlantic Telephone Company in the form of contract previously submitted to the board.

It is extremely important that every effort should be made by the board to ascertain not only what a company applying for such a privilege is willing to do, but also what it is able to do before action is taken upon an application which affects so large a proportion of the inhabitants of the city.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Cost of Suction Gas Power.

In this communication W. A. Tookey gives the log of a small suction gas producer plant from the beginning of the present year up to the latter part of October. The plant consists of a twenty-horse-power engine drawing its gas from a suction producer, and driving by chain belt a dynamo. The plant is in charge of a man who is employed at other duties, and previously had no knowledge of gas engines or gas producers. The chart shows the ordinary output of the generator, the coal consumption and the fuel cost per unit generated. The producer was operated at times for six weeks without stopping. The engine is frequently started some time before the load is thrown on the generator, so that the system is not operated in the most efficient way, considered from the fuel consumption point of view. The chart shows that with an output of 500 kilowatts the coal consumption was 1,100 pounds. The cost per kilowatt-hour for fuel alone was then 0.6 cent. When the output fell to 180 kilowatts the coal consumption was 540 pounds, and the cost of fuel per kilowatt-hour was 0.8 cent. These are the extreme figures. The average cost for the nine months was 0.73 cent per kilowatt-hour. Allowing for depreciation and service it is estimated that the cost per kilowatt-hour of this small plant was not more than three cents.—*Abstracted from the Electrical Review (London), November* 16.

Mules and Electric Locomotives.

A comparison is made here by W. F. Murray of the cost of mine haulage by mules and by electric locomotives. The chief advantage in using mules lies in the fact that the mule can enter any portion of the mine unhindered, while the electric locomotive can not leave the trolley, except by means of a cable reel. Another fact worthy of consideration is the difference in the weight of the rails that may be used in each system. Sixteen-pound rails may be used for mule traction, while thirty-five-pound rails are necessary for electric traction. Further, with the latter system rails must be bonded. On the other hand, mules can not be used in the low-vein mines, as there is not sufficient height. Also, each mule requires five times as much air as a man, so that removing fifty mules from a mine would make possible the addition of 250 men without any increase in the ventilating system. Mules further make a rough roadbed, wearing out the ties and making drainage difficult. The average life of a mine mule is from seven to ten years, while that of a locomotive is twenty-five years. An example is taken in which fourteen mules are replaced by a single locomotive. The cost of the mules and harness is $2,870. The working expenses, including care of the mules, drivers, interest and depreciation, are $6,577, so that the cost of hauling the 367,500 tons yearly load delivered by these animals is 1.8 cents per ton. The electric locomotive and generating apparatus would cost $11,200. The working expenses, including interest and depreciation, are $4,617.50. This locomotive would haul the same amount of coal as the mules, and the cost would be only 1.27 cents per ton. No allowance is made here for the cost of the stable for the mules nor for losses by accident.—*Abstracted from the Engineering and Mining Journal (New York), November* 24.

The Production of Radium from Actinium.

It is generally stated that radium is a decomposition product of uranium, but all the facts known regarding this change have not been in agreement with this idea. Both Soddy and Whetham have stated that they observed an increase with the time in the amount of radium in solutions of certain uranium salts which were under examination. B. B. Boltwood was able to show that, starting with a solution of uranium nitrate carefully purified by repeated crystallization, the amount of radium formed in an interval of eighteen months was less than one-two-thousandth of the amount which was to be expected from the disintegration theory. He here offers an explanation of this discrepancy, which is based upon a recent experiment made on the growth of radium from actinium. A kilogramme of carnotite ore containing about twenty per cent of uranium was decomposed with an excess of hydrochloric acid. This solution was then treated to separate the actinium from the other constituents. It was secured in the form of chloride, which was then sealed in a glass tube. This was allowed to stand for two months, when the gases contained in the tube were removed and introduced into an electroscope. The activity of the emanation was then determined. The tube was then sealed and allowed to remain undisturbed for several months longer. The emanation was again removed, and it was found that the activity as compared with the former corresponded to an increase of nearly three times in the content of radium. From the rate of increase it is computed that the indicated half period for the evolution of the emanation would be about 3,100 years, though this figure is only approximate. The author thinks that these facts constitute another step toward the solution of the somewhat complex problem of the genesis of radium, and since the amount of actinium in a mineral is apparently always proportional to the amounts of uranium and radium present, that actinium will prove to be the looked-for intermediate product.—*Abstracted from Nature (London), November* 15.

Some Measurements of Phase Displacements in Resistances and Transformers.

Dr. C. V. Drysdale has been investigating the problem of measuring small phase displacements. He here gives a description of one method which has been found very accurate. The device, the effect of which is to be investigated, is connected in series with a non-inductive resistance across one phase of a two-phase system. In parallel with it is a high-resistance shunt provided with a slider for making contact at any point. This slider is connected to one pair of quadrants of an electrometer, the other pair being connected to the point intermediate between the device under investigation and the non-inductive resistance. A high-resistance shunt is connected across the quadrant of the electrometer, and the central point of this shunt is connected to one terminal of the secondary of a step-up transformer,

Digitized by Google

the other terminal being connected to the electrometer needle. The primary of this transformer may be connected to either of the two phases of the supply. To make a measurement the slider on the high-resistance shunt is moved until the electrometer needle stands at zero. The transformer primary during this measurement is connected to the phase of the system which supplies the load. Readings are then taken of the position of the slider. A second reading is taken with the transformer primary connected to the other phase. This gives a deflection of the electrometer needle proportional to the voltage across the load. With these readings it is possible to construct a voltage triangle, because it is known that the potential across the load and that due to that section of the high-resistance shunt corresponding to it form the base and hypothenuse of a right-angle triangle. The diagram, when laid off, at once shows the angular displacement of the load current. A modification of this method is given, which avoids errors due to inaccuracies of the electrometer. The method is accurate, enabling the angle of displacement to be determined within a small fraction of one per cent. Some figures are given showing the application of this method to various devices. No. 10 standard gauge wire, wound in spirals about one inch in diameter, with three-eighths-inch pitch, gives an angle of lag at fifty cycles of from sixteen to eighteen degrees. Resistances of Constantan strip, wound in spirals of about one-half-inch diameter, show an angle of lag of less than one-tenth degree. Incandescent lamps with ordinary looped filaments may be regarded as absolutely non-inductive at fifty cycles, as no angle of lag was noticeable, although a displacement of two-hundredths of a degree could have been detected easily. Interesting results are also given showing the effect of various liquid resistances. Various experiments with one solution do not give results agreeing entirely, but the difference is attributed to changes in the electrolyte, and not to the method. Lead plates in dilute sulphuric acid, at a frequency of fifty-three cycles per second, show angles of lag varying from two to five degrees. In caustic potash the lag was less than one degree. In caustic soda it varied inversely with the density from one to three degrees. Iron in caustic soda gave an angle of lag of less than one degree. Aluminum in caustic soda gave angles of lag varying from thirteen degrees down. The general conclusions from the measurements of liquid resistances are that in all cases, except where aluminum electrodes are employed, the power-factor is unity within one-half per cent, or less. In the case of regulation tests, however, the two or three degrees of lead which may be introduced by liquid resistances may appreciably improve the regulation of an alternator above that on an absolutely non-inductive load. Iron wire coils are appreciably inductive at ordinary frequencies. The large angle of lead produced with aluminum electrodes may make them of decided value for induction motor starters.—*Abstracted from the Electrician (London), November* 16.

A Method of Producing Undamped Electrical Oscillations, and Its Application in Radiotelegraphy.

At a recent meeting of the German Electrotechnical Society, Valdemar Poulsen described the work which he has been conducting for several years past with the singing arc, the object being to obtain a means of setting up undamped high-frequency electrical oscillations. The singing arc, as described by Duddell, consists of an arc struck between two electrodes, which is shunted by a circuit containing inductance and capacity. This system will set up electrical oscillations through the shunting circuit and the arc, which produce, under certain conditions, a musical note. By changing the constants of the shunting circuit the frequency may be changed. The frequency is also affected by the conditions at the arc itself. Duddell succeeded in obtaining a frequency of oscillation of 40,000 per second. This is too low for use in radiotelegraphy, and it has been Poulsen's endeavor to increase the frequency. Various modifications have been tried. It was found that the gas through which the arc passed affected the frequency enormously. The first work was done by striking an arc through a flame such as is given by a spirit lamp, but it was found that hydrogen gas gave the best results, particularly if it contained a little hydrocarbon vapor. By this means frequencies up to 700,000 a second have been obtained. The next step is to maintain the frequency absolutely constant, in order that the full benefits of tuning may be obtained. To do this it is necessary to maintain the arc in a fixed position and of fixed length. The former condition is secured by placing it in a magnetic field which holds it steadily at the upper edge of the two electrodes placed horizontally. To maintain the length constant the positive electrode is made of copper and cooled by water circulated through it. This electrode is tipped with a copper ring, which is easily removed if it becomes roughened. The negative electrode is of carbon, considerably larger than the other, and is cut so as to present an acute angle at its edge, the end of the electrode being slightly concave. This electrode does not wear away, but grows slightly, due to the deposition of carbon from the surrounding vapor; and to maintain the distance between the electrodes absolutely constant the carbon electrode is revolved slowly. If desired, a knife may be placed for trimming off the deposit formed. This arrangement gives oscillations of fixed and very high frequency. The oscillating circuit is coupled to the sending antenna. The coupling preferred is that known as loose, for while this is more wasteful of energy than a close coupling, the frequency of the oscillating system is not so much affected by those of the auxiliary circuits. To obtain a higher voltage than that given by the simple oscillating circuit a second circuit is connected in parallel with the first, but with the apparatus arranged in the reverse order. This gives practically double the potential. A number of experiments have been made by Poulsen with this apparatus. It was found that great distances could be covered with a small generating set. For the receiver an oscillating circuit, loosely coupled to the antenna, was used, a telephone being connected across the capacity. In series with the telephone was a device called a "tikker," the object of which was to avoid the damping effect on the receiving oscillating circuit due to the telephone. This circuit is allowed to oscillate until considerable energy has been set in motion; then the "tikker" closes the telephone circuit, producing a sound in this instrument. Transmission was easily secured across Denmark, a distance of about 200 miles, with an energy output of 700 watts, 100 of which was transformed into electric waves. Later, messages were easily sent several thousand kilometres over water, the energy consumption being 2,800 watts. The system is suitable for producing wave-lengths varying from 1,000 to 10,000 feet, and as neighboring stations may operate without interference if more than one per cent out of tune, there is a possibility of operating 100 stations in a given district.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin),* November 8.

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

The following article is one of a series of four by Frank B. Rae, Jr., which will be published in the ELECTRICAL REVIEW. These articles will form a coherent analysis of a number of important phases in central station publicity methods. The subjects which will be discussed in future articles are as follows:

Article II, ORGANIZATION OF SOLICITING FORCE—Personnel of soliciting force; system of reports; solicitors' meetings and education; display room and its relation to soliciting work; cooperation between solicitors and advertising.

Article III, ADVERTISING COPY—Different kinds of copy; publicity; announcements; "reasons why," and other styles in advertising copy.

Article IV, ADVERTISING COPY—Circular letters; booklets; folders; mechanical details; pictures and engravings; printing and papers; useful hints.

ADVERTISING ELECTRICITY.

BY FRANK B. RAE, JR.

The following series of articles does not constitute a guide of "how to advertise successfully." There is no royal road to advertising experience. It is not a trick to be learned from books nor by correspondence. On the contrary, it is a life-study, to be approached with the same reverence and earnestness which any profession demands. The object of this writing is to clear away some of the mists which envelop this subject of advertising in the minds of those unfamiliar with it except in its superficial manifestations. The writer will, if it be possible, awaken an intelligent interest in, and appreciation of, the underlying principles; an understanding of the amount of labor and concentration necessary to be expended in plans and preparation before any advertising campaign can hope to merit or attain practical success.

The ultimate object of advertising is profit. It is not, as some casual observers appear to believe, simply a device to get more business. It is a system to secure more profit. Net profit, not gross income, is the figure which interests the business man and the investor. Looking at it from this angle, advertising is a subject of the utmost importance to any electric light company whose load curve is anything but a horizontal line.

THE ELEMENTS OF ADVERTISING.

What advertising is is largely a matter of opinion. To one of average inexperience in such matters, central station advertising consists merely in a quantity of more or less interesting and artistic printed matter, in newspaper announcements and in posters upon hoardings or within street cars. But to the man versed in the art of turning public opinion into dollars the advertising of electricity is a subject of almost unbelievable complexity. It begins with the placing of orders for prime movers and generating machinery and permeates the entire system and organization of the lighting company from the coal pile to the lamps and motors—from the obscurest shareholder to the president of the company, and so on down to the very arc-lamp trimmer. And it is this very difference in viewpoint upon the part of the advertiser which marks the difference between good central station advertising and that which fails of its mission. The inefficient advertising is based upon superficialities; effective advertising takes account of whatever is germane to the commodity advertised and concerns itself quite as much with subjects of company policy and politics as with the preparation of plates and printing.

Eminent authority has stated that advertising is at present an art, having not as yet reached a place where it may be accepted as an exact science. It must be noted, however, that even considering it as an art the professional practitioners, especially those familiar with the ethics and more common technicalities of central station practice, have a very decided advantage over those who may fitly be termed amateurs. Further, it may safely be set down as a truism that, while some men unpractised in this art of advertising may attain successful results, the advantage lies most decidedly with those who, through experience in handling similar problems, can tell, within very close limits, exactly what results accrue from a given method of procedure. Advertising experience costs money, and advertising ability costs years of training and study in addition to natural aptitude. Nowadays it is cheaper to hire experience than to buy it blindfolded.

The most common and at the same time the most altogether inexcusable error made by those entering the advertising field for the first time is that of beginning to spend money before giving due study to their business as an advertising proposition. This mistake takes the common form of the hurried issuing of a few disjointed circulars, or the insertion in newspapers of a statement reading "Use Electric Light." Returns upon these tentative efforts are awaited with feverish anxiety by the amateur advertiser, and the limited results obtained too frequently lead the experimenter to abandon publicity work as futile. The time factor alone would preclude its success. Not alone is such abortive advertising undertaken wholly without proper study of conditions, but it is frequently patterned after or copied from the work of some other company, the advertiser expecting to accomplish without sufficient preparation, by the use of what might be characterized ready-made or second-hand material, and at infinitesimal expenditure, what one experienced in the art and with an eye to every circumstance and contingency could not hope to accomplish. Time is a factor in all advertising. Even the so-called "mail-order" propositions expecting instant cash-with-order replies gain momentum as they continue. How absurd, then, to expect returns upon a two-time trial, or even upon less than a six-months' effort in advertising electricity.

THE STUDY OF LOCAL CONDITIONS.

No central station advertising should be undertaken without a most thorough and disinterested canvass of local conditions. To make such a canvass effective requires a species of impartiality almost superhuman, in that the man undertaking it must criticise himself, his company and his service from the cold and indifferent viewpoint of the disinterested public.

Digitized by Google

Upon this rock founders many a good central station advertising project. Not one man in fifty has the moral courage to look his business fairly in the face and admit its shortcomings. Yet it must be done, for to solicit increased patronage it is imperative that the present consumers be satisfied. To appeal to the public for support the company must deserve support. This frequently means that before an advertising campaign can be undertaken both the physical and moral equipment of the lighting company must undergo a vigorous and often an unpleasant rejuvenation, if not an actual reform. The advertiser must make it his business, first and foremost, to place himself and his company in such position that the public can not question either his commodity or his good faith. He must realize that advertising is merely the process of molding public opinion into a condition favorable to the advertiser and his goods. He must realize that he can not successfully and favorably mold public opinion so long as a reasonable excuse for prejudice and adverse criticism exists.

While it is no part of our business to discuss specifically the questions which will naturally be raised in the reader's mind by this statement, it may be suggested that the subject very naturally subdivides under such headings as: equitable rates, courteous treatment and good and continuous service to present customers, the prompt serving of all who may contract for future service, an accessible and inviting room for the transaction of business with the public, and a staff of solicitors and office assistants qualified to deal with that public intelligently and with unvarying tact and courtesy. The satisfactory solution of the problems which will come within the bounds of these subjects may be considered as preliminary to any active campaign of advertising, and this for the simple and very natural reason that the disregarding of any one item mentioned will partially or wholly neutralize the most skilful and enthusiastic effort of the most practised advertising man.

When such measures have been instituted as will make certain the prompt, efficient, courteous and equitable serving of the public, the lighting company is ready to consider the subject of advertising as the term is ordinarily used. It has provided for the effective handling of the business that must inevitably result from direct advertising effort. It has taken care of those items known as indirect advertising. Let us now turn to the more interesting, though really less important problems of actual business-getting—of salesmanship, personal and on paper.

PLANNING A CAMPAIGN.

First there must be a plan. The preliminary canvass of local conditions should have indicated exactly what class or classes of lighting or power business may be most desirable and profitable, and how much of each of these several classes can, at reasonable expense, be procured. Basing the careful estimates upon the probable net increase, it becomes necessary to decide how much money should be spent in the advertising and soliciting of this trade. Upon the amount of the appropriation depends almost entirely the plan, for in advertising is to be found one of the few cases where the basis of trade lies rather in the purchaser's pile than in the seller's price. The plan must be made to fit the appropriation unless the field is so large and the amount of surplus energy for sale so nearly unlimited that the appropriation can be made to fit any reasonable plan.

The backbone of any plan of campaign for selling electricity lies in the soliciting force. It must be self-evident that electric current can not be sold by mail or by any of the devices employed to secure what are known as "direct returns." The closing of every sale lies with the solicitor, and our advertising campaign can, at best, only assist by broaching the subject of electric service to the prospective customer, presenting and arguing its fundamental advantages and bringing him to the point of so far committing himself as to ask for a personal interview with the contract agent. The first question, then, is how many solicitors can be profitably employed? In this, as in other analytical questions connected with business-getting departments, preferences and prejudices must be cast to the winds. Only so many solicitors should be taken on as can be kept actively at work all of the time. Few solicitors rather than many should be the main idea—few solicitors, and let them be thoroughly competent and well paid. It is a serious mistake to employ "card presenters" in such work. Cheap men cost more than good ones.

Having set aside the amount necessary to take care of the soliciting force, the balance of the appropriation should represent what may be spent for the real advertising. The problem instantly resolves itself into a question of what kind of advertising can most profitably be undertaken; and this question brings us to the consideration of the several methods of publicity in vogue—newspaper advertising, bill-boards and street-car cards, and direct advertising.

SUBDIVISIONS OF ADVERTISING.

As to the actual value of newspaper advertising for electric light and power business there is a vast difference of opinion. One man, well known in the field of central station advertising, when asked what effect his campaigns of newspaper publicity were giving, replied with a shrug of the shoulders. Others, on the contrary, contend that it is the only "safe-and-sane" method of reaching the right people. It is very probable that the truth of the matter lies between these two extremes and that local conditions should be permitted very largely to govern the extent to which the press is used. To most men the main factors in newspaper advertising are very naturally copy and circulation. But good copy in representative mediums is only a part of the newspaper proposition. Editorial and news cooperation is necessary. It is obvious that a large percentage of newspaper circulation goes to people who could not by any possibility become customers of the electric light company, either through lack of means or their location of residence. On the other hand, newspapers are read with extreme care by certain classes which the contract agent is anxious to reach—notably merchants, who study the newspapers, not alone to read their own advertisements, but the advertisements of their competitors. The newspaper which reaches the better classes of homes is also a profitable medium, but it must be remembered by the advertiser in charge of a central station appropriation that he can not discriminate between mediums, as can a merchant or manufacturer, but must use all, lest he incur enmity and consequently call down upon his company the abuse of some.

On the subject of bill-boards and street-car cards, very little need be said. These constitute in the broadest sense general publicity, the results of which can be traced only from the general attitude of the public toward the company or commodity advertised and a healthy increase in business. It is the writer's conviction that street-car cards are wholly unprofitable except where the electric light company and the traction company are combined and control space in their own cars. In such cases the space is likely to be cheap and the company can perhaps afford to use it.

Direct advertising, the third and most important division of the means of molding public opinion, subdivides under many heads and includes anything that can be

Digitized by Google

sent by mail, from personal letters to elaborate books. Circumstances must dictate to what extent and in what variety this material is used, the only fixed rule being that it must be used systematically and continuously, and not in a haphazard manner. The keynote of direct advertising lies in system. The campaign must be carefully planned, closely followed up and vigilantly watched. This does not mean that a cut-and-dried routine should be established and a certain fixed advertising policy maintained in the face of unexpected circumstances. On the contrary, the greatest flexibility should obtain in the campaign. But it is essential that approximate dates for the mailing of advertising should be adhered to, and sufficient persistence and insistence be employed to ensure adequate results. Tentative efforts are futile. Disjointed and disconnected material confuses the prospect without convincing him on any single point. Only systematic, persistent presentation of the proposition, each mailing supplementing the last and complementing what follows, will develop customers.

The advantage of direct advertising for an electric light company lies in the fact that it is possible to secure accurate lists of bona-fide prospects. We say "possible." It is only too easy to have lists which are anything but accurate, and this in the face of very honest endeavor. The need of good lists will appear self-evident. It is worse than useless—it is damaging—to send a series of letters and other advertisements to people who can have no possible use for your product. To exhort a man to use electric power when he has absolutely no use for power of any kind gives the impression that the company is remarkably careless, and that this carelessness doubtless extends to the meter and billing departments. If, at a later date, this same individual is approached on the subject of lighting, he will be doubly indifferent to the appeal. Again, advertising costs money. To waste the one is equivalent to wasting the other.

The actual preparation of direct advertising hinges wholly upon local conditions. Generalities no longer convince. The public is "wise." This fact, as has been pointed out by one of our leading textbooks on the subject, makes present-day advertising success at once easier and more difficult than similar success a few years back. To-day we must get at the very heart of our subject and demonstrate its advantages by a species of vivisection. The advertiser who can do that clearly, tersely, sustaining the reader's interest and convincing him by logical presentation of fact, is absolutely assured of success.

The American Institute of Electrical Engineers' Land and Building Fund.

The announcement recently of the large donations from George Westinghouse, representing the various Westinghouse interests, of $50,000, and from the Allis-Chalmers Company, of $3,500, to the land and building fund for the Engineering Societies' Building, has stimulated interest among electrical engineers in this undertaking.

Contemporaneously with this announcement the Land and Building Fund Committee of the American Institute of Electrical Engineers has issued the following appeal, dated November 24:

DEAR SIR: You will be glad to learn that the Land and Building Fund Committee of the Institute, appointed for the purpose of raising $200,000 to provide for our share of the necessary real estate and equipment for the Engineering Societies' Building, given us by Mr. Andrew Carnegie at a cost of over $1,000,000, has already secured subscriptions to the amount of $150,000 and has collected nearly $100,000 of that sum, the other portion being due in yearly instalments. Contributions to the fund from individual members, aside from corporations, have ranged from $5,000 to $5.

The building is now practically complete and the administering body, the United Engineering Society, has notified the prospective occupants of the building that it is available on December 15. Soon after that date the American Institute of Electrical Engineers will take possession of its commodious new quarters there, and will at once come under heavier responsibilities than it has encountered in the past unless the entire amount necessary is raised to relieve it of the burden of debt.

It is the hope of the officers of the Institute and of the committee that when the building is formally dedicated next April, the Institute may be able then to declare itself free from financial obligation in connection therewith, and it now asks you to join your fellow-members in subscribing to the fund and thus by your generosity aiding in the execution of this splendid enterprise. You are therefore earnestly requested to fill out the accompanying subscription blank so that the committee may include your name in the next list, which it is hoped will be the final one. You will notice that contributions to the fund can be made on the instalment basis, extending over a period of five years.

A general response from the members who have not yet subscribed, each for a modest sum, will give the Institute the $50,000 which it still needs in order that its regular work as a professional body may be carried on with undiminished efficiency and with greater vigor than ever in the new home and with the enlarged facilities.

Awaiting your prompt consideration of this appeal and the return of the subscription blank,

Yours truly,
T. C. MARTIN,
Chairman.

The Land and Building Fund Committee of the Institute is made up as follows:

Institute Committee—T. C. Martin, chairman; J. C. Barclay, John J. Carty, C. L. Edgar, F. W. Jones, J. W. Lieb, Jr., F. J. Sprague, J. G. White.

Advisory Committee—U. N. Bethell, N. F. Brady, Eugene Griffin, Samuel Insull, James H. McGraw, Charles W. Price, Samuel Reber, L. B. Stillwell, Charles A. Terry, Elihu Thomson.

All communications should be addressed to George H. Guy, secretary to the committee, 114 Liberty street, New York city.

Technical Publicity Association.

The Technical Publicity Association held a meeting on Thursday evening, November 22, at the rooms of the Aldine Association, New York city. The report of the circulation committee, consisting of H. M. Davis, of the Sprague Electric Company; C. N. Manfred, of the H. W. Johns-Manville Company, and Paul M. Wade, of the Standard Paint Company, was submitted.

The advertising departments of the following companies were also represented at the meeting: John A. Roebling's Sons Company, American Locomotive Company, Yale & Towne Manufacturing Company, Patterson, Gottfried & Hunter, American Wood Working Machinery Company, General Electric Company, Crocker-Wheeler Company, A. S. Cameron Steam Pump Works, B. F. Sturtevant Company, M. H. Treadwell Company, and the Robins Conveying Belt Company.

The next monthly meeting of the association will probably be devoted to a discussion of catalogues, circulars, etc., and will be held on December 20.

Large Power Scheme for Paris.

It is stated in the *Mechanical Engineer* (London) for November 17 that several members of the Paris (France) municipality and electricians are considering a scheme for utilizing the power of the Rhone river for supplying electric light to the French capital. It is proposed to erect a huge dam across the river at Seyssel, a village near the Swiss frontier. The dam would be over 200 feet high. The entire system would cost $12,000,000. This would be the largest electric power system in Europe, and it is estimated that it would save the city of Paris $5,000,000 a year over what is now the present cost for lighting.

Illuminating Engineering Society.

The monthly meeting of the Illuminating Engineering Society will be held in the Edison Auditorium, 44 West Twenty-seventh street, New York city, on Friday evening, December 14, at eight o'clock. A paper will be presented by Dr. C. P. Steinmetz, the title of which is to be announced later.

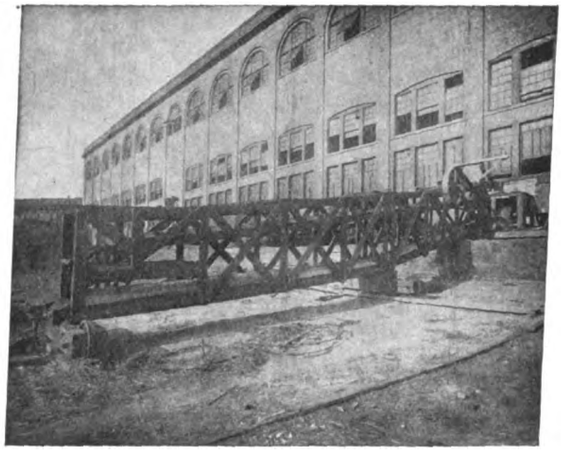
Digitized by Google

INDUSTRIAL SECTION

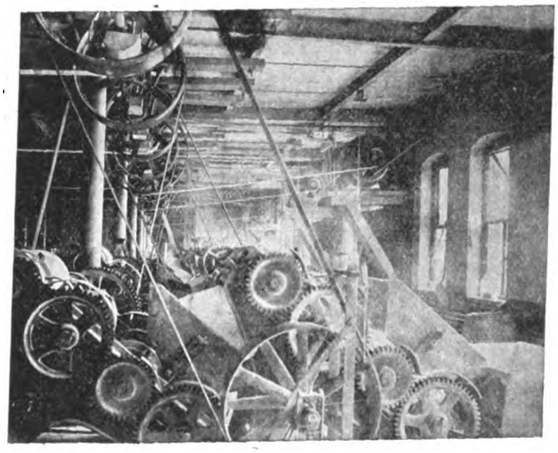
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Electric Motor Drive in the Packing Industry.

There is no better example of the versatility of the electric drive for industrial purposes than that afforded in the modern packing house. The comprehensiveness of this industry, including as it does a series of establishments for the manufacture of a wide variety of products, makes the application of the electric drive very apt.



ELECTRICALLY OPERATED COAL CONVEYERS.

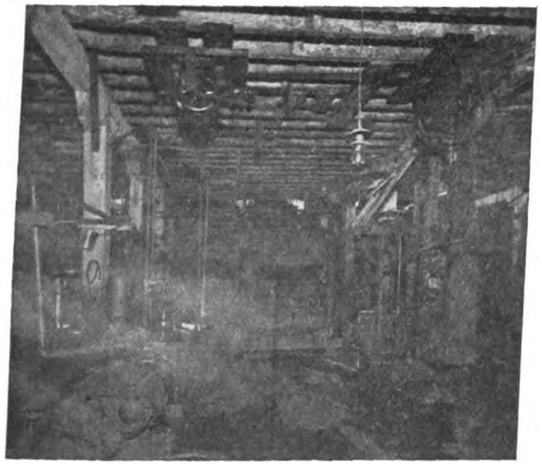


INDUCTION MOTORS DRIVING SOAP MACHINES.

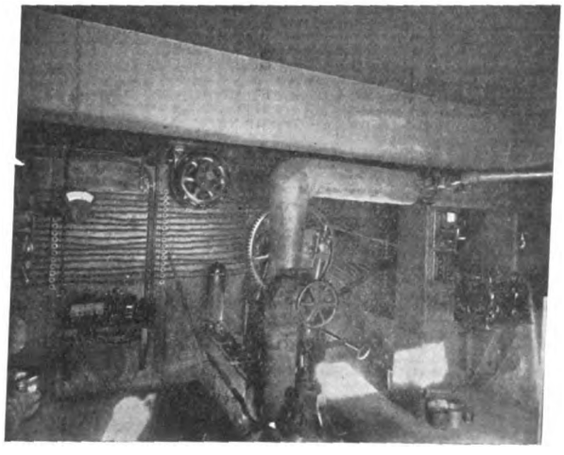
The power house is placed in the most economical location and the power generated is economically transmitted to the various shops and machines without the use of long lines of wasteful shafting. The transmission lines running from the central station switchboard may be so arranged that not only the exact amount of power used in each department may be measured, but the various shops may be run independently. In this way a certain department may work overtime without necessitating the generation of considerable power usually wasted in running idle shafting at such times.

At the receiving end of the transmission line, the advantages of an alternating current induction motor drive are marked. Ease of control, safety and reduced maintenance charges are the most apparent gains. Machines are of various sizes and each has peculiar needs for power. Many products of the packing house are highly inflammable and the detached power house as well as the use of a sparkless induction motor materially reduce the fire-hazard. In some portions of the establishment, particularly hard operating conditions are encountered. Take for example the hog-killing room. Here the steam-saturated air is a particularly severe test for machinery, and the induction motor is the only type capable of handling this class of work continuously.

The plant of Swift & Company, at Chicago, Ill., affords an excellent example of the application of the motor drive. This plant covers a floor space of eighty-seven and three-quarters acres. The different branches of the industry are conducted on the most approved modern lines for the quickest and best conversion of live animals to finished food products, as well as the various by-products. Every hour of the working day 250 head of cattle, 700 hogs and 625 sheep are



INDUCTION MOTOR IN PRESSROOM.



INDUCTION MOTOR-DRIVEN HOUSE PUMP.

Digitized by Google

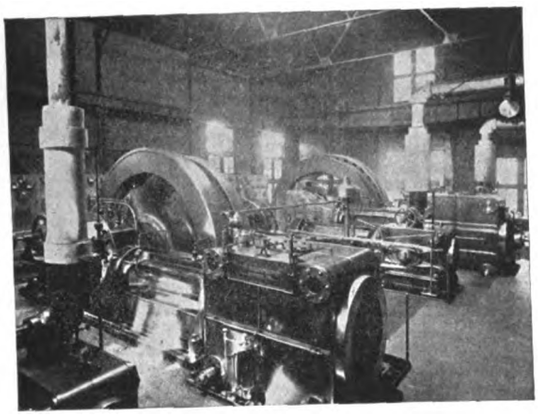
slaughtered. The refrigerating plant has a daily capacity equivalent to 2,500 tons of ice.

The packing establishment is operated electrically from a central power station. The boiler house contains 6,400 horse-power in Babcock & Wilcox boilers, delivering steam at 150 pounds pressure to the engines, and equipped with Murphy stokers and the necessary coal and ash handling machinery. Draught for the boilers is obtained by a 265-foot stack.

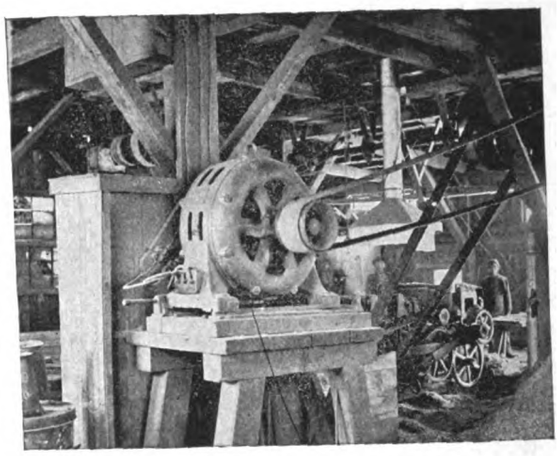
number of series alternating-current arc lamps are employed for illumination.

It is interesting to note that the packing establishment was originally operated by several separate plants, with direct-current generators for furnishing light and power. After careful investigation the alternating-current system, with a central power house was installed, and the direct-current system abandoned. Actual experience with both systems was afforded by a previous installation of a smaller

at all times. The bed-plate and pedestals are of the best quality of cast iron, strong and tough, and of ample proportions to withstand the shocks and strains incident to the heaviest and roughest usage. The bearings of each hoist are all of the same length and diameter, lined with the best quality of babbitt metal. Ample provision is made for thorough lubrication and the bearings are of such size as to make a very low bearing pressure, thus insuring cool running.



GENERATING ROOM—POWER-HOUSE.



INDUCTION MOTOR IN PLANING MILL.

In the engine-room there are installed three General Electric three-phase, revolving-field 240-volt, sixty-cycle generators, direct connected to Filer & Stowell cross compound Corliss engines, all operating at 120 revolutions per minute. The generators comprise one 300-kilowatt, one 600-kilowatt and one 1,200-kilowatt machines respectively.

From this central generating station the power is led to the various departments both for motor application and lighting. In all, about 3,600 horse-power in induction motors of the General Electric squirrel-cage armature type are installed. The motors range in size from one to 140 horse-power, the average horse-power per motor being 14.37. Many of the motors are in odd and unusual places, some in coolers at zero temperature, others in dry, dusty rooms at a temperature of over 125 degrees, and many novel and special constructions have necessarily been developed in connection with the motor installation and wiring system. A few synchronous motors are used which tend to help the power-factor. One of these is a 100-kilowatt General Electric machine, driving pumps.

The lighting system is made up of both arc and incandescent lamps, about 12,000 230-volt incandescent lamps and a large multiphase plant in one of Swift & Company's other packing houses. The installation as a whole brings out forcibly the peculiar advantages of the alternating-current motor to this class of service.

Allis-Chalmers Electric Hoists.

The accompanying illustration shows an electric hoist, which is one of a line recently placed on the market by the Allis-Chalmers Company, of Milwaukee, Wis.

The single-drum electric hoists are of fifteen, twenty-five, thirty-five, fifty and seventy-five-horse-power capacity, and double-drum hoists are made by the company in thirty, fifty, seventy-five, 100, 125 and 150-horse-power sizes. The rope speeds and load capacities meet average requirements, and especial attention has been given to insuring reliable, economical and satisfactory operation. Following is a description of the general design and construction details of these machines.

The drum (or drums) and motor are mounted upon a heavy substantial bed-plate of box section, with broad bearing surface on the foundation. The bearings are carried on pedestals cast in one piece with the bed-plate, so that there are no bolts to work loose, and the proper alignment of the machine is thus maintained

The drum runs loose upon the shaft and is made in one piece, of the best quality of cast iron. The spider hubs are fitted with bronze bushings, which can be readily replaced in case of wear. The drum spiders have strongly ribbed arms, and the drum shell is reenforced by deep circular ribs so that all twisting and bending strains are fully met. The hole in the shell through which the rope passes for fastening has a long radius curve, thus avoiding any sharp bend in the rope and doing away with rope breakage at this point. The face of the drum is straight, and the flanges are of ample depth.

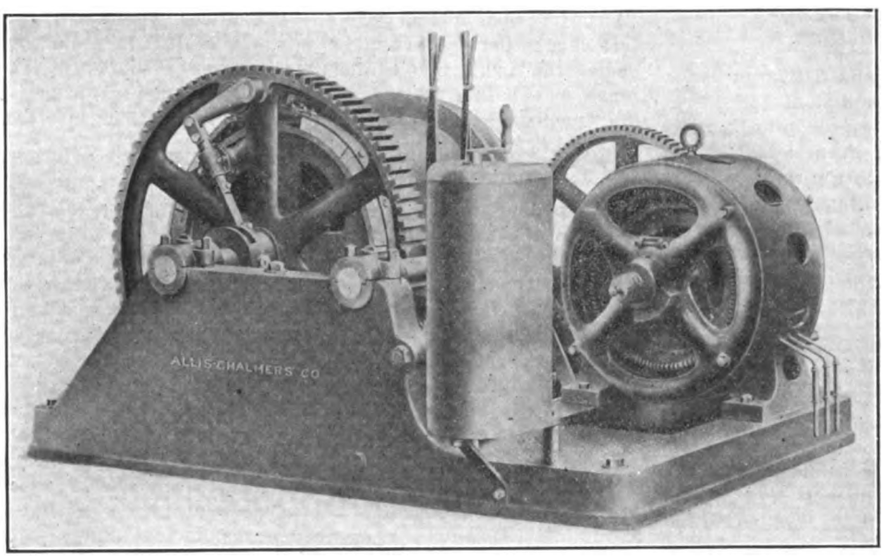
The brake is of the steel band type, with wide face, and is provided with suitable turnbuckle adjustment for taking up the wear on the brake blocks. One end of the brake band is securely anchored by eye-bars around the operating shaft and the other end has a turnbuckle attachment to the lever on the operating shaft controlled by the operator's hand lever.

The main gear, keyed on the drum shaft, forms the driving member of the clutch, which is of the band friction type. The fixed end of the band is securely anchored to the driving gear and has suitable adjustment for shortening the band to compensate for wear. The movable end of the band is actuated by a simple and strong

Digitized by Google

arrangement of toggle lever, motion to which is imparted by a collar sliding on the drum shaft and controlled by the operator's hand lever through suitable connections. When the clutch is thrown in, the band is tightened around the drum shell by the powerful toggle motion, and the pull of the rope on the drum tends to still further tighten the grip of the band on the shell, thus securely holding and lifting the load. Both band friction clutch and band brake are hand operated, the operating levers being conveniently arranged, and provided with quadrants and locking pawls.

Both drum and intermediate shafts are of best quality of open-hearth steel, accurately turned and keyseated to receive the gears. They are made extra large in diameter and are calculated to withstand the most severe usage.



ALLIS-CHALMERS ELECTRIC HOIST.

The gears are cast of a special mixture of the best quality of tough, strong iron with heavy rims, arms and hubs. The pinions are of cast steel. The teeth of both wheels and pinions are cut. The accuracy of the workmanship and the low rim speed of the gears insures their quiet running and long life. When desired, the pinion on motor shaft will be made of rawhide at a small additional cost.

For driving these hoists the company furnishes either direct or alternating-current motors wound for the usual voltages, and if alternating current, either twenty-five-cycle or fifty-cycle machines.

The controllers used with these hoists are of the drum type, similar to those in common use in street-car service. On all single-drum hoists the motor is not reversed, but on double-drum hoists the handle or lever of the controller not only controls the speed but also reverses the motor, and is locked in the "off" position. The controller is securely attached to the frame of the hoist, and the lever is so located as to be conveniently reached and easily handled by the operator. If desired the lever of the controller can be made of the same design as the brake and clutch levers.

BOOK REVIEWS.

"Practical Lettering." Thomas F. Meinhardt. New York. The Norman W. Henley Publishing Company. Paper. 16 pages. 9 by 14 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 60 cents.

This is intended to be a guide for draughtsmen, engineers and others having occasion to letter. It analyzes the various letters and gives an original system for spacing. Charts of letters are given, as well as hints for pen work and for duplication.

"Manual of Wireless Telegraphy." A. Frederick Collins. New York. John Wiley & Sons. Cloth. 232 pages. 5 by 7½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.50.

This work is put forward as a manual containing detailed and explicit instructions for setting up various types of apparatus used in wireless telegraphy, for adjusting the circuits, and for testing. Diagrams are given of the various systems.

"Fowler's Electrical Engineer's Handbook." Manchester, England. Scientific Publishing Company. Leatherette. 730 pages. 4 by 6 inches. Illustrated. Price, 2*s.* 6*d.*; superior binding, gold edges, 3*s.* 6*d.*

The new edition of this well-known handbook contains about 100 pages of additional matter, which includes information regarding electric meters, long flame arc lamps, cable testing, resistance wires, etc. The volume contains as usual a large amount of useful engineering data, and, in addition, a directory of British power systems.

"Dynamoelectric Machinery." Vol. ii. Seventh edition. S. P. Thompson. New York. Spon & Chamberlain. Cloth. 848 pages. 6 by 9 inches. Illustrated and containing 24 plates. Supplied by the ELECTRICAL REVIEW at $7.50.

In this new edition of Dr. Thompson's well-known textbook an effort is made to bring the matter up to date so as to include all changes that have been made during the nine years that have elapsed since the sixth edition. The volume has been practically rewritten and less than 100 pages have been taken from the former edition. A good deal of new matter is added, including a chapter on periodic functions, which gives a new and simplified method of harmonic analysis. Much prominence is given to methods of design, especial attention being paid to the developments necessitated by the introduction of the steam turbine. The book concludes with a chapter on the single-phase commutator motor, which has, of late, been the subject of so much discussion. The subjects are treated in the author's well-known clear and logical manner.

"The Design of Steel Mill Buildings and the Calculation of Stresses in Framed Structures." Second edition, enlarged. Milo S. Ketchum. New York. The Engineering News Publishing Company. Cloth. 480 pages. 6½ by 9 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $4.

This book is intended to provide a short course in the calculation of stresses in framed structures and to give a brief discussion of mill building construction. It is to supplement elementary books on stresses, on the one hand, and the more elaborate treatises on bridge design on the other. A great deal of the matter contained in it is applicable to all classes of steel frame construction. Part i discusses the various kinds of loads to be provided for; Part ii the stresses in the structure, and Part iii takes up the design of buildings. There are two appendices, one giving specifications for steel frame mill buildings, and one problems in graphic statics. There are also a number of useful tables showing the dimensions of structural iron. The author has evidently made a special study of the subject and his teaching experience enables him to present it excellently. The book is well adapted for students of building construction and should be equally useful as a work of reference for structural engineers.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

INDIANA TRACTION MERGER—Plans for the organization of a holding company to include the eight interurban traction lines known as the Indiana Union Traction, Indianapolis & Western, Indianapolis & Northwestern, Indianapolis & Eastern, Indianapolis & Martinsville, Indianapolis Coal Traction, Wayne & Wabash Valley and the Richmond Street and Interurban are about to be perfected. This merger will result in the largest or the second largest traction system in the world.

TO ELECTRIFY PENNSYLVANIA RAILROAD—According to a statement by an official of the Pennsylvania Railroad, cars will soon be run by electricity over the Pennsylvania Railroad between Philadelphia and Pittsburg, Pa. According to this statement, work will soon be started on a power plant and dam at Iroquois, about twenty miles west of Harrisburg, to furnish power to supply the telegraph and signal towers and to run cars between Aqueduct and Mifflin. Hundreds of acres of land have been purchased by the railroad at Iroquois, much of it along the river front.

NEW OHIO ELECTRIC ROAD—The Cleveland & Sharon Traction Company has been incorporated with a capital of $2,500,000. This is the organization financially of a four-year-old project, and, it is said, is headed by interests with which Francis Morgan is identified, although his name does not appear in the incorporation papers. The incorporators as filed are: E. Jay Pinney, C. W. Dille, H. Nord, D. C. Pinkey and C. M. Pierce. Several routes for the proposed road have been laid out. One goes through Chagrin Falls and another *via* Solon and Geauga Lake. As yet no contracts for work have been let.

INCORPORATION OF CALIFORNIAN PUBLIC SERVICE COMPANY—The Pacific Coast Development and Securities Company has been incorporated with a capital of $1,000,000 at San Diego, Cal. It is stated that English capital is interested in the enterprise. The Californians who control the subscribed stock are: John Campbell, Arthur Small, Frank Turnbull and John K. Durrill. Mr. Small states that the company's operations will include the erection of plants to supply gas and electric lights and power to places where these utilities have not thus far been developed, but that the main work to be undertaken will be the construction and operation of transportation lines of an interurban character.

ELECTRIC CONCERNS TO MERGE—Official announcement of the proposition of the Electric Bond and Share Company, of New York city, to take over the Electric Company of America, of Philadelphia, Pa., has been made. The proposition provides for an exchange of the present stock of the Electric Company of America into a collateral trust five per cent gold bond equivalent to a value of $14 per share, to be secured by a pledge of the securities turned in by the Electric Company of America. The bonds will also be secured in the sum of $1,000,000, which will be paid to a trustee and constitute a fund which can be used only for betterments and extensions to the Electric Company of America properties. The exchange will work out equivalent to a dividend of seven per cent of the par value of the present Electric Company of America stock.

TRANSIT LINES UNITE—The Hoboken & Manhattan Railroad Company and the Hudson & Manhattan Railway Company have filed articles of consolidation under the name of the Hoboken & Manhattan Company, with a capital stock of $38,500,000. Of this amount $15,000,000 will be preferred, bearing six per cent cumulative dividends. In consolidating, the companies provided for an increase of $6,400,000 in addition to the combined authorized stock of the two concerns. Recently both the Hudson and Hoboken companies increased their capital stocks to carry on the boring of the tunnels under the Hudson river. At that time the Hoboken company increased its stock from $500,000 to $15,000,000 and the Hudson concern from $100,000 to $17,100,000. The officers of the new company are: president, Alexis P. Bartlett, New York; vice-president, Edward R. Greene, Brooklyn; secretary, Ross A. Mackey, Brooklyn, and treasurer, Neil A. Weathers, New York.

HUDSON RIVER WATER POWER COMPANY—Judge Ray in the United States District Court at Utica, N. Y., on November 26, made a decision in the matter of the application to have the Hudson River Water Power Company declared a bankrupt. The Court refuses to dismiss the proceedings pending the settlement of some legal questions by the Appellate Division. About one year and a half ago the National Contracting Company, of New York, which alleged that it had a claim for nearly $500,000 against the power company, with two other creditors for nominal amounts, filed a petition in the United States District Court, following the appointment of a receiver in the state courts, asking that a receiver be appointed and the company declared a bankrupt. The litigation which followed, it was generally understood, disclosed that some sort of a settlement was under way. Judge Ray in a long opinion denied the application to dismiss the proceedings, "with leave to renew on some papers and additional proceedings in the case when the Appellate Division has passed upon the questions involved."

NEW YORK CITY TERMINAL OF HUDSON RIVER TUNNELS—Details have been made public in regard to the terminal buildings in New York city for the New York & New Jersey Railroad and the Hudson & Manhattan Railroad Company. There will be two buildings in Church street, from Cortlandt to Dey streets, and from Dey to Fulton streets, Manhattan. The northerly building will be known as the Fulton Building, and the southerly as the Cortlandt. They will each be twenty-two stories above the surface, and will extend seventy-five feet below the street line to bedrock. There will be space for 4,000 offices, and when completed, it is said, will constitute the largest office structure in the world. Beneath these buildings will be the terminal station of the Hudson & Manhattan Railroad Company, which will operate the tunnels now being built under the Hudson river. Passengers will enter upon the street floor and pass down into the station by means of easy stairways, inclined planes and elevators. The first floor below the sidewalk will be known as the concourse. Here will be the waiting rooms and ticket booths. Below this will be the train platforms. There will be five tracks running between six platforms. The cars will be of steel and capable of seating fifty persons each. The passage under the river, it is calculated, will average three minutes, so that a resident of Jersey City should be able to reach the heart of the Manhattan shopping district in from ten to fifteen minutes. Of the four trolley tunnels now being built under the North river, the two down-town are about three-fifths completed, and the up-town completed to Sixth avenue, Manhattan. It is estimated that the entire outlay of money in the tunnel enterprises projected by the companies will reach $60,000,000. The Church street terminal buildings will cost about $8,000,000.

NEW PUBLICATIONS.

CENSUS OF MANUFACTURES, 1905—The Department of Commerce and Labor, Bureau of the Census, Washington, D. C., has issued bulletin No. 57, composing the census of manufactures, 1905, for the United States. The census is to be taken every fifth year, and the next enumeration will cover the year 1909.

THE ANNUAL REPORT OF THE WATER AND LIGHT DEPARTMENTS OF DANVILLE, VA.—The annual report of the water and light departments of Danville, Va., for the fiscal year 1905-1906 has been published. This includes a description of the new pumping station, the bacteriological report on the mechanical filtration plant, the balance sheet and statements concerning the physical operation of the plants.

Digitized by Google

PERSONAL MENTION.

MR. ALFRED T. SCOREY has resigned as electrical superintendent of the Lowell (Mass.) Electric Light Corporation.

MR. C. H. JOHNSON, vice-president of the Curtis Advertising Company, Detroit, Mich., was a visitor to Chicago last week.

MR. L. P. SAWYER, manager of the Buckeye Electric Company, Cleveland, Ohio, was a Chicago visitor from Saturday, November 24, to Monday evening, November 26.

MR. JOHN DALE, president of the Dale Company, a large fixture manufacturing house of New York, recently returned from a six-months' trip around the world.

MR. SYDNEY IRVING WAILES, manager of sales of the National Brake and Electric Company, Milwaukee, Wis., was married on Tuesday, November 27, to Miss Adelaide Harrington Brown, at St. John's Church, Los Angeles, Cal. Congratulations and best wishes to Mr. and Mrs. Wailes.

MR. JOHN H. MILLER, of San Francisco, Cal., and Timothy D. Merwin, heretofore a member of the firm of Boardman, Platt & Soley, of New York city, have formed a partnership under the firm name of Miller & Merwin for the practice of patent law, with offices at 35 Wall street, New York city, and 553 Van Ness avenue, San Francisco, Cal.

MR. WILLIAM H. BROWNE has resigned as director, treasurer and general manager of the Stanley Instrument Company, Great Barrington, Mass. Mr. Browne has been connected with the Stanley company since January, 1902. For some time the business of the company has been shut down by injunction obtained in patent litigation by the Westinghouse Electric and Manufacturing Company, and on June 1 its manufacturing plant and property were sold to the General Electric Company. Mr. Browne continued his official relations with the company until last month, when he resigned in order to be free to seek opportunity for the varied and extensive experience he has had since 1886 in the electric light, power, traction and manufacturing business. In 1886 Mr. Browne was interested in the organization and building of the electric railroad and lighting plants at Richmond, Va., and was associated with these interests until 1889. From May, 1888, to July, 1894, he was general manager of the United Electric Light and Power Company, of New York city. From July, 1894, to January, 1895, he was receiver of the Flushing & College Point Railroad, Flushing, Long Island. From January, 1895, to January, 1902, he was general manager of the Royal Electric Company, Montreal, Canada. From January, 1902, to November, 1906, he was with the Stanley Instrument Company. Mr. Browne has not made any definite arrangements at the present time, but expects to undertake the supervisory administration and management of several plants. His headquarters at present are at 34 Pine street, New York city.

ELECTRICAL SECURITIES.

The holiday was in some measure responsible for the small amount of trading done in the stock market last week. There has been no change in the public attitude either from a speculative or investment viewpoint, and while there has been a great apathy with regard to public buying, there has also been evident a similar condition of mind with regard to public selling. The expected monetary tightening over the heavy December payments forced call rates up to 27 per cent. It is held in some quarters that conditions to-day are so similar to those of a year ago that a repetition of last December's increasing money tension will be witnessed. These same interests predict that the 125 per cent call money rate made previous to the beginning of last year may even be surpassed. The presidential message will be studied with keen interest in all sections of the country, as it is expected that it will be in line with congressional action during the year, and until the message has had careful scrutiny and the effect of its expressions has been discounted, very little advancement may be expected in stock-market conditions.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 1.

New York:	*Closing.*
Allis-Chalmers common	17⅛
Allis-Chalmers preferred	45½
Brooklyn Rapid Transit	80⅜
Consolidated Gas	137
General Electric	177
Interborough-Metropolitan common	37
Interborough-Metropolitan preferred	76⅝
Kings County Electric	150
Mackay Companies (Postal Telegraph and Cables) common	73
Mackay Companies (Postal Telegraph and Cables) preferred	69
Manhattan Elevated	143¼
Metropolitan Street Railway	106
New York & New Jersey Telephone	126
Western Union	87¼
Westinghouse Manufacturing Company	151

Directors of the General Electric Company have decided to offer $10,861,200 new stock, equal to 20 per cent of present holdings, at par to stockholders of record December 8. The issue represents in part stock that has long been in the treasury and part of the recently authorized $20,000,000.

J. & W. Seligman & Company and Redmond & Company, with associates, secured 38,000 shares of the total of 48,000 shares of the Manhattan Railway Company, sold at auction on November 28, paying an average price of 141¼. It is announced that a large amount of the stock purchased has already been placed. Through the sale at public auction of the 48,000 shares of the Manhattan Railway Company stock, the Interborough Rapid Transit Company will receive a total of $6,776,643. The indebtedness of the Manhattan to the Interborough on September 30 last for direct advances amounted to $3,452,183. Consequently, this indebtedness will be wiped out and a balance of $3,324,460 left to the Interborough, which will be used for additional improvements and equipment in connection with the Manhattan system. The annual fixed charges of the Interborough will be increased $336,000 per annum as a result of the issue, as dividends of 7 per cent will have to be paid on the stock the same as on that already outstanding. The outstanding stock of the Manhattan now amounts to $60,000,000, which is the total amount authorized, and dividends of $4,200,000 must now be paid on this issue.

Stockholders of the Western Union Telegraph Company have been notified by circular of their privilege to subscribe between December 6 and December 17, both dates inclusive, for the convertible 4 per cent redeemable bonds, authorized recently, equal to 10 per cent of their respective holdings of the stock of the company of record December 5. The bonds will be convertible at the option of the holder into the stock of the company at par at any time after January 2, 1909, and before January 2, 1919. The bonds will be redeemable at the option of the company, at 5 per cent premium and accrued interest on May 1, 1912, or any interest day thereafter, on notice of call. The price fixed by the board of directors for the bond is $875 for a bond of $1,000 face value.

Boston:	*Closing.*
American Telephone and Telegraph	137
Edison Electric Illuminating	225
Massachusetts Electric	70
New England Telephone	129
Western Telephone and Telegraph preferred	79
Philadelphia:	*Closing.*
Electric Company of America	11¾
Electric Storage Battery common	69
Electric Storage Battery preferred	69
Philadelphia Electric	8¼
Philadelphia Rapid Transit	21¾
United Gas Improvement	97
Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	141
Metropolitan Elevated preferred	70⅛
National Carbon common	85½
National Carbon preferred	115
Union Traction common	—
Union Traction preferred	—

The Metropolitan Elevated November daily average was 152,471 passengers, an increase of 24,195.

The daily average of passengers carried by the South Side Elevated during November was 94,281, an increase of 2,125 over the figures for 1905.

Digitized by Google

ELECTRIC LIGHTING.

ESSEX, IOWA—Oscar Nelson has been granted a franchise for a light and power system.

NIAGARA FALLS, ONTARIO—The city has disposed of $20,785 of light bonds to the firm of Wood, Gundy & Company, Toronto.

CLINTON, MO.—Work on Clinton's municipal electric light plant has been started. It is thought that the plant will be in operation by the middle of January.

BRONTE, TEX.—An electric lighting company has been organized at Bronte, and it is expected to have the plant in operation by Christmas. Frank Hickman is president of the company and Robert Knierim general manager.

DELHI, N. Y.—A new lighting company has been formed in Edmeston. The building and equipment of the old company has been bought and will be moved to a site near the Wharton creek. C. T. Coats, V. D. Robinson, R. C. Huestis and Bert Gilson compose the new company.

LAPEER, MICH.—Outside parties have been induced to help finance the Schlegel electric power plant and Mr. Schlegel states that it will supply the city with power by January 1. Already the poles have been set within a half-mile of the city. The plant itself is two and one-half miles out. Machinery has been shipped for the completion of the plant.

DENVER, COL.—Another $400,000 is about to be expended in Nevada electric power schemes by the Nevada Power, Mining and Milling Company, of which concern Lawrence C. Phipps and other Denver capitalists are directors. Preparations are being made to extend the power lines of the company to the Bullfrog mining district, a distance of ninety miles from the present lines.

WELLAND, ONTARIO.—The Welland town council has given the contract for street lighting to the Stark Electric System, Limited, of Toronto. The contract is for forty arc lights of 2,000 candle-power, each of the most improved style, and the price is to be $40 per light per year, all public buildings belonging to the corporation to be lighted free. The rate for private lighting is to be eight cents per kilowatt-hour, with twenty-five per cent discount if paid by the fifteenth of the month.

ELIZABETH, PA.—The Elizabeth Electric Light, Heat and Power Company has changed hands and will be under new management. The new owner is the West Penn Electric Company, which operates the trolley lines which cover the coke-region towns and also the electric light systems in all of these towns. To the list have recently been added all the towns in the Monongahela valley from Monongahela to Brownsville. The central power station of the company is located at New Haven, across the river from Connellsville. For the present the works at Elizabeth will be operated independently.

BATAVIA, N. Y.—Franchises have been granted to the Niagara & Lockport Power Company and to the Genesee County Electric Light, Power and Gas Company by the town board and highway commissioners. There was a little discussion regarding the matter, as copies of the proposed grants had been carefully examined by the town officers in advance. The franchises give the companies the privilege of distributing electricity in Batavia and contain provisions calculated to protect the town's interests. The town gets nothing for the franchises. For lamps twelve cents per kilowatt-hour, with a discount of two cents if the bill is paid in a specified time, will be charged, except that no bill shall be rendered for less than $1.

MIDDLEVILLE, N. Y.—The Middleville Electric Light Company has been granted consent by the commission of gas and electricity to increase its capital stock from $4,000 to $12,000, the increase to be used for the purpose of the further development of the plant, installation of a new power-house and canal, etc. New generating equipment is to be installed and many improvements made. The capacity is now fifty horse-power and when the changes are made the capacity will be increased to 120 horse-power. The company furnishes light only at present, but will be able to supply power when the improvements are completed. The power comes from the West Canada creek. David E. Ford is the president and general manager of the company, Lewis H. Goodman the secretary and treasurer and A. M. Goodman the vice-president.

ELECTRIC RAILWAYS.

EASTLAND, TENN.—The Nashville, Chattanooga & St. Louis Railway Company will, it is stated, build a line from Eastland to Dunlap.

SENECA FALLS, N. Y.—The scheme for connecting the village of Seneca Falls with the city of Ithaca by an electric railroad has been again revived.

PITTSBURG, PA.—Charles Gibson, manager of the Pittsburg & Butler Railway Company, announces that the first cars will be operated between Butler and Pittsburg about December 28.

DETROIT, MICH.—The Detroit Trust Company has taken charge of the Detroit, Saginaw & Flint Electric Company, which has bonds amounting to $410,000, interest on which was defaulted. The bonds are held principally in Detroit. Thirteen miles of the proposed line have been built and are in operation. The company will be reorganized.

GETTYSBURG, PA.—The Pennsylvania Railroad and the Cumberland Railroad, backing the Valley Traction Company, operating lines in Cumberland valley, have purchased forty miles of turnpike from Chambersburg to Littlestown *via* Gettysburg. The consideration was around the $50,000 mark. Work will begin at once to extend trolley lines over this road.

DAVENPORT, IOWA—Announcement is made of the formation of the Tri-City Railway and Light Company to take over the light and traction interests of Davenport. At present these interests are held by eight companies, and it is planned to reduce these to three, these three in turn to be controlled by one corporation. The new company proposes to make certain reductions in traction fares.

RIVERSIDE, CAL.—The franchise for an electric railroad which will connect Riverside with Colton has been awarded by the city trustees to A. C. Denman, Jr., president and general manager of the San Bernardino Valley Traction Company. This road will give Riverside direct trolley communication with San Bernardino and Redlands and will be an important link in the chain of southern California interurban electric lines.

PITTSBURG, PA.—Division Superintendent B. W. Duer, of the Baltimore & Ohio, has recommended to the higher officers of the road that the branch of the Buffalo, Bradford & Kane road, from Kane to Mt. Jewett, which the Baltimore & Ohio operates as part of its narrow-gauge branch from Foxburg to Mt. Jewett, be standardized and operated by electricity. This proposition may also eventually be extended to the Foxburg-Kane narrow-gauge line.

ALBANY, N. Y.—A certificate of merger of the Olean Street Railway Company and the Rock City Railroad Company, forming the Olean Street Railway Company, has been filed with the secretary of state. The capital stock is $1,400,000, and the directors are: James F. Johnson, M. L. Lee, Thomas Gilligan, I. W. Meller and W. P. Page, of Olean; W. B. Merserfen, of Portville; Clare Willard and Edward Torrey, of Allegany, and Julius C. Calisch, of Buffalo.

SPRINGFIELD, OHIO—A corps of engineers is already at work surveying for the new interurban line which is to be built by the Springfield, Wilmington & Cincinnati Railway Company, incorporated by George F. Parmalee and others. This is known as the Frey line, and will run from Springfield to Clifton, Cedarville, Jamestown, Wilmington and Cincinnati, with a branch to Xenia. It is considered the best traction proposition in this section, and is not touched by any other interurban or steam road. Eldenbel & Company, of New York, will construct the line.

BALTIMORE, MD.—Nearly fifty per cent of the work on the Baltimore and Washington electric car line has been completed, and officials of the Baltimore, Washington & Annapolis Electric Railway Company say the cars will be in operation between the two cities next summer. The entire line to Washington will be only thirty-three miles long, or more than seven miles shorter than the routes followed by the steam roads. The line will pass through an undeveloped territory. It will connect with the trolley road now in operation from Laurel to Washington, which it owns, but this will not form a part of its line, as might be supposed. The cars to be operated on the line will be capable of attaining a speed of forty-five miles an hour, and, while no announcement has yet been made, will probably be run on a fifteen-minute schedule. There will be express and local trains, and freight as well as passenger service will be provided.

Digitized by Google

TELEPHONE AND TELEGRAPH.

WHEELING, W. VA.—John A. Howard has secured entire control of the National Telephone Company, paying about $100,000 for the allied Schmulbach interests.

PROVIDENCE, R. I.—The state capitol has been equipped with a complete telephone system. The new board has 100 pairs of wires, although only sixty will be in service at the start.

MILWAUKEE, WIS.—The Milwaukee city council has passed by a vote of forty-five to one a franchise allowing the Wisconsin Independent Telephone Company to do business in the Wisconsin commercial centre.

GLENWOOD, MINN.—The Glenwood Telephone Company has sold its exchange, consisting of 225 local and thirty rural subscribers, to the Minnesota Central Telephone Company, which will rebuild the same.

MARLBOROUGH, CT.—The Southern New England Telephone Company will extend its line from Marlborough Centre to Marlborough Mills, and discontinue the old line running from the mills to the East Hampton line.

STEUBENVILLE, W. VA.—The National Telephone Company will establish a branch exchange in Steubenville, at an approximate cost of $80,000. The company expects, within the next year, to have 2,000 subscribers in the city.

WATERBURY, CT.—Manager J. D. Veitch, of the Waterbury division of the Southern New England Telephone Company, announces that there has been an increase of about 500 telephones in his division since the first of this year.

APPLETON, MINN.—The Minnesota Central Telephone Company has recently reconstructed its exchange at Appleton, replacing overhead wires with cable distribution. One hundred new rural subscribers in adjoining townships are being connected.

WOODBURY, CT.—The Waterbury Automatic Telephone Company will place all the telephone wires running north in a cable. New poles will be set to carry the cable. The capital stock of the company has been increased from $15,000 to $22,500.

CUMBERLAND, MD.—The Burlington Telephone Company, of West Virginia, has purchased the Chesapeake & Potomac Telephone Company, operating in the vicinity of Cumberland, Md. The former company now controls the territory east and south of Keyser, W. Va., and will build to Norfolk and Richmond, Va.

CHARLOTTE, N. C.—The corporation commission of North Carolina has sent out notices to all the telephone companies in the state to the effect that it has under consideration the question of fixing rates for charges for messenger service and rental of telephones by the various telephone companies in the state, and directing the various companies to forward, for file in the office of the commission and for their consideration, the schedule of rates now charged.

CHICAGO, ILL.—It is stated that access to Chicago will be given the Tri-State Telephone and Telegraph Company, of Minneapolis, by the Automatic Company, of that city. Some time ago E. H. Moulton, president of the Twin City and toll independent line, announced that he might build to Chicago. He now states that his company will enter Chicago over the Automatic Company's wires. The Automatic people will build lines to distances ranging from thirty to sixty miles out of the city to meet the independent leads.

NEW MANUFACTURING COMPANIES.

COLUMBUS, OHIO—The Engler Electrical Manufacturing Company has been incorporated with a capital of $5,000 by John J. Angel, H. P. Engel, E. H. Blum, George Scott and H. D. Champlin.

ALBANY, N. Y.—The Bayley-Lee Electric Company, of Brooklyn, has been incorporated to manufacture and sell light, heat and power-generating machinery. The capital stock is $15,000, and the directors are George W. Bayley, George H. Bayley and William H. Heim, of Brooklyn.

INDUSTRIAL ITEMS.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., is distributing circular No. 1139, describing and illustrating starting and field rheostats.

THE FRENCH BATTERY COMPANY, Madison, Wis., has ready for distribution a new catalogue descriptive of its "Fleur de Lis" dry batteries and electric novelties. This catalogue will be sent to any one interested upon request.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., is about to issue a new bulletin descriptive of its direct-current, engine-type generators designed for general lighting and power work in connection with steam, gas or oil engines.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has published bulletin No. 4465, devoted to trolley frogs, their proper selection and location for different services; and bulletin No. 4467, devoted to the emergency straight air-brake system.

THE UNION SWITCH AND SIGNAL COMPANY, Swissvale, Pa., in bulletin No. 26 describes and illustrates its electric interlocking system. In bulletin No. 28 the Westinghouse automatic electro-pneumatic block signals on the electrified division of the West Jersey & Seashore Railroad are described.

THE INDUSTRIAL MOTOR COMPANY, 1310 G street, N. W., Washington, D. C., has published a catalogue illustrating and describing its telpher system adapted to overland transportation of mail, express, freight and passenger service, and loading and unloading vessels at sea away from wharf facilities.

THE BRILLIANT ELECTRIC COMPANY, Cleveland, Ohio, it is understood, is contemplating enlarging its plant. Notwithstanding the fact that this company has one of the best-equipped lamp factories in the country, so great has been the demand for Brilliant incandescents that the company, so rumor has it, is looking up a new site for the erection of a larger plant, equipped with every modern facility.

THE LOMBARD-REPLOGLE ENGINEERING COMPANY, Akron, Ohio, is calling attention to a letter received from the Montreal Cotton Company, Valleyfield, province of Quebec, testifying to the efficiency of a type L.R.-18 governor controlling two sixty-inch Smith-McCormick turbines operating under twelve-foot head and driving a three-phase alternating-current generator.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago, Ill., has published a handsome catalogue descriptive of wireless clusters and lighting specialties. In addition to the descriptive matter and price list there are scores of engravings showing various forms of clusters and other illuminating standards. This catalogue is very interesting and forms a worthy addition to the trade literature of this character.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has published an attractive booklet entitled "Air-Compressor Lubrication." This calls attention to a number of statements which have appeared in several technical journals concerning the lubrication of air-compressor cylinders. The utility of graphite for this purpose is pointed out, and some interesting conclusions drawn with regard to the use of graphite for lubrication in general.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., is distributing two attractive folders entitled, respectively, "The Question of Operators" and "Now On To Chicago." The first deals with the utility of the Automatic telephone because of its freedom from operator's troubles. The second contains a reproduction of several newspaper clippings concerning the reorganization of the South Bend (Ind.) Home Telephone Company. This company is to be equipped with Automatic telephones, and efforts will be made to have direct toll service with Chicago, Indianapolis, Grand Rapids and several Ohio cities.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, announces that the Boston (Mass.) branch will move early in December to a new building at Nos. 55-59 High street, Boston. The entire building, which comprises seven floors, will be occupied by the offices, sales and shipping rooms of the company. Every facility will be provided for doing business comfortably, con-

Digitized by Google

veniently and promptly. The increased space will enable the company to carry a much larger stock on hand than ever before.

THE NATIONAL BRAKE AND ELECTRIC COMPANY, Milwaukee, Wis., reports among recent orders for generators the following: Simmons Manufacturing Company, Kenosha, Wis., one 1,000-kilowatt engine-type alternator; Union Electric Light and Power Company, St. Louis, Mo., two 500-kilowatt three-unit synchronous motor-generator sets, and one 200-kilowatt induction motor-generator set; Proctor & Gamble (for Staten Island plant), one 400-kilowatt engine-type alternator, and one 125-kilowatt engine-type alternator; Hicks Locomotive and Car Works, Chicago, Ill., one 500-kilowatt belted alternator; Clymer Power Company, Riegelsville, Pa., one 250-kilowatt water-wheel type alternator; United States Light and Traction Company, Hobart, Okla., one 250-kilowatt engine-type alternator, and one 250-kilowatt engine-type alternator for the company's Sheridan (Wyo.) plant.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the Second Issue of Each Month.)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Ct.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Sadtler, 59 South Tenth street, Philadelphia.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty street, New York. Meetings, fourth Friday of each month.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnston, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Professor Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 12 West Thirty-first street, New York.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, 60 Wall street, New York.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, S. W. Mower, London, Canada.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Ernest H. Davis, Williamsport, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Annual meeting, Atlantic City, N. J., June 19, 1907.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington street, Newton, Mass. Annual meetings held in Boston on third Wednesday in March.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Ontario.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. F. Dostal, Denver, Col.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Ct.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt street, New York.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water street, Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine street, St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary-Treasurer, George H. Erich, 401 Monadnock Block, Chicago. Next annual meeting, Chicago, January, 1907.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada. Next annual meeting, January 14, 1907.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall street, New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, Rolland A. Davidson, 58 William street, New York city, N. Y.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Dr. Arthur H. Elliot, 4 Irving place, New York. Meetings in New York, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.; assistant secretary, J. A. Harney, Electric Building, Cleveland, Ohio.

IOWA ELECTRICAL ASSOCIATION. Secretary, L. B. Spinney, Iowa State College, Ames, Iowa.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Iowa.

KANSAS GAS, WATER AND ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kan., October 16, 1907.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. W. Chambers, Winchester, Ky.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James F. Barnett.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee street, Utica, N. Y. Next meeting, New York city, 1907.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, 136 Liberty street, New York city.

Digitized by Google

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State street, Boston, Mass.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty street, New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, B. C. Adams, Madison, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, Ohio.

OHIO SOCIETY OF MECHANICAL ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Bullard, Cleveland, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York city.

ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Annual meeting, Milwaukee, Wis., October 14, 1907.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Secretary, T. H. Stuart, Waco, Tex.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electrical Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, Chicago.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

DATES AHEAD.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.

Northwestern Electrical Association. Chicago, Ill., January 16-18, 1907.

Jamestown Ter-Centennial Exposition. Norfolk, Va., April 26 to November 30, 1907.

Record of Electrical Patents.

Week of November 27.

836,666. ELECTRIC CONTROLLER. Roy W. Brown, Amsterdam, N. Y. Filed January 23, 1906. A number of switches are closed successively by a single mechanism.

836,691. STOP DEVICE FOR CIRCULAR KNITTING MACHINES. Ernest H. Ludwig, Manitowoc, Wis. Filed January 29, 1906. An electrically controlled stop device.

836,754. PROCESS OF IMPROVING THE MAGNETIC QUALITIES OF IRON-SILICON ALLOYS. Robert A. Hadfield, Sheffield, England. Filed February 27, 1906. The alloy is heated above its critical point and then cooled.

836,755. PROCESS OF IMPROVING CERTAIN MAGNETIC QUALITIES OF A MAGNETIC BODY. Robert A. Hadfield, Sheffield, England. Filed July 5, 1906. The alloy is maintained at a temperature between 700 and 800 degrees centigrade and then slowly cooled.

836,756. MAGNETIC ALLOY. Robert A. Hadfield, Sheffield, England. Filed July 5, 1906. An alloy of iron, silicon and manganese.

836,757. PROCESS OF IMPROVING THE MAGNETIC QUALITIES OF IRON-SILICON-MANGANESE ALLOYS. Robert A. Hadfield, Sheffield, England. Filed July 5, 1906. Manganese is added to an alloy of iron and silicon.

836,758. MAGNETIC ALLOY. Robert A. Hadfield, Sheffield, England. Filed July 5, 1906. An alloy of iron, silicon and aluminum.

836,759. METHOD OF MAKING MAGNETIC MATERIALS. Robert A. Hadfield, Sheffield, England. Filed July 5, 1906. An alloy containing silicon is reduced to sheet form and then successively heated and cooled.

836,760. METHOD OF MAKING MAGNETIC MATERIALS. Robert A. Hadfield, Sheffield, England. Filed July 5, 1906. An alloy containing silicon in the form of sheets is successively heated and cooled.

836,761. METHOD OF MAKING MAGNETIC MATERIALS. Robert A. Hadfield, Sheffield, England. Filed July 5, 1906. The alloy is heated to a temperature below its melting point and then rolled into sheets and again heated to a lower point.

836,762. PROCESS OF IMPROVING THE MAGNETIC QUALITIES OF IRON-SILICON-ALUMINUM ALLOYS. Robert A. Hadfield, Sheffield, England. Filed August 21, 1906. A magnetic alloy containing silicon and aluminum is successively heated and cooled.

836,774. ARC LAMP. Frederick S. Murray, New York, N. Y., assignor to the New York Calcium Light Company, New York, N. Y. Filed April 13, 1904. An arc lamp with a frustrum-shaped reflector.

836,789. PORTABLE ELECTRIC HOIST. Walter N. Vance, Chicago, Ill., assignor to the Yale & Towne Manufacturing Company, Stamford, Ct. Filed July 9, 1906. The motor and its controller are mounted on a hoisting sheath.

836,794. AUTOMATIC DEVICE FOR OPERATING VALVES AND OTHER MECHANISMS. Oscar Winter and Fred W. Waterman, Elyria, Ohio. Filed February 17, 1906. A gravity actuated, electrically released valve.

836,805. TELEPHONE OR SWITCHBOARD PLUG. Alva B. Dozier, Taylor, Tex. Filed May 10, 1904. A method of construction.

836,808. ELECTRIC TIME SWITCH. John Gunning, Bournemouth, England. Filed December 16, 1905. A spring-actuated time-switch.

836,836. TRANSMISSION TOWER. Daniel R. Scholes, Chicago, Ill., assignor to Aermotor Company, Chicago, Ill. Filed February 21, 1906. A tower of structural iron with a truss-formed cross-arm.

836,848. TELEPHONE APPARATUS. David H. Wilson, Chicago, Ill., assignor to George W. Kretzinger, Chicago, Ill. Filed December 8, 1902. The telephone receiver is mounted opposite the pole pieces of an induction coil.

836,863. PROCESS OF MAKING ELECTRIC CONDENSERS. Henry P. Clausen, Chicago, Ill., assignor to American Electric Telephone Company, Chicago, Ill. Filed February 2, 1903. A metal sheet is laid between paper dipped in paraffin and two such elements folded into a convenient form.

836,895. ELECTRIC BLOCK SIGNAL. Walter E. Sands, Brooklyn, N. Y., assignor to the L. A. Thompson Scenic Railway Company, New York, N. Y. Filed December 29, 1905. The signals are actuated by the cars.

836,904. AUTOMATIC SYSTEM OF INTERCOMMUNICATION. Anthony Van Wagenen, Sioux City, Iowa. Filed July 31, 1902. Renewed March 3, 1906. The switches at the exchange are operated by magnets branched across the subscriber's lines.

836,915. ILLUMINATED SIGN. William T. Bradshaw, Oakland, and Charles H. Townsend and Oscar F. Erickson, Berkeley, Cal. Filed August 7, 1906. Curved reflectors are provided to throw the light from a few lamps through a number of openings.

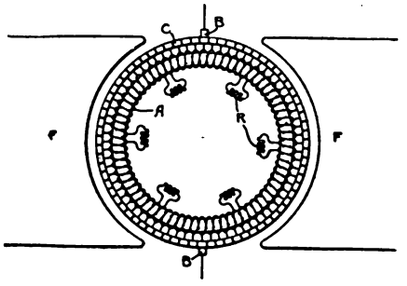
Digitized by Google

836,936. TEMPORARY TELEGRAPH STATION. Chas. S. Maynard, Chardon, Ohio, assignor of one-fourth to John Maynard and one-fourth to W. B. Treat, Cleveland, Ohio. Filed September 24, 1906. A clip for cutting in on a telegraph line.

836,965. ELECTRIC DOOR-OPENER. Edwin W. Fyler, Hyde Park, Mass., assignor of one-half to Warren E. Fyler, Hyde Park, Mass. Filed April 9, 1906. An electromagnetic door-striker.

836,973. SYSTEM OF MOTOR CONTROL. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. Filed May 20, 1905. A controller system of the unit-switch type, actuated pneumatically, controlled electrically.

836,974. METER. Frank Holden, Rugby, England, assignor to General Electric Company. Filed April 24, 1905. The rotating member is immersed in a conducting bath placed in a magnetic field.



836,978.—Alternating Current Motor.

836,978. ALTERNATING-CURRENT MOTOR. Marius C. A. Latour, Paris, France, assignor to General Electric Company. Filed May 16, 1905. The armature has a plurality of separate windings connected to successive commutator segments, and connections are made between a plurality of equipotential points.

836,981. TRAIN-CONTROL SYSTEM. Charles E. Lord, Cincinnati, Ohio, assignor to General Electric Company. Filed October 1, 1904. A pneumatically operated motor-controlled system.

836,982. EMERGENCY BRAKE. George Macloskie, Schenectady, N. Y., assignor to General Electric Company. Filed March 21, 1903. Renewed March 7, 1906. An attachment on the controller applies the brake if the controller handle be released.

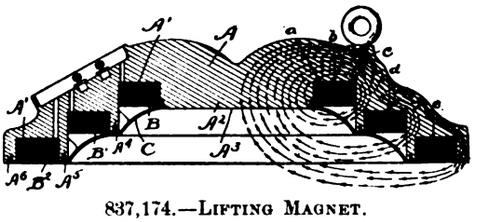
836,998. ALTERNATING-CURRENT MOTOR. Ernest Schweiger, Schenectady, N. Y., assignor to General Electric Company. Filed May 2, 1904. The motor is provided with a secondary winding connected to a commutator with short-circuiting brushes.

837,022. SAFETY APPARATUS FOR RAILWAYS. Granville T. Woods and Lyates Woods, New York, N. Y., assignors to General Electric Company, Schenectady, N. Y. Filed October 5, 1904. The brake apparatus may be brought into action by a movement of the motor controller.

837,023. CIRCUIT-BREAKER. Gilbert Wright, Pittsfield, Mass., assignor to Stanley Electric Manufacturing Company, Pittsfield, Mass. Filed January 11, 1904. The circuit-breaker is opened by a series coil and held open by a shunt coil.

837,033. COOLING DYNAMO-ELECTRIC MACHINES. Paul Bunet, Paris, France, assignor to General Electric Company. Filed March 23, 1905. The commutator bars are provided with heat-radiating wings.

837,037. MOTOR-CONTROL APPARATUS. Frank E. Case, Schenectady, N. Y., assignor to General Electric Company. Filed April 17, 1905. A unit switch-control system, certain of the units being controlled automatically.



837,174.—Lifting Magnet.

837,044. TESTING DEVICE. Alvarado L. R. Ellis, Lynn, Mass., assignor to General Electric Company. Filed October 23, 1905. The effective strength of a magnet is tested by comparison with a standard.

837,054. CONSTRUCTION OF INCANDESCENT-ELECTRIC-LAMP SOCKETS. Gilbert W. Goodridge, Bridgeport, Ct., assignor to the Bryant Electric Company, Bridgeport, Ct. Filed April 9, 1906. The cap is provided with spring clips for holding to the case.

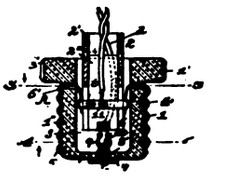
837,055. CONSTRUCTION OF INCANDESCENT-ELECTRIC-LAMP SOCKETS. Gilbert W. Goodridge, Bridgeport, Ct., assignor to the Bryant Electric Company, Bridgeport, Ct. Filed April 9, 1906. The cap is held to the case by clips and is notched to prevent rotation.

837,066. METER. Frank Holden, Rugby, England, assignor to General Electric Company. Filed November 17, 1905. The rotating member consists of a plurality of conductors submerged in a conducting liquid which connects them in series.

837,073. INCANDESCENT-LAMP SOCKET. William W. Jones, Bridgeport, Ct., assignor to the Bryant Electric Company, Bridgeport, Ct. Filed May 12, 1906. A two-member lamp socket, the parts of which are held together by spring catches.

837,084. APPARATUS FOR ILLUMINATING PHOTOGRAPHIC STUDIOS WITH ELECTRIC INCANDESCENT LAMPS. Philipp G. von der Lippe, Vienna, Austria-Hungary. Filed January 9, 1906. A device providing movable lamp sockets.

837,092. CIRCUIT-BREAKER. William Merrill, Wilmington, Del. Filed October 19, 1905. The switch is held open or closed by a tube containing liquid.



837,184.—Attachment Plug.

837,097. ELECTRIC ALARM. Ernest S. Moorer, Anderson, S. C. Filed September 16, 1905. A thermal alarm for attaching to telephone or other circuits.

837,154. RAILWAY SIGNALING SYSTEM. Louis H. Thullen, Edgewood Park, Pa. Filed May 22, 1905. The signals are controlled by pulsating currents sent out over the motor circuit.

837,174. LIFTING MAGNET. Charles E. F. Ahlm, Cleveland, Ohio, assignor to Cleveland Armature Works, Cleveland, Ohio. Filed May 22, 1906. Two or more concentric pole-pieces are provided.

837,178. AUTOMATIC CIRCUIT-CLOSER. Tully W. Benson, Wewoka, Ind. Terr. Filed January 4, 1906. An automatic telegraph circuit-closer.

837,182. ATTACHMENT PLUG FOR ELECTRIC LIGHTING. David E. Bown, Pittsburg, Pa. Filed August 14, 1905. A method of construction.

837,183. FUSE PLUG FOR ELECTRIC LIGHTING. David E. Bown, Pittsburg, Pa. Filed August 14, 1905. The fuse is contained within a chamber of the plug.

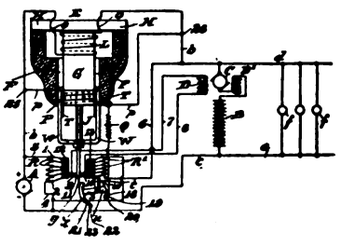
837,184. ATTACHMENT PLUG. David E. Bown, Pittsburg, Pa. Filed November 6, 1905. A swivelling plug.

837,185. AERIAL-CABLE SUPPORT. Charles L. Brown, Philadelphia, Pa. Filed July 21, 1905. A wire-loop support.

837,201. AUTOMATIC CIRCUIT-BREAKER. Albert E. Doman, Elbridge, N. Y., assignor to the Elbridge Electrical Manufacturing Company, Elbridge, N. Y. Filed May 21, 1902. The brake is opened by an intermittently acting make-and-break device.

837,213. ELECTRIC MOTOR. Manes E. Fuld, Baltimore, Md. Filed February 6, 1906. A toy motor.

837,227. RAILWAY-SIGNALING SYSTEM. Joseph G. Horazdovsky, Cleveland, Ohio, assignor of one-sixth to John J. Koller, one-sixth to Ladimir Herold, and one-third to Victor Nusbaum, Cleveland, Ohio. Filed May 21, 1906. A train-operated system.



837,231.—System of Electric Regulation.

837,231. SYSTEM OF ELECTRIC REGULATION. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company, New York, N. Y. Original applications filed September 24, 1904. Divided and this application filed February 17, 1905. A method of controlling a battery-charging booster.

837,241. ELECTRIC SWITCH. William J. Murray, Leavenworth, Kans., assignor of one-half to Herbert W. Wolcott, Leavenworth, Kans. Filed May 2, 1905. A rotating snap-switch.

837,256. TELEPHONE TOLL APPARATUS. Edward P. Baird, Evanston, Ill., assignor to Baird Manufacturing Company, Chicago, Ill. Filed May 11, 1903. A plurality of coin-shifters is provided and means for closing the coin slots.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 24. NEW YORK, SATURDAY, DECEMBER 15, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK

PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO

WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON

NEW ENGLAND OFFICE, ... 95 MILK STREET

LONDON

EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
Electricity the Safest of All Powers 965
A Proposed Method of Wireless Telegraphy 966
A Noteworthy Paper 966
Electrolytic Resistances 967
Simple Diagrams 967
Transformation of Electric Power into Light, by Charles Proteus Steinmetz 968
Electrical Equipment for Iron Mines 971
The Question Box of the National Electric Light Association 971
The Greenwich Power Station of the London County Council, by Albert H. Bridge 972
Southern Power Company Lets Contract for Extensive Equipment 975
Cuts Off Free Telegraphs 975
Indoor Illuminants, by James Swinburne 975
Electric Power in France 977
The Hamilton, Ohio, New Telephone Exchange, by J. E. Peavey 978
The University of Illinois 979
The Measurement of Received Energy at Wireless Stations, by Greenleaf W. Pickard 980
Another New Telephone Company for Chicago 981
New Head of Smithsonian 981
The Telephone Situation in Chicago 982
BOOK REVIEWS 984
The Telephone Manufacturer's Association 984
New York Electrical Society 984
Brilliant Electric Company to Build New Factory 984
Strike at the Works of the General Electric Company 984
The Evolution of Gas Power, by F. E. Junge 985
Pupin Telephone Cable across Lake Constance 987
Increased Value of Copper Exports 987
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 988
METHODS OF GETTING NEW BUSINESS—"Advertising Electricity," Part II, by Frank B. Rae, Jr 990
The Boston Rejuvenation of the Sons of Jove 992
New York City May Grant a Telephone Monopoly 992
The Telharmonium at the Automobile Club Dinner 992
INDUSTRIAL SECTION:
The "American" Water Softener 993
Two-Hundred-and-Fifty-Volt Indicating Plug Fuse 994
A New Slide-Wire Bridge 995
New York Central & Hudson River Railroad Storage Battery Equipment 995
CURRENT ELECTRICAL NEWS 996
RECORD OF ELECTRICAL PATENTS 1001

Copyright, 1906, by Electrical Review Publishing Co.

ELECTRICITY THE SAFEST OF ALL POWERS.

An able analysis of industrial accidents by Dr. Josiah Strong under the caption "Our Industrial Juggernaut" appeared in the mid-November issue of the *North American Review*. No one can read this article thoughtfully without being impressed with the need of an awakening of American industries on the subject of accident prevention, and we earnestly hope that active measures will be taken to reduce the serious economic waste and suffering which careless methods of production invite. At the same time we can not help pointing out that Dr. Strong is greatly mistaken when he includes the increasing use of electricity in machine driving as a contributory cause of more and more industrial accidents.

The electric motor in itself is one of the safest pieces of machinery in the world. It is compact, can be placed in the most inconspicuous and convenient locations, may be made both moisture and fool-proof, will stand tremendous overloads without breaking down, can not explode and in certain types will run in water, dust, mud, chemical fumes and extreme heat or cold. If anything like decent engineering is used in adapting it to the work in hand it will operate for long periods with little or no attention, and without overheating.

The electrically driven machine is the safest of all, provided the machine is individually operated, and even if it be belt driven the hazard is no greater than with any other method. In fact it is less, for even with group driving, machines can be shut down when not in service, and there is less obstruction to light and air than with belts and shafting entire. And finally, the electric wire is safer than the steam pipe with its explosive powers, the gas pipe with its inflammable contents, or the compressed-air main with its heavy pressures and possibilities of rupture. Of course, high-potential circuits are dangerous if not properly installed and maintained, but the point is that there is an intrinsic accident hazard about other means of power supply that is quite foreign to electricity. In the largest field of electric motive-power application—the electrified steam railroad—we believe operating experience will prove that the electric locomotive is far and beyond safer than the smoke-emitting steam locomotive of the present; and in the smallest field of electric power—the operation of toy motors for children's play—there is no question about the greater safety of the electric machine in comparison with gas or alcohol toy engines. We believe that it can be demonstrated in every case that the use of electricity increases the operating safety of the industry which adopts it, and that any industry employing electric power in contradistinction to older methods will have fewer accidents as a result.

Digitized by Google

A PROPOSED METHOD OF WIRELESS TELEPHONY.

The success attained in transmitting telegraphic signals without employing connecting wires naturally led a number of inventors to seek for a similar means of transmitting spoken words. Various attempts have been made to do this, the most noteworthy being that of E. Ruhmer, whose system of optical telephony is well known and has been widely exhibited. This system consists simply in imposing upon the current of an electric arc variations produced by the voice in a telephone transmitter. These variations in the current of the arc produce corresponding variations in its luminous intensity, and a beam of light reflected from the arc is caught by another reflector and thence thrown upon a receiving device sensitive to light. This device is a selenium cell whose resistance is varied by the variations in the light falling upon it, and these resistance variations are utilized to reproduce in a telephone receiver the words spoken at the other end of the beam of light. Naturally, such a system of transmitting speech can not have a great range. The two points in communication must be in view of each other, but the system has been employed, with more or less success, for carrying on conversations over some miles.

To increase the distance of transmission requires the employment of some other means of conveying the variations caused by the voice. One naturally would endeavor to apply to this purpose some of the methods devised and found successful for radiotelegraphy, but there is this fundamental difference between transmitting simple signals and transmitting speech: in the former case it is only necessary to know whether the signal is made or not, while in the second case not only must the signal be caught, but its value must also be determined. In transmitting speech we must not only vary the intensity of the vibrations, but we must vary their frequency. In other words, as the chemist would say, we must find a quantitative as well as a qualitative method; while radiotelegraphy is simply qualitative.

For such a purpose any of the ordinary means of setting up electric waves are inapplicable because they are not of a constant and predetermined pitch and there is no means of imposing upon them variations produced by the voice, which may at the receiving station be sorted out from the more or less irregular carrying waves. If, however, arguing from Ruhmer's success with a beam of light, one can produce electric waves of constant pitch and intensity, it might be found possible to impose upon these waves variations representing speech. But to do this successfully the frequency of the waves should be high, so high in fact that one complete period of the highest note of the voice corresponds to a comparatively long train of waves. If this be not the case there is then little hope of being able to sort out the variations at the receiving station, and thus reproduce the original message.

A method offering some possibilities of accomplishing the same result is that devised by Valdemar Poulsen for use in radiotelegraphy, which was described in the issue of the ELECTRICAL REVIEW for December 8. Ruhmer, it seems, was quick to see the possibilities of Poulsen's device, and has already made some preliminary experiments by means of this high-frequency oscillating arc to determine its suitability for transmitting speech. An investigation with a cathode tube oscillograph showed that variations could be imposed upon the waves by means of a telephone circuit interlinked with the arc circuit; but the frequency of the waves was so high that it was impossible to determine whether the variation produced was simply one of intensity or also one of frequency. A few experiments made to transmit speech in this way seem to have been somewhat successful, although, of course, with laboratory apparatus the distances were short. One hundred feet was the longest reported. However, Ruhmer is confident that he already has apparatus which will enable him to cover several miles.

A system of wireless telephony would doubtless find some important applications. It would be particularly useful on ships for communicating with a near-by shore, as well as to establish communication with other points not easily reached by means of a cable. But a general use of any such system seems at present utterly impracticable. Nor can one expect to communicate over distances at all comparable with those covered by radiotelegraphy, for, in the first place, the message transmitted is represented not by the energy of the waves, but by their variations; and, in the second place, these variations can not themselves represent a great variation of energy because of the method by which they are produced. Nevertheless, the system would probably prove to be invaluable for some locations.

A NOTEWORTHY PAPER.

At the recent meeting of the American Society of Mechanical Engineers, held in New York city, December 4 to 7, a number of valuable papers were presented, though none of them appeals particularly to electrical engineers. Two papers dealing with gas-engine practice have some interest, and abstracts of these will be given in the ELECTRICAL REVIEW.

There was, however, a notable contribution to engineering knowledge made at this meeting. President Fred W. Taylor presented, in lieu of a presidential address of general nature, a study entitled "The Art of Cutting Metals." This paper has 250 pages of text and twenty-four large folding sheets of diagrams and tables. It represents the results of an investigation started by Mr. Taylor and his associates twenty-six years ago, and is probably the most important contribution to the art that has been made for many years. But this paper represents more than a mere contribution to the knowledge of cutting metals, for it is in effect a giving to the public of a great mass of invaluable information obtained after years of patient study and by the expenditure of nearly a quarter of a million of dollars, information which up to the present time has been rightly considered the property of those acquiring it. Such a contribution will help mightily in advancing the art with which it deals. Would that others who have such knowledge dealing with their own particular work could see their way to such a noble and inspiring use of it.

Digitized by Google

ELECTROLYTIC RESISTANCES.

In the issue of the ELECTRICAL REVIEW for October 13, in calling attention to certain phases of the use of liquid resistance in alternating-current circuits, it was pointed out that the electrolytic reaction, with an apparent capacity effect, introduces a phase displacement between current and electromotive force which in some cases might be detrimental. The well-known Kohlrausch method of measuring electrolyte resistance makes use of alternating currents in order to avoid errors which would be introduced by polarization, but it takes no account of this capacity effect. It was suggested that while it did not seem likely that much error was introduced by this neglect, still the subject was one worthy of examination.

In an article contributed to the *Electrician* (London) for November 1 by Dr. C. V. Drysdale, some tests are given bearing, in a way, upon this question. An abstract of this article will be found on another page of this issue. It does not give data which can be applied directly to determining the actual error due to the Kohlrausch method, since no measurements were made with similar apparatus. It is customary in the latter work to use platinum electrodes, as they take no part in the electrolytic reactions. All the electrodes employed by Dr. Drysdale may do so. Nevertheless, his results indicate that the error due to this effect is negligible in the Kohlrausch method. For example, it was shown that with lead plates in dilute sulphuric acid the angle of lag was only a few degrees. The maximum angle observed was a little over five, which would correspond to an error of less than one-half per cent, if it be assumed that Ohm's law apply directly. It would, however, be interesting to have the effects observed under the actual conditions employed in determining electrolytic resistance, particularly since one frequently finds tables of such measurements having four or five significant figures.

There is another phase of this capacity effect of electrolytic resistance pointed out by Dr. Drysdale. While measurements of the power output when running an alternator on such load may be sufficiently accurate, there is a possibility that the leading component of the current may modify the regulation characteristic of the alternator, changing it from what it would be on purely non-inductive load. For instance, a lag of eight degrees will cause an error in the power-factor of less than one per cent, but at this time the sine of the angle of lead is nearly 0.14—that is to say, the reactive component of the current is nearly fourteen per cent of the whole, a value sufficient to affect the regulation characteristic considerably. Although it is not likely, according to Dr. Drysdale's results, that an angle of lag of eight degrees will be met in any ordinary electrolytic resistance, since such values were obtained only when using aluminum for the electrodes, angles of lead of two, three and even five degrees were observed when using lead in various solutions. These would correspond to inductance factors of from three to nine per cent. Iron, however, shows considerably less capacity effect. In no case was the angle of lead as great as one degree, so that the inductance factor was probably little more than one per cent.

Such small angles are very difficult to measure with ordinary instruments; in fact, it is only by special methods that results of any degree of accuracy can be obtained. But even though ordinary methods of measurement are not accurate for measuring quantities such as these, it does not follow that the quantities themselves may not be large enough to introduce considerable error in other measurements.

SIMPLE DIAGRAMS.

No method of treatment has done more to assist the student of science and technics than the use of diagrams. These present to the eye a picture, in conventional form, of the apparatus or the performance that is being studied. They are in effect what a theory is to the investigator working over some incompletely understood phenomena.

But to be the most useful a diagram should always be the least complex. It should be as simple as it is possible to make it and contain not an unnecessary line or letter. This necessity is well recognized in the use of diagrams for representing physical forces and quantities, and no effort is spared to reduce them to the plainest form possible. But when the method is used to represent a system, such, for example, as the wiring of a building, this feature is frequently neglected. The wires are drawn apparently just as the draughtsman happens to think of them, and little regard is paid to their relative positions. The finished diagram seems to be rather a neat copy of the draughtsman's first sketch than a finished drawing embodying the results of the sketch, but with the lines arranged so as to present the clearest possible picture. And even in simpler diagrams the patience of the reader is abused, and little or no thought is paid to proper construction. In such cases much of the value of the diagram is lost, and a drawing that should of all things be simple is made unnecessarily complex.

These few words are inspired by the diagrams in an interesting little article appearing in an esteemed contemporary, which, while they offend, are rather typical of what one frequently sees. One of these diagrams represents the wiring for a motor starting box. One of the armature leads circumnavigates more than three sides of the box and crosses other wires four times, when it could be carried directly to the armature without a single crossing. In another diagram the shunt-field lead, like the king of France, crosses the armature lead at the top of the figure apparently merely for the sake of recrossing it again at the bottom. True, it is not a serious matter, but if a diagram is worth drawing at all it is worth drawing properly; and if the object be not to assist the student as much as possible it might as well be omitted.

The adoption of the name "radio-telegraphy," by the international wireless telegraph conference, will, no doubt, lead to some hybrid term for designating messages transmitted in this way. The expression "radio-telegram" is certainly clumsy, and some such term as "radiograph" will, no doubt, be suggested, although this is not only etymologically incorrect, but offensive to the ear. Here is a need for a new word and an opportunity for the services of an expert word-maker.

Digitized by Google

TRANSFORMATION OF ELECTRIC POWER INTO LIGHT.[1]

BY CHARLES PROTEUS STEINMETZ.

(Concluded.)

Conduction through vapors can be of two distinctly different characters: spark or Geissler tube conduction and arc conduction. Vapors or gases can be divided into two classes: conducting vapors and non-conducting vapors. The conducting vapors are all of very high resistance. Hydrogen or air may be called a conducting gas, because a current can be passed through it, especially at a moderately high vacuum, as in the Geissler tube, which is nothing more than a tube containing the gas used as a conductor, at a few millimetres' pressure. At this pressure, air becomes a fairly good conductor, but the resistance is very high compared with the resistance of conducting solids or liquid. The passage of current through the conducting gas of the Geissler tube produces light, by some form of luminescence.

The mechanism of this light production does not seem to be known, but the light seems to be somewhat of the character of a by-product. The Geissler tube is extremely efficient when operated with an alternating current of very high frequency. With decrease of frequency, its efficiency decreases and heat is produced; that is, the frequency of radiation from the Geissler tube seems to vary with the frequency of the impressed alternating electromotive force, and have its intensity maximum near the visible range only at very high frequency currents. The production of light in the Geissler tube therefore seems to be connected in some way with the change of electric stress. It is not dependent on it, because even with a steady current the Geissler tube gives light, but its efficiency of light production vastly increases and the energy is converted more into light and less into heat, with increasing frequency. Herein seems to lie the great difficulty in this method of producing light by using conducting gases at low pressure.

Considerable work has been done in this direction by able investigators, and with some success. The Geissler tube gives a very nice light; and by using a suitable gas it can be made to give any color, only the intrinsic brilliancy is very low. Very large tube surfaces must therefore be used for illumination, of a magnitude probably a hundred times as large as with the mercury arc, which latter is already recognized as a luminous source of low intrinsic brilliancy. In the last years, even with a frequency of sixty cycles, good efficiencies seem to have been reached. I do not believe it possible, however, to approach the magnitude of efficiency as given by the mercury, calcium or titanium spectrum.

In the Geissler tube the current is carried by the gas or vapor which fills the space between the electrodes. The conduction is disruptive in character, or a spark discharge; that is, a minimum voltage is required. Below this voltage, no conduction takes place; above it the current passes, with the appearance of luminescence, and if the voltage falls below the minimum value required to start conduction, the current again ceases. The material of the electrodes has no direct effect, but the spectrum is that of the gas between the electrodes. The character of the current also seems to have no direct effect; alternating current passes at about the same voltage as direct current.

An entirely different set of phenomena is met in arc conduction. The electric arc makes its own conductor. That is, the current is carried across the gap between the electrodes by a vapor-bridge, produced by the current from the material of the negative electrode and maintained by the current as a high-velocity vapor-stream issuing from the negative toward the positive, and more or less surrounding the positive terminal. The spectrum of the arc, therefore, is that of the negative terminal, but independent of the gas or vapor filling the space around it, or of the material of the positive terminal, except indirectly by the effect of heat, etc.

The continuous production of the vapor-stream requires power in raising the negative material to the boiling point, evaporating it, and producing its rectilinear velocity. This power must be supplied by the electric circuit, as the potential drop at the arc terminals, independent of the length of the arc, and of the current—if the volume of the vapor-stream is assumed as proportional to the current, which seems to be the case. This potential, drop, e_0, may be called the counter-electromotive force of the arc.

The temperature of the arc-stream, at constant pressure in the surrounding space, must be constant, that of the boiling point of the material of the negative terminal. The power radiated per unit surface may, therefore, be also assumed as constant, and the total power radiated, and therefore the power consumed in the arc-stream, as proportional to its surface; that is, to the product of length by diameter. Since the section of the arc-stream can be assumed as proportional to the current, it follows that the voltage consumed by the arc-stream is inversely proportional to the square root of the current, and approximately proportional to the arc-length, or, when allowing for the abstraction of energy from the arc-stream by the terminals, proportional to the arc-length plus a small constant quantity.

This gives the theoretical volt-ampere equation of the arc:

$$e = e_0 + \frac{a(l + c)}{\sqrt{i}}$$

Giving the arc-length l in inches, numerical values of this equation are:

Carbon Arc—

$$e_0 = 36 + \frac{130\ (1 + 0.33)}{\sqrt{i}}$$

Magnetite Arc—

$$e_0 = 30 + \frac{123\ (1 + 0.05)}{\sqrt{i}}$$

With zinc or cadmium the counter-electromotive force of the arc is:

$e_0 = 16$ volts: with mercury, $e_0 = 13$ volts.

These equations obviously apply to the arc at constant pressure, as an arc in air, in which the arc-section varies with the current. For an arc of constant section, in which therefore the pressure and the temperature vary with the current, as the mercury arc in a vacuum, by similar considerations an approximate volt-ampere characteristic is found. This is for the mercury arc:

$$e = 13 + \frac{1}{1.68\ d - 0.066\ i - \frac{1.3\ d^2}{l}}$$

with non-volatile positive terminal, and:

$$e = 13 + \frac{1}{1.68\ d - 0.114\ i - \frac{1.3\ d^2}{i}}$$

with mercury anode,[1]

where: l = arc-length,

d = arc-diameter, in inches.

From the character of arc conduction—that the current makes its own conductor—it follows that the arc must be started; that is, the vapor-bridge which carries the current must first be produced by the expenditure of energy before the current can flow. It also follows that the arc is a direct-current phenomenon, and in general can not exist with an alternating current. With an alternating electromotive force at the end of the half-wave, the current

[1] A paper presented at the two hundred and fourteenth meeting of the American Institute of Electrical Engineers, New York, November 23. Slightly condensed.

[1] The effect of the anode material on the arc characteristic is indirect. In the case of the mercury anode the heat produced at the anode causes evaporation, and increases the vapor pressure above that existing with a graphite or iron anode.

Digitized by Google

dies out and therefore also the vapor-stream; and the next half-wave, to pass in opposite direction, requires a vapor-stream moving in the opposite direction. This does not exist, and the current does not pass; but the arc dies out at the end of the half-wave, except if the supply voltage is sufficiently high to jump a spark across the terminals at every half-wave, through the residual vapor left by the preceding half-wave. An alternating arc, therefore, must be at every half-wave in the condition for starting by a spark. Stroboscopic photographs with metal arcs show this phenomenon: a sharply defined static spark at every half-wave, gradually spreading out to the more diffuse arc-flame and then dying out at the end of the half-wave, to start again by a spark at the next half-wave.

The voltage required to maintain the vapor-stream, that is, the voltage consumed by a direct-current arc, as discussed above, increases with increase of the arc-temperature; that is, increase of the boiling point of the terminal material. It is lowest for the mercury arc, highest for the carbon arc. For a one-half-inch arc it is shown approximately by Curve I in Fig. 2, with the temperature as abscissas. The voltage required to jump a spark across the gap between terminals, shown roughly by Curve II in Fig. 2,[1] decreases with increasing temperature, as is well known, and intersects Curve I at some temperature, A, probably somewhere between 2,500 degrees and 3,000 degrees centigrade. Above this temperature, the spark-voltage is below the arc-voltage, and a voltage sufficiently high to maintain an arc is therefore sufficiently high to start it again at each half-wave of alternating electromotive force. That is, materials as arc terminals, which have a boiling point above the temperature of intersection A of Fig. 2, maintain a steady alternating-current arc at about the same voltage as a direct-current arc; while materials with a lower boiling point than A require a higher voltage, usually very many times higher, to maintain an alternating, than a direct-current arc. It must be considered, however, that the temperature of the boiling point, while being the foremost factor, is not the only factor in determining the position of a material on Curves I and II, Fig. 2. Individual characteristics somewhat modify the position.

Where, therefore, spark-gap terminals are desired not to maintain an alternating arc, as for lightning-arrester cylinders, they are found on the lower range of the curve: mercury, cadmium, zinc, antimony, bismuth—the so-called "non-arcing metals. Where electrodes for alternating-current arc lighting are required, they are found at the upper end, above A. In this range belong carbon and most carbides, as those of calcium and titanium. Even carbon shows the phenomenon of restarting at every half-wave, by a high peak at the beginning of the electromotive-force wave, as shown first by Tobey and Walbridge, in a paper on alternating-current arc waves.[1] With increasing approach to A, this peak at the beginning of the electromotive force increases in height, and the power-factor of the circuit tends to decrease, by wave-shape distortion. Immediately below the intersection point A are found very refractory metals as tungsten, and metal oxides as those of titanium, etc.

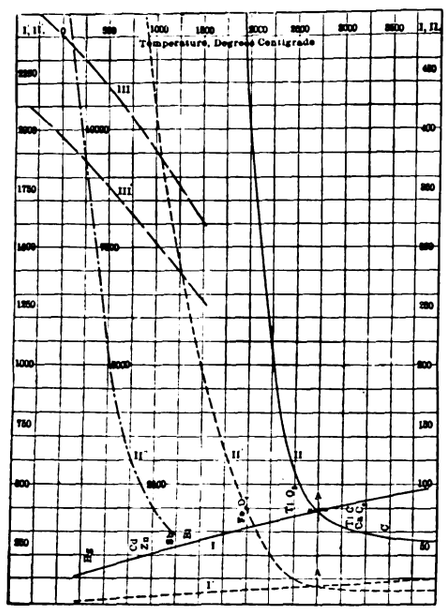


FIG. 2.—VOLTAGE REQUIRED TO MAINTAIN VAPOR-STREAM UNDER CHANGES OF TEMPERATURE.

The range of voltage between Curves I and II in Fig. 2 is the range in which rectification takes place. That is, by maintaining the vapor-stream issuing continuously from one terminal, by an outside source, or by the overlap of several arcs, the alternating electromotive force can pass a current in one direction only, and so is rectified. In this range the arc-stream is a unidirectional conductor, of very low resistance in one direction, of practically infinite resistance in the opposite direction.

The voltage range of rectification, then, is the highest at the lower end of the curve, and decreases gradually to zero at the point A. With the first members of the group, the upper limit of the rectification range is somewhat cut down by the disruptive strength of the air surrounding the arc-stream, being lower than that of the arc-stream, and so passing a static spark outside of the arc-stream, or, with a vacuum-tube arc, by a Geissler tube discharge through the residual gas. In the latter case the maximum voltage which can be rectified depends upon, and measures the perfection of evacuation. Such Geissler tube discharge curves are sketched roughly, in dotted lines, as III, III[1] in Fig. 2.

While vapors like mercury, zinc, etc., are very good conductors when in motion under the influence of the current, of a conductivity comparable with that of electrolytes; when not under the influence of the current they are almost perfect insulators, and so can be distinguished from the so-called "conducting gases," as hydrogen, air, etc., as "non-conducting vapors." Low-temperature metal vapors thus are non-conductors.

The spectrum of the arc is that of the negative material; its temperature that of the boiling point of the negative. There are, however, some apparent exceptions. For instance, the arc-stream can be superheated by using a high-frequency oscillating current of sufficiently high voltage to maintain an alternating arc, and a frequency so high that a sufficient vapor-stream can not be formed during the half-wave. In this case, groups of spectrum lines frequently become prominent, which are insignificant with saturated vapor; the mercury arc becomes bright red in color; the iron arc loses most of its brilliancy, but gives a great quantity of intense ultraviolet rays, etc. Likewise, the spectrum of the positive, or a constituent of the positive terminal can be made to appear in the arc.

The tip of the positive is heated to the temperature of the vapor-stream, in the carbon arc the temperature of boiling carbon. If the positive terminal consists of, or contains some material which boils below the temperature of the vapor-stream, then it will evaporate out of the positive, and may thus enter the arc-stream. For instance, in a carbon arc, or arc with carbon as negative, if a carbon is used as positive, impregnated with calcium fluoride or borate, which has a relatively low boiling point, then the calcium vapor enters the arc-stream and is thereby heated to the temperature of the carbon arc.

[1] This curve is only estimated, and so can make no claim to numerical accuracy. Curves I and II, the arc and the spark curve, are shown once more in ½ scale (left-side ordinates) in dotted lines, and the lower part of II once more, in ¼ scale, as II ″, in Fig. 2.

[1] Transactions A. I. E. E., 1890, vol. vii, p. 367.

Digitized by Google

It becomes luminescent, whether directly by heat, or indirectly by chemical dissociation, or otherwise, need not be considered here. So the efficiency of a carbon arc can be increased by feeding into the arc-flame the vapor of some material which gives a brilliant spectrum—as calcium, which gives a yellow light of very great brilliancy. It is fed into the arc by the positive terminal, because this is the hottest, and the efficiency depends entirely on the temperature of the positive. If the positive is very large, so as to keep cool and consumes slowly, the efficiency decreases, because it is produced only indirectly by material being evaporated from the positive and then as vapor entering the arc-stream. Therefore a high temperature and rapid consumption of the positive are necessary.

It is entirely different with the true luminous arc, which carries the light-giving material into the arc-flame by the electric current, as the vapor-blast, which carries the current. The carbon as negative material is objectionable, since it gives the non-luminous carbon arc. Iron appears to be a very suitable material, since it gives a spectrum extending over the whole visible range. It produces practically a white light. The positive can then be maintained cold without affecting the brilliancy or inefficiency of the arc. The negative can also be cooled without appreciable effect on the efficiency, since the current still produces the vapor-blast from it, and so the light. If cooled too much the voltage in the arc may rise a little, because it requires more energy to produce the iron vapor from the cool negative than from the hot negative, but still the efficiency is not much affected.

There are, then, two distinct ways of producing luminescence of the arc: first, directly by using some material as negative which gives a luminous spectrum; that is, a spectrum with many lines in the visible range, preferably covering this whole range, to get white light; secondly, indirectly by using some material to carry the current which gives a very high temperature to the arc-stream—which means practically carbon—and making the arc-stream luminous by feeding some light-giving substance into the arc from the positive terminal. In the former case the arc has the characteristic of the iron arc or titanium arc, whatever material is used; in the latter case it has the characteristic of the carbon arc.

Since the carbon arc is the steadiest arc, the most work has been done in the latter direction. The former method of feeding the luminescent material by the current from the negative material has the advantage, however, that the efficiency does not depend on the temperature of the electrodes: the rate of consumption of the negative electrode can thus be greatly decreased by maintaining it at low temperature; while the positive electrode, which takes no part in the arc conduction, can be made entirely non-consuming. This method seems to be a more direct conversion of electric power into light.

These two forms of arc have come into prominence recently: the flame-carbon arc and the metal compound arc; that is, an arc in which carbon is not used, but some other material which gives a luminous spectrum, as iron or titanium. In the former case the characteristics are those of the carbon arc. All the materials which can be used to increase the efficiency of the carbon arc—calcium compounds are used almost exclusively—deposit as solids after passing through the arc-flame, and therefore ventilation must be provided to carry off the smoke; that is, the arc must be a so-called "open" or "burning" arc. The life of the electrodes is about ten hours. Flame-carbon arcs therefore have short-life electrodes, though their efficiency is high. Again, efficiency has to be balanced against life, or decreased cost of power against increased cost of electrodes and attendance. Here in the States the short-burning arcs for street lighting have practically disappeared. Indoors the excessive brilliancy and the smoke are objectionable, so that the flame-carbon arc does not offer much prospect for general illumination.

More prospect of success appears to exist in the true luminous arc, an arc using as negative a material giving an efficient and brilliant spectrum. Such material should give lines uniformly distributed not only in the green or yellow, but over the whole visible range, and the material should not be attacked in air, even at high temperature. The arc must be an open arc, since the material deposits as solid, and to get electrodes with long life, a material is required which is stable at high temperature in the air.

There are very many metals which give luminous spectra, but those which give white are substantially the metals of the iron group only—iron, titanium, wolfram, etc.

Long-burning quality requires a material which is not affected, or only little affected, by the air. This, in general, excludes the metals, but requires a stable oxide or other fairly stable compound, as some carbides are. It should also be a conductor, since as arc electrode it has to carry the current. In the intermediate oxide of iron magnetite (Fe_3O_4) a material is found which is a good conductor, is stable at high temperatures as well as at low temperatures and gives a white spectrum. In such an electro-luminescent arc any stable material is suitable as a positive terminal. Copper is generally used because it is cheap, is stable at fairly high temperature, is a very good conductor of heat, and when heated by the arc carries the heat away with sufficient rapidity not to melt or oxidize appreciably. In all these arcs the vapor-stream from the negative is a necessity. In the mercury arc it is easiest of observation, because the arc is enclosed in a glass tube.

The amount of vapor produced by the current from the negative is usually many times greater than necessary to carry the current, and most of it can be condensed without any appreciable change in the arc-stream. So also magnetite consumes at a much greater rate than is necessary, of an order of one-quarter gramme per ampere-hour. This rate of evaporation is greatly reduced by the addition of small quantities of a material which is chemically not much different from magnetite, but is much more refractory; so that at the temperature where the magnetite melts this material is still solid and forms a kind of sponge in which the melted magnetite is held and its consumption greatly retarded.

Magnetite, however, while a good conductor of the arc-stream, is not very efficient as a producer of light, and added thereto are other materials which give a very high efficiency, as titanium compounds.

In the magnetite arc—as used at present, that is, in which the magnetite electrode contains titanium oxide, etc.—magnetite is essentially the carrier of the arc conduction, just as carbon in the yellow-flame arc; titanium with its highly efficient white spectrum takes in the magnetite arc the same place as calcium in the flame arc, as light-giving substance, but titanium is carried into the arc-stream by the current from the negative, while calcium in the flame arc enters by evaporation from the positive.

The elimination of carbon in the magnetite arc excludes combustion, and this increases the life of electrodes to about twenty times that of carbon electrodes un-

Digitized by Google

der the same conditions; but just as with the carbon arc, the efficiency of the magnetite arc can be varied over a wide range, with a corresponding variation of life in opposite direction. That is, by sacrificing some efficiency the life can be greatly increased, or the efficiency can be increased by somewhat reducing the life, by increasing the percentage of light-giving material—usually titanium oxide in the magnetite arc, calcium fluoride or borate in the flame-carbon arc. In either case, a very high percentage of the light-giving material tends to the formation of a non-conducting slag at the electrode surface, and if the highest possible efficiencies are desired—one-quarter watt per candle-power, and better—the effect of the non-conducting or poorly conducting electrode surface has to be eliminated by starting the arc from the side of the electrode, or some other method.

Magnetite, titanium oxide, and most metals or their compounds are on curve Fig. 2 below the intersection point *A*; that is, do not maintain a steady alternating arc. For alternating arcs, therefore, one of the materials is required which is above point *A* in Fig. 2. In this range there are carbon, carbides and similar compounds.

Thus the titanium arc with alternating current can not use magnetite as carrier, and titanium oxide as light-giving material: but titanium carbide is used as arc conductor. It obviously is not so incombustible as the oxide, but still so much more stable than carbon as to be well within the range of long-burning arcs.

To conclude, then, in the luminous arc, we seem to have the first instance of a commercial application of a direct conversion of electric power into light, without heat as intermediary form of energy. It is not limited to very low values of efficiency. But so far it seems that only the green-mercury spectrum, the yellow-calcium spectrum and the white-titanium spectrum offer an efficiency so vastly superior to that of incandescent solids, that as regards the efficiency of light production no possible improvement in incandescent lighting could hope to approach it. Typical of these three most efficient spectra are the mercury-arc lamp, of practically infinite life and bluish-green color of light: the yellow-flame carbon arc of the short life of the open arc lamp of old; and the white-titanium carbide or magnetite arc, of a life equal to or greater than that of the enclosed-carbon arc.

Electrical Equipment for Iron Mines.

The new power plant which Witherbee, Sherman & Company are erecting on the Lake Champlain shore at Port Henry, N. Y., furnishes an interesting example of the growth of electricity in mining. It is not generally known that the lower Champlain Lake region produces a goodly proportion of the United States annual supply of iron ore. The various shafts of this company alone yield from 500,000 to 600,000 tons of iron ore yearly, while with the new electrical equipment the ultimate output will be 1,000,000 tons.

Owing to the fact that the principal shafts of the mines are scattered over a considerable area, electricity has been found to be the most flexible form of power transmission and is almost universally used. Power for this purpose is generated at present both by water and steam. At Mineville there is a steam plant with a 750-kilowatt, engine-driven generator which supplies current at 3,300 volts for local distribution. This power is supplemented by two small water power plants; a 300-kilowatt, water-wheel-driven generator unit is located at Wadham's Mills, and a 370-kilowatt unit at Kingdom, about eight miles from this point. At Wadham's Mills, a Morgan-Smith water turbine is used, operating under a forty-eight-foot head. Power at the Kingdom plant is furnished by a Pelton impulse wheel under a head of 290 feet, water being carried through a thirty-two-inch pipe, a distance of one and one-eighth miles from the reservoir. These stations are situated about eleven miles from Mineville and deliver current at Mineville at a potential of 6,000 volts. This voltage, made desirable because of the saving in transmission, is stepped down to 3,300 at Mineville and is used in conjunction with the 750-kilowatt, 3,300-volt, steam-driven machine to supply power at the various shafts. Induction motors are used for driving hoists, pumps, air compressors, etc., operated at twenty-five cycles and 440 volts.

The power-house which is being built at Port Henry is some six miles from the mines, and will be interconnected with the other sources to supply the increasing demand for power. The station is to be thoroughly modern, being built of monolithic reenforced concrete. Not only the building but the stack will be constructed of this material. "Iron Clad" Portland cement, manufactured by the Glens Falls Portland Cement Company, will be used, mixed with tailings from the mines. Fireproof construction will be employed throughout and the station is to be a typical example of the use of this building material.

The structure is planned after the Roman style of architecture and is of pleasing design. The main building containing the boilers is 116 feet by fifty-four feet, while the turbine generator room measures thirty-nine by fifty-nine feet and extends at right angles from the centre of the main structure.

Steam will be generated by four 500-horse-power Babcock & Wilcox boilers, arranged in pairs on either side of a 175-foot stack which occupies about the centre of the power-house. There is space for two more boilers of the same capacity, one at the side of each pair.

The boilers are hand fired, and coal is conveyed to each by a car on a track running the length of the building. This car is filled from an overhead hopper through a hinged chute. The hopper is filled by a vertical bucket conveyer which carries the coal from a pit filled directly from cars outside the building.

The generating equipment comprises an 800-kilowatt Curtis steam turbine-generator which will deliver current directly to the line at a potential of 6,600 volts and twenty-five cycles. The compactness of the vertical unit has permitted a remarkably economical disposition of machinery in the generating room. Space is left for the installation of a second turbine which will probably be installed at once.

The switchboard is located in a gallery with a reenforced concrete floor. On this floor is placed also the motor-driven exciter sets, and space is available for two frequency-changer lighting sets. A supplementary exciting unit is provided by a twenty-five-kilowatt horizontal Curtis steam turbine-generator. The entire electrical equipment for this power-house will be furnished by the General Electric Company.

The Question Box of the National Electric Light Association.

Paul Lüpke, Trenton, N. J., editor of the question box of the National Electric Light Association for 1907, has issued a list of headings and a data sheet to members of the association. It is earnestly requested by Mr. Lüpke that complete lists of questions be filed at once, so that the question box for 1907 may be as comprehensive and as valuable as those of former years. Mr. Lüpke is working hard to make this question box a complete success, and expects the cooperation of every one interested in this important part of the association's convention work.

Digitized by Google

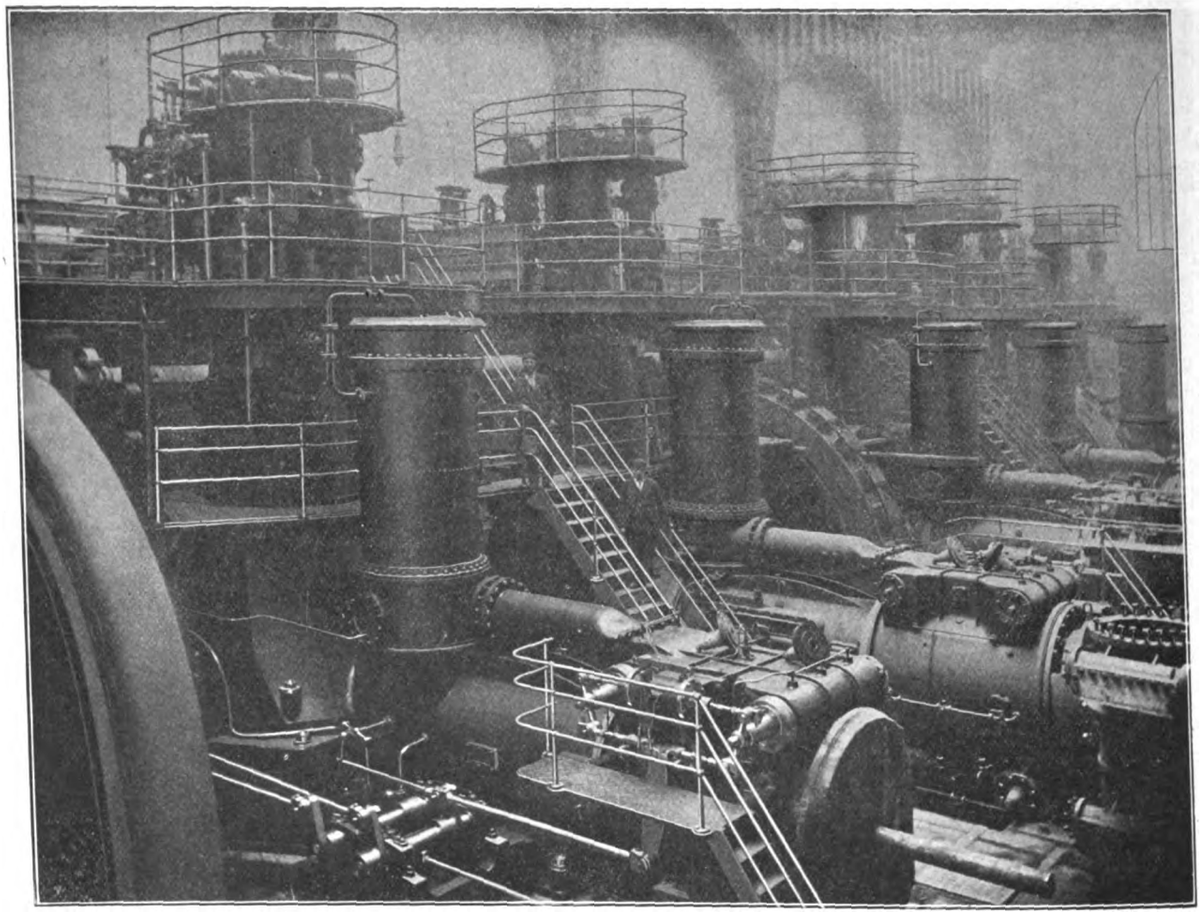
The Greenwich Power Station of the London County Council.

By Albert H. Bridge.

WHEN it was resolved in the year 1899 that the street tramways of London should be converted from horse to electrical operation on the underground conduit system, it was only possible—for reasons into which we need not now enter—to proceed straight away with the lines in that part of the London County Council area south of the Thames. The northern lines have had to continue the use of horse cars for some years longer; indeed, at this moment the electrification of many of these on the conduit system is in course of carrying out, while others are to have the overhead trolley, if matters can be satisfactorily arranged with the local authorities. Some of these have been educated up to expecting the costly conduit construction, and the avoidance of overhead wires, because that class of construction has been considered necessary for the large amount of conversion work already completed in more central and congested districts.

The council is now operating 106 route-miles of street tramway nearly all with conduit, but there are many new lines planned, as well as those already referred to as being now reconstructing.

The first electrically converted section was that between Westminster and Tooting, and it was opened for traffic in May, 1903, but at that time the great generating station, which was erecting at East Greenwich expressly for the tramway power supply, was in a very incomplete condition, so that it was necessary for temporary arrangements to be made with the electric light and power companies that were already operating in the area, to furnish the council with the necessary energy under special contract rates and conditions. At one station, for instance, the council installed some generating sets and took steam for driving them from the company, but at others electrical energy was bought to the tune of a good many million units per annum. It was only by entering into such arrangements as these that the council was able to prevent delay in electrically operating the converted system; but the arrangements, while convenient for the council, were very acceptable indeed to the companies, notwithstanding the low charge per unit, for it has turned out to be just the thing to help them on to their legs. From their works the energy was transmitted to a number of conveniently located substations for conversion to a 550-volt, direct-current service for distribution to the various sections of the line.

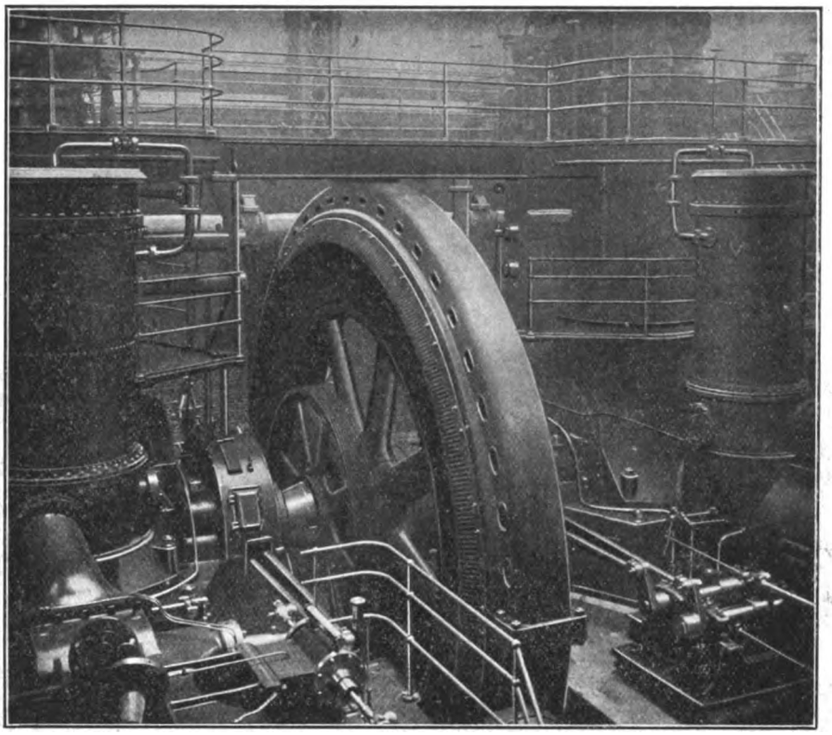


General View of Greenwich Station of the London County Council.

It was not until May of this year that the first section of the Greenwich power station was able to be opened. Its 14,000 kilowatts capacity, however, is quite inadequate for operating the lines already converted, therefore the contracts with the supply companies have not been concluded; they are still responsible for a good deal of the needed power, and according to their own statements they will be fur-

Digitized by Google

nishing the council with a great deal of energy for three years to come, and perhaps after that date too.



ONE OF THE ALTERNATORS IN THE GREENWICH STATION OF THE LONDON COUNTY COUNCIL.

For the present section reciprocating steam engines have been adopted, but for the next section, for which the buildings are now in course of construction, turbo-generators aggregating 20,000 kilowatts (four of 5,000 kilowatts each) are to be installed. According to present hopes this section will be completed in the year 1908.

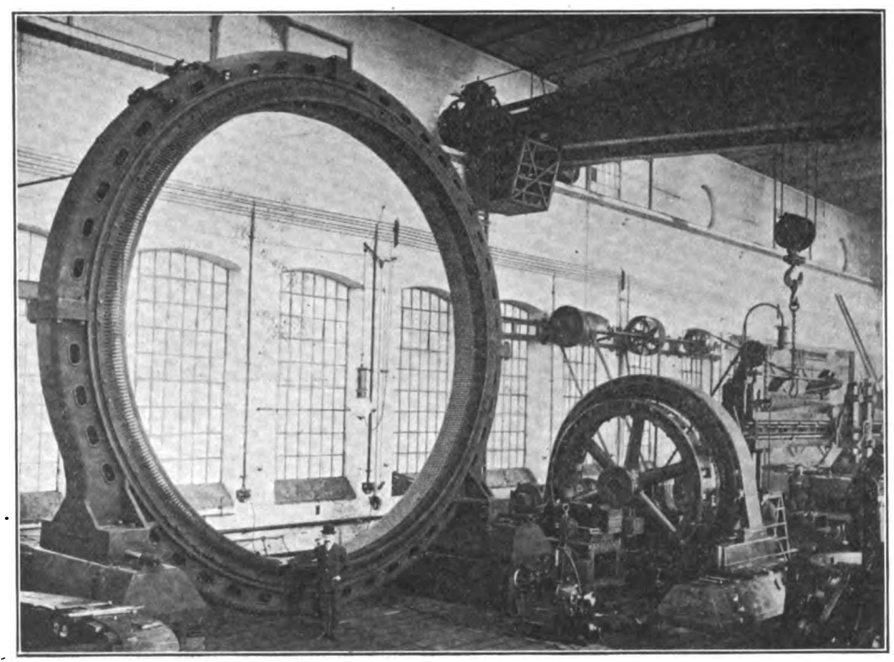
In view of the magnitude of the system and the very wide area covered by the tramways the council's engineering experts had to devote special care to the proper location of the power station or stations. A proposed site at Camberwell, central to the area, but devoid of feed and condensing water facilities, had to be abandoned in favor of the one on which the station now stands at Greenwich, and which has a fine river frontage with consequent ample coaling and water facilities.

As originally planned, the Greenwich works were to contain plant aggregating 40,000 horse-power, but the position of affairs has undergone considerable change since then by the introduction of the London power supply question, with the accompanying ambition of the council to be the controlling authority for such supply as well as for the tramways. What may eventually happen at Greenwich it would be unwise to attempt to conjecture at the present moment, not only on account of the uncertainty of the power supply outlook—with the possibility of Parliament next year authorizing the council to be London's chief power supplier—but also because of the fact that the operation of the plant has raised the wrath of the Greenwich Observatory authorities by reason of its interference with the world-wide important work of that institution. This subject is just now undergoing complete investigation at the hands of Admiralty and other expert representatives of great scientific and engineering eminence, with a view to finding the exact nature and extent of the trouble, and seeing whether and how it can be modified or overcome. We remember that, at the recent meeting of the British Association when the balancing of engines was receiving attention, Dr. J. A. Ewing, one of the experts in question, remarked that if a specialist in steam-engine balancing had been consulted some time ago concerning the running of the Greenwich engines, the present difficulty might not have arisen.

The council has a second big site in mind for another station—at Battersea, higher up the Thames—where works may eventually be erected, but this is a connection with its power supply scheme. In the course of the evidence given early in this year before the Parliamentary Committee the council's electrical engineer, J. H. Rider, who designed the Greenwich station, spoke of a proposed station there which would contain eight 10,000-kilowatt machines.

We will now briefly state the particulars of the Greenwich plant:

Fuel is brought from steamers on the Thames to a specially constructed pier, where electric cranes with twenty-five-hundredweight grabs unload it; thence it is conveyed by trucks to a 2,000-ton steel bunker and from this point by gravity bucket conveyers it is carried, at the rate of forty tons per hour, to the bunkers above the boilers for feeding through



ONE OF THE GREENWICH THREE-PHASE, 6,600-VOLT, ELECTRIC CONSTRUCTION COMPANY'S ALTERNATORS IN COURSE OF MANUFACTURE.

Digitized by Google

hoppers. This conveyer also serves for clearing away the ashes.

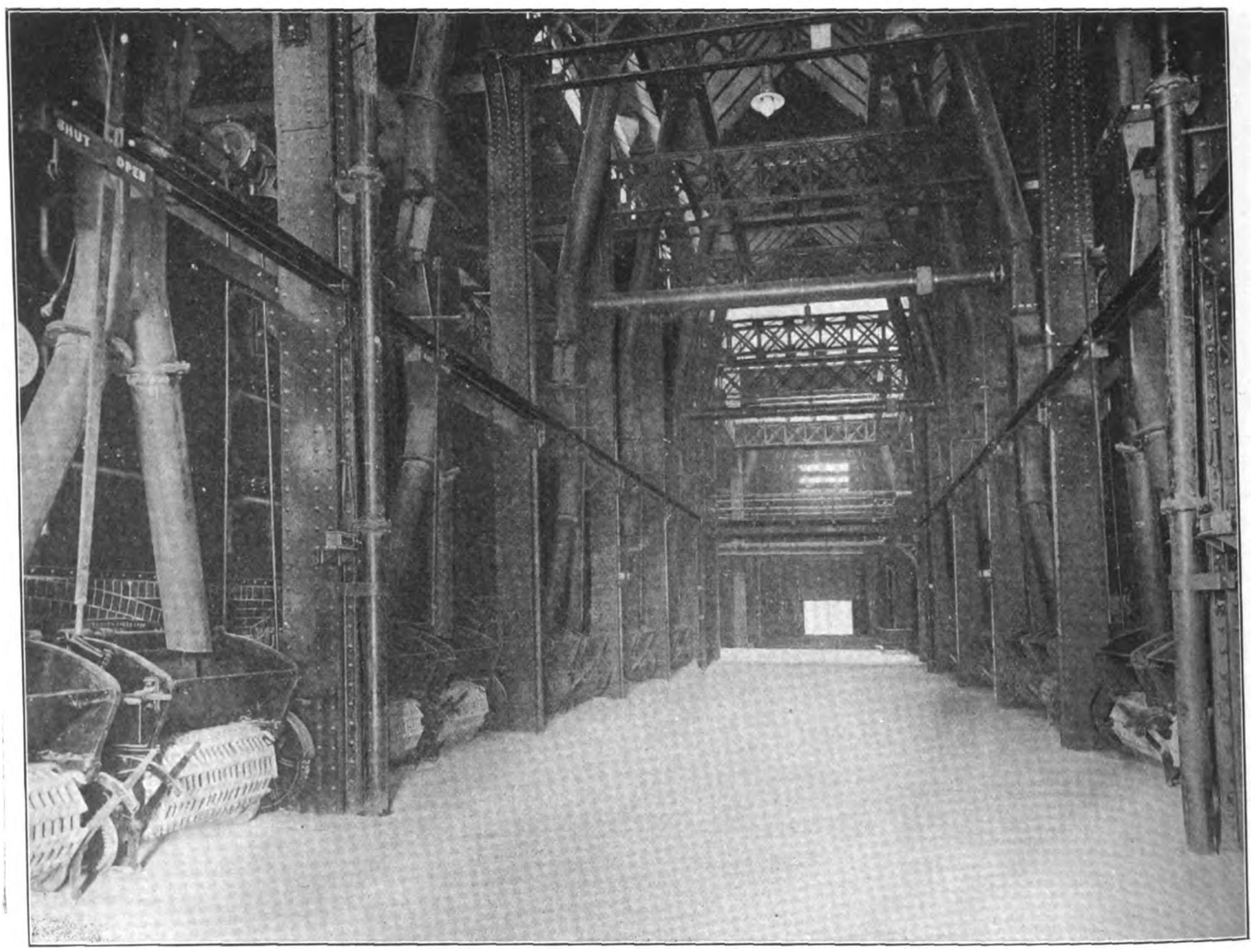
The boiler house equipment comprises at present twenty-four water-tube boilers of the Stirling five-drum type arranged in pairs, with twelve boilers on each side of the firing floor, as shown in one of the accompanying illustrations. Each boiler has a heating surface of 3,650 square feet and is capable of evaporating 15,000 pounds of water per hour; each is fitted with two Stirling chain-grate stokers giving sixty square feet grate area, and a superheater capable of imparting 150 degrees Fahrenheit superheat to the steam.

We suppose that there are few power stations regarding whose equipment there has been so much controversy. When the design was originally undertaken the steam turbine had not shown its good qualities sufficiently convincingly to lead the council's advisers to adopt it. That being so the first instalment of the station steam plant consists of four twin vertical horizontal Corliss steam engines each to develop a normal indicated horse-power of 5,000 and a maximum indicated horse-power of 7,500 with a boiler pressure of 180 pounds. There are two complete compound engines for each set, one on either side of an Electrical Construction Company's three-phase alternator. The vertical, high-pressure cylinders are thirty-two and one-half inches in diameter, the low-pressure cylinders being sixty-six inches in diameter, and the stroke four feet. The engines were made for running at ninety-four revolutions per minute, and they each have a separate surface condensing plant situated in the station basement. There are Edwards three-throw air pumps (sixteen inches diameter, fourteen inches stroke, running at 110 revolutions per minute), and the surface condensers each contain 2,080 tubes.

The alternators, which were made by the Electric Construction Company, Limited, of Wolverhampton, each have an output of 3,200 kilovolt-amperes with a power factor of ninety-four per cent at 6,600 volts when running at ninety-four revolutions per minute, three-phase, twenty-five periods. They are capable of giving an overload of twenty-five per cent for two hours. The field-magnet system is constructed directly upon the rim of the engine flywheel in which the amount of stored energy when revolving at normal speed is 10,000 foot-tons. The stators are star wound with the neutral point earthed.

There are 125-volt rope-driven exciter sets provided for each alternator, and there are also two auxiliary steam-driven direct-current sets of 150 kilowatts each which serve various purposes about the station. The main engines are electrically controlled from the switch-operating gallery, each being provided with electrically operated barring gear.

The switchgear which is placed on two galleries on the side of the station opposite the boiler house is of the British Westinghouse oil-break, remote control, electrically operated type. It provides for eight generators and thirty-two feeders and each machine is directly coupled to four feeders and through isolated switches



THE BOILER HOUSE AT THE GREENWICH POWER STATION.

Digitized by Google

to the main bus-bars. On the top gallery are oil switches of Westinghouse type encased in brick, while on the lower gallery is placed the operating switchgear. The feeders are led out from the station through two tunnels—one taking the cables for the supply needed in the north of London, and the other the cables for the south.

The tramway section in the immediate vicinity of the Greenwich power station is served from a substation by the side of the main station; this substation has a number of 500-kilowatt induction-motor generators (by Dick, Kerr & Company, Limited) which transform and convert the 6,600-volt, three-phase current to the requisite 550-volt, direct current, and it further has a Tudor battery. There are other substations located at many different points in the area.

We ought perhaps to mention that one of the principal pieces of the council's tramway construction work that is now in hand is the laying of conduit lines along the Thames embankment. It has taken years to get Parliament to give a right of way for trams along the embankments and across Westminster Bridge, but the thing went through early this year and no time is being lost in carrying out the change. It is announced in connection with this section, that an arrangement has been entered into with the London Underground Electric Railways Company for a supply of power for six months from the commencement of the supply.

Southern Power Company Lets Contract for Extensive Equipment.

The Southern Power Company has contracted with the Westinghouse Electric and Manufacturing Company for $400,000 worth of electrical machinery. The order includes twelve 3,000-kilowatt generators and eighteen 2,000-kilowatt transformers, with switchboards and exciters. This machinery is for the equipment of the two new stations at Rocky Creek, near Great Falls, and at the Ninety-nine Islands, near Gaffney, S. C. Work at both places has already begun.

Cuts Off Free Telegrams.

Clarence H. Mackay, president of the Postal Telegraph-Cable Company, has announced that the board of directors of that company has adopted a resolution to the effect that owing to changed conditions it has been found necessary to stop all free transmission of messages after January 1, 1907.

INDOOR ILLUMINANTS.[1]

BY JAMES SWINBURNE.

It is very difficult to make any useful comparison of the costs of various illuminants, as each has special advantages and drawbacks. Thus, in comparing costs of gas and electric light, you fall foul of the fanatics, or, at any rate, keen partisans of each light, and both try to quarrel with you. It is not possible to get a fair comparison. In the old days we used to compare the electric lamp giving about a third of a candle per watt with a flat-flame burner giving two candles per cubic foot, and it was usual to assume that the gas was left on longer through carelessness and difficulties of lighting. Now it is more usual to compare the electric lamp giving about a quarter of a candle per watt and lasting a short time with incandescent mantles giving twenty candles per cubic foot and lasting forever. Now, the fact is that the average electric incandescent lamp in use in this country was badly graded to start with, and has been run until it is black. Its bulb is also dirty, and it is inside a dirty shade, which cuts off a large percentage of any light that has been fortunate enough to get so far. The incandescent mantle, on the other hand, may have been capable of giving twenty candles per cubic foot to begin with, and it has gone down considerably, and it is on a burner with the gas pressure wrong, and part of the mantle has tumbled off, and the jets and burner are partially choked. It is enclosed in a chimney which has an opaque white deposit on it, and a black deposit of dirt outside, and that is again in an outer glass which is opalescent or colored, and is also dirty. The whole arrangement probably casts a shade just where the light is wanted. It is not easy to make any comparison between such sources of light; but allowing for all inaccuracy, the incandescent mantle must come out far ahead of the carbon incandescent lamp. But there are many other questions. One of the most important is the size of the lamp. The electric lamp most used is eight candles now, and it is no use comparing this with a sixty-candle gas lamp. The cost per candle-power in payment to the supply company is not difficult to get out.

An interesting diagram, prepared by Mr. Claypoole, gives a great deal of information in a graphic form. It tells you how many candle-power-hours you can get for a shilling from various illuminants. Taking the top figure, the price per unit is given up and down, and the candle-power-hours horizontally. Thus, if electrical energy is at five pence per unit, a carbon filament will give you, roughly, 500 candle-power-hours (say ten candles for fifty hours) for one shilling paid to the supply company. If the electrical energy is three pence per unit, as at the bottom of the diagram, a shilling's worth of energy will give you 2,000 candle-hours with a metallic-filament lamp, say twenty candles for 100 hours; or with a mercury-vapor lamp you can get 8,000 candle-hours, or, say, 100 candles for eighty hours. A flame arc at four pence per unit, again, gives 10,500 candle-hours for one shilling, or, say, 1,050 candles for ten hours. Turning to the gas diagram below, you find that if gas is at, say, one shilling six pence, a flat-flame burner gives about 1,400 candle-hours for one shilling, and so on. The incandescent burner, however, gives over 3,000 candle-hours for one shilling at four shillings six pence—that is to say, on the top line. This might be, for example, sixty candles for fifty hours. At three shillings six pence it gives about 4,000, and so on, the horizontal distance being the candle-hours for one shilling, and the scale of prices of gas. Oil lamps have been taken for one price of oil only—eight pence a gallon—and acetylene with carbide at six pence per pound. These figures take no account of the costs of renewals of electric lamps or mantles, or of trimming and providing globes for arc lamps. It, therefore, does not really give a comparison of the costs. Moreover, the lamps and mantles are taken as new. All the same, the figures are very instructive. It will be seen that oil lamps are much cheaper than either ordinary electric carbon lamps or gas with ordinary burners, and acetylene is astonishingly cheap.

Each illuminant has, however, its own special advantages and drawbacks. Though most of them are obvious, it may do no harm to run over some of them, merely to bring them to mind. To begin with the humblest, the common candle has many points in its favor. I think it was Sir William Crookes who remarked that if the candle had not been known, and some one invented it now; we would have long newspaper articles about the wonderful new light. The new light is portable, so that it can be carried about without needing any flexible wire or troublesome rubber tube; it carries its own store of energy; it is devoid of all complicated mechanism, and never gets out of order or breaks

[1] Excerpt from a paper read before the Association of Engineers-in-Charge of Great Britain, November 14.

Digitized by Google

down; it is cheap and can be easily replaced; it needs no recharging; its light is steady and it gives no smoke; it does not require cleaning; when out of use it can be carried and stored away in any position; though the price per 1,000 candle-hours is not so low as that of some other illuminants, it is so portable and can be placed in such convenient positions for reading, writing and sewing, that that drawback is not felt; and finally it can be lighted at a moment's notice with a match, and be extinguished at will. The petroleum lamp has a good many advantages. It is cheap and very portable, and requires no installation. Its chief drawbacks are that it is dangerous, and takes a good deal of attention, and generally smells. The smell is not inherent in the lamp, and is due to bad trimming. It is, of course, known that in a large establishment where the lamps are looked after by men they are all right; but in ordinary houses they are in the hands of women, and women seem unable to manage paraffine lamps. Another drawback is that they do not throw the light down well, and a shade or reflector is necessary. The petroleum lamp, however, will hardly interest this society any more than the candle, for it is essentially the light for small private houses, or for those in the country.

By far the most important illuminants from this society's point of view are gas and the electric light. As far as cost of gas and electric energy go, it is not difficult to compare the rivals, but it is much more difficult to compare the cost per candle-hour, including lamps and mantles and incidental expenses. As I have already pointed out, the cost per candle-hour is not everything; the most important considerations are between the burner and the eye. We need hardly consider the ordinary flat-flame burner now, though it is still very generally used, because the society is probably interested almost entirely in new, or at any rate modern buildings, which are not lighted with bat's-wing burners. In the same way we might almost put the carbon lamp on one side, because it appears to be doomed, as the metal wire lamps seem bound to push it out of existence as soon as they can be made in large enough quantities, and, what is more important, as soon as the public gets into the habit of asking for them. The metal lamps are far more efficient than the carbon, but they have some special drawbacks of their own. Some do not work well on alternating circuits. The makers are of the opinion that this is due to the mechanical vibration set up by the electromagnetic repulsion between neighboring stretches of the fine wire. This is a difficulty that exists in some lamps only, and will most likely soon be overcome. The other and very serious difficulty is that it is apparently impossible to make small lamps for reasonably high pressures.

One of the great advantages the carbon lamp had over the mantle was that it could be made very much smaller without loss of efficiency. If you only wanted three candles to light a passage, for instance, it was no use having a fifty-candle gas lamp unless the fifty candles cost as little as the three-candle electric lamp. Again, in lighting a large room a number of small lamps is better than a few large burners. But in cases where the question of small lamps does not come up the mantle seems to be much more economical. It is remarkable that though the Welsbach Company introduced small mantle burners, taking gas in proportion, they do not seem to have taken. It is, therefore, not a fair comparison to put the small electric lamp against the mantle, and then to claim in favor of the incandescent lamp that it alone can be made small. The fact is that people who buy mantles do not seem to want small lamps. It has always seemed to me that we are rather apt to give a consumer too much credit for economy and foresight, and to suppose he makes estimates of the relative advantages of gas and electric light. I am inclined to think the average consumer never troubles about such matters at all. If he has gas in the house he wants more light, and so he puts in mantles, and he never compares his accounts to see whether he is paying more or less, and he has no ideas at all on the subject of relative prices per candle-power. If his servants are careless about the mantles, he blames the mantles and has them taken out again; if the gas company looks after them for him he is quite satisfied, unless his wife objects to the color of the light. His wife can now have yellow-light mantles.

Another man will have electric light because it is the fashion or because the builder has wired his house for him. He begins by using new lamps, and at first always turns the lights out whenever he leaves the room for a moment. But after a year or two he uses blackened lamps and burns his lamps carelessly, and his quarterly account increases continually for the same number of lamps, and he never notices it. This is not the fault of the electric light, but the electric light is not very well treated by its friends.

It is thus impossible to get any sort of clear idea as to the relative prices of lighting by electricity and gas. Broadly, we may say that gas lighting with mantles is very much cheaper than any form of indoor electric light, except the mercury lamp. There are other questions, however. One is that of health. Gas uses up the air. This is a matter of great importance, especially in towns.

There is another consideration as well as that of light, and that is the convenience of gas and electric supply for other purposes, such as power and heating. For distribution of power in small quantities, of course, the electric motor is supreme, though for what would be large powers in domestic use the gas-engine comes in. In heating neither would appear to have a chance against coal, but gas has many very great advantages. It can be turned on just when wanted, and it is clean and needs no attention, and no fires have to be laid or grates cleared up and polished. Just as gas heating can replace fires, electric heating can in some cases replace gas. One can not help feeling that this is largely the fault of the gas engineer. I would suggest with diffidence, as I am not a specialist in gas stoves, that there are a few fundamentally wrong principles adopted. It seems to have been the idea of the original makers of gas fires that a Bunsen burner got more heat out of the gas than the ordinary flame; and the result is that most heating and cooking stoves have Bunsen burners. The reason why Bunsens are used in a laboratory is that bodies such as glass vessels can be put in the flame without being smoked, but it does not follow that the combustion is complete because there is no smoke. Though a Bunsen may burn perfectly alone, if you put a kettle on it seems at once to have the combustion checked and to give off bad gases—probably carbon monoxide. A Bunsen burner on the floor of a room to boil a tea-kettle will thus make it unfit to sit in in a few minutes. Now nearly all the boiling burners on a cooking stove are of the Bunsen type. If they are on the top of the kitchen range so that the fumes go up the chimney that does not matter; but a gas stove is generally not in an open chimney, and the fumes go out into the room. Nine-tenths of the heating stoves for living rooms have Bunsen burners whose flames are choked with asbestos or iron radiators. The fumes then escape partly into the room even where there is no down draught in the chimney. Any one who values his health should never use a Bunsen flame gas stove without making sure that no Bunsen

Digitized by Google

fumes come into the room. There are gas stoves for living rooms with luminous flames and perfect combustion, but they are very uncommon. The gas stove might learn something from the electric stove. The object of a stove is not to heat the air that is in contact with it, but to radiate heat. If the heat is given to the air in contact with the flame and stove, most of it goes up the chimney and is wasted. The rest heats the air, which makes a current of hot air to the ceiling and a cold current along the floor. This is again of no use. Yet most gas stoves are constructed so as to give every facility for heating the air—a very bad way of heating a room. The electric stove radiates most of its heat, and thus gives it just where wanted, and is, therefore, useful in spite of its ridiculously low efficiency. The gas stove, on the other hand, is not made with any intelligent comprehension of radiation. If it were, the radiating portion would be as hot as possible, and the gas stove would most likely become a set of Bunsen burners keeping a row of mantles at a luminous temperature. The hotter the radiator the more it radiates and the less loss by convection. There would then be complete combustion, too.

Gas and electric light are by no means the only kinds of illuminant that concern us. In many cases acetylene is especially suitable. Acetylene does not seem to have been as successful as it deserves. Everything new has a strong prejudice against it, and people have some false idea that acetylene involves promiscuous explosions in the back premises. Acetylene is cheap taken in candle-hours per shilling's worth of carbide, but, of course, the generator needs attention, and the foul lime has to be got rid of somehow. In places where there is neither electric nor gas supply there is a great opening for acetylene, and it will probably increase as prejudice is transferred to something newer. Carburetted air gas is another claimant for favor. The idea of carburetted gas is old, but it has never been successful. According to the inventors of the latest system, that is because people used to saturate the air with a view to getting an illuminating flame, and the air used to vary in percentage of hydrocarbon, and used to deposit fluid in the pipes. In the "National Air-Gas" system the air takes up about one-half per cent of hydrocarbon and it is used for the incandescent mantle. The company claims that with cheap petroleum at eight pence a gallon its system gives 1,000 candle-hours for one-half pence, or 24,000 candle-hours for one shilling. This would be less than half the price of the light of the flame arc. I have no knowledge of this system myself. I have merely taken these figures as given to me; but they are good enough to warrant our giving this system very careful attention.

Electric Power in France.

Consul Chapman Coleman, of Roubaix, shows the tendency in France toward the utilization of electricity for industrial purposes, which can now be obtained at reasonable prices, running as low and lower than one cent per horse-power per hour. Mr. Coleman writes:

"In connection with an industrial exposition recently held in the neighboring city of Tourcoing, several French authorities in electrical science have delivered instructive lectures on the more extended use of electrical energy in industrial establishments in France. While its industrial use in this region is yet limited, its contemplated larger employment in a section of France teeming with factories whose enormous varied productions, of which a considerable amount is exported to the United States, can not but be regarded with great interest in view of the increase in that output to be expected from a greatly extended application of the more economic method of manufacture by means of electrical energy.

"This Department of the North, with an area of 2,205 square miles and a population of about 2,000,000, exported to the world in the calendar year 1905 products of the value of about $88,000,000 and to the United States of about $2,500,000.

"The local press says that the putting in full operation of certain great stations, already established or in process of construction, for the development of electrical energy and its transmission to manufacturing enterprises, together with further anticipated activity in this direction, will soon bring about a veritable revolution in the industries of this region. The success, notwithstanding the relatively high prices demanded, recently achieved by the 'Société Lillois d'Eclairage Electrique,' through the increased capacity of their plant, which has greatly stimulated competition in this domain, has led to the establishment in the city of Lille or its environs of four further plants of large capacity for the production of electrical energy. The latest is a plant of 25,000 horse-power about to be constructed at Marquette.

"It is also reported that a fifth enterprise will obtain the supply of electrical energy needed for its customers from certain mining companies of the Department of the Pas-de-Calais.

"While it will not be practicable to make general competitive price comparisons, an idea of relative cost may be formed from a comparison of proposed prices for electrical energy in the annexed table with the cost of prices given in the following examples of motive power generated by the ordinary means of steam and gas: (1) For an industry whose continually varying needs are from twenty-five to 100 horse-power, the industry considered being a printing establishment, the cost price per kilowatt-hour is per machine 0.19 franc; (2) for an industry constantly requiring 100 horse-power, the industry considered being a spinning mill, the cost price per kilowatt-hour per spinning frame is 0.146 franc (franc = 19.3 cents).

"The new electric companies have established price schedules, the figures being essentially the same for all. These are based upon a progressive decrease in cost, beginning with a charge of 0.20 franc per kilowatt-hour for a smaller horse-power and lowered to a charge of 0.05 franc and less per kilowatt-hour for subscribers for five horse-power or more, utilized during a stated number of hours.

"The prices given in the following table are stated by the companies on the basis of the reckoning that the hours of utilization are equal to the kilowatt-hours consumed, divided by the kilowatt-hours installed:"

POWER INSTALLED IN KILOWATTS.	PRICE IN FRANCS PER KILOWATT-HOUR.			
	For the first 1,000 hours of utilization.	For the 1,500 hours following.	For the 2,000 hours following.	For more than 4,500 hours.
Less than 3 kilowatts	0.20	0.20	0.20	0.20
From 3 to 6 kilowatts	.20	.14	.09	.05
From 6 to 10 kilowatts	.19	.13	.085	.05
From 10 to 15 kilowatts	.18	.12	.08	.05
From 15 to 24 kilowatts	.17	.115	.075	.05
From 24 to 36 kilowatts	.16	.11	.07	.05
From 36 to 50 kilowatts	.15	.10	.07	.05
From 50 to 80 kilowatts	.14	.095	.065	.05
Above 80 kilowatts	.13	.09	.06	.05

Digitized by Google

THE HAMILTON, OHIO, NEW TELEPHONE EXCHANGE.

BY J. E. PEAVEY.

On the northeast corner of Second and Ludlow streets, a quiet and choice district in the city of Hamilton, Ohio, the Cincinnati & Suburban Bell Telephone Company, of Cincinnati, Ohio, has recently completed and put into service a model manually operated telephone exchange.

After the company decided to erect and equip a new exchange, the first matter considered was to erect a building and supply an equipment that could not be surpassed by any other for durability, neatness in design and efficiency in service. The completed building is as nearly absolutely fireproof as building material, aesthetic design, convenience in service and comforts of the occupants would permit. Brick, ferro-concrete, steel, stone and marble are used throughout; wood being used only for doors, minor trimmings and floors in the operating rooms, operators' retiring room and manager's office. On the side of the building, adjacent to other property, wired glass has been used in all windows.

The building has an ultimate capacity of 4,900 subscriber's lines and 120 toll lines—a liberal provision, to accommodate the growth of the business for a number of years to come. The exchange was completed and put into service on October 24. The cut-over from the old exchange, which was located on High street, was accomplished in a very short space of time with no interruption to the service whatever.

The Western Electric standard common battery relay equipment is used throughout—arranged for two-party selective service in the city, and six-party semi-selective service in the country for farmer lines.

Fig. 1 is an exterior view of the building.

Both toll and the local boards are on the second floor; the toll board being separated from the local operating room by a fire-proof and sound-proof partition. All employés gain admittance to this floor by one stairway of marble and steel construction, so located as to cause a minimum amount of confusion, and kept immediately under the supervision of the chief operators at all times.

Fig. 2 is a view of the local operating room, showing the local switchboard, chief operator's desk and stairway. Fig. 3 is a view of the toll room. In connection with this view, the matter of providing auxiliary artificial lights for the operating rooms may be of interest and will be explained. All switchboards are provided with the customary electric lamps, placed above the multiple in reflectors—arranged to throw the light down on the multiple and keyshelf. To provide an auxiliary or emergency light should the electric lights fail, it has been the custom to pipe the operator positions for gas. This being an objectionable arrangement, not alone from the cost of installation and maintenance, but from inconvenience and delay in lighting the gas, a combination gas and electric fixture was designed. The gas-burner consists of a four-burner Welsbach arc around which electric incandescent lamps are arranged forming a neat ceiling fixture. In case the electric lights should become extinguised from any cause, it is only necesary to pull a small chain pendant beneath the chandelier and light the gas arc, which illuminates the operating room.

Fig. 4 is a view of the power room. The battery-charging and ringing machines are

FIG. 1.—EXTERIOR VIEW OF HAMILTON (OHIO) EXCHANGE OF THE CINCINNATI & SUBURBAN BELL TELEPHONE COMPANY. FIG. 2.—MAIN OPERATING ROOM AND CHIEF OPERATOR'S DESK. FIG. 3.—TOLL BOARD. FIG. 4.—BATTERY CHARGING AND RINGING MACHINES.

Digitized by Google

in duplicate. One battery-charging unit consists of a motor-generator set, the other unit being gas-engine driven.

Fig. 5 is the battery room. There are twenty-two cells of chloride accumulator mounted upon pedestals and arranged so that tanks may be easily removed for cleaning.

Fig. 6 is the local manager's office, the company's local manager, M. R. Barr, being shown in the foreground.

Fig. 7 is a view in the basement, showing the tunnel and runway for the underground lead cables. The tunnel extends out to a manhole under the street in front of the exchange building. In this view is also shown the entrance of the electric light and power wires by way of the cable tunnel, with their protection panels and meters.

A feature of special interest in connection with this exchange is the use of forty-eight volts for transmission in the place of twenty-four volts, as now almost universally used by all telephone companies.

The use of forty-eight volts gives a much larger radius of common battery service, thereby enabling subscribers living in the remote suburbs to have all of the advantages of those living in the city proper. Also by the use of this increased line voltage, standard common battery service has been extended into the rural districts, and the telephone company is now giving a six-party farmer service, using standard common battery instruments, permitting the farmer to have all of the advantages of his city neighbors.

Another feature of particular interest is the improved method of handling toll connections. A highly developed system has been installed that permits of more speed in handling connections, and giving far better transmission. With this exchange the telephone company expects to give to the city of Hamilton 2.5 second service on the speed of answering calls, and an equally high efficiency on all other features of operating.

The city of Hamilton is a manufacturing town, with a population of approximately 30,000. It is surrounded by a well-developed farming country, which justifies this generous provision of telephone facilities. In conclusion it may be well to say that no better evidence can be shown of the public appreciation, than to state that since the exchange was put into service an increase in subscription beyond all expectations has developed, necessitating placing orders for additional switchboard equipment to be used at an earlier date than was contemplated in the beginning. All credit for Hamilton's telephone equipment is due to B. L. Kilgour, general manager of the telephone company.

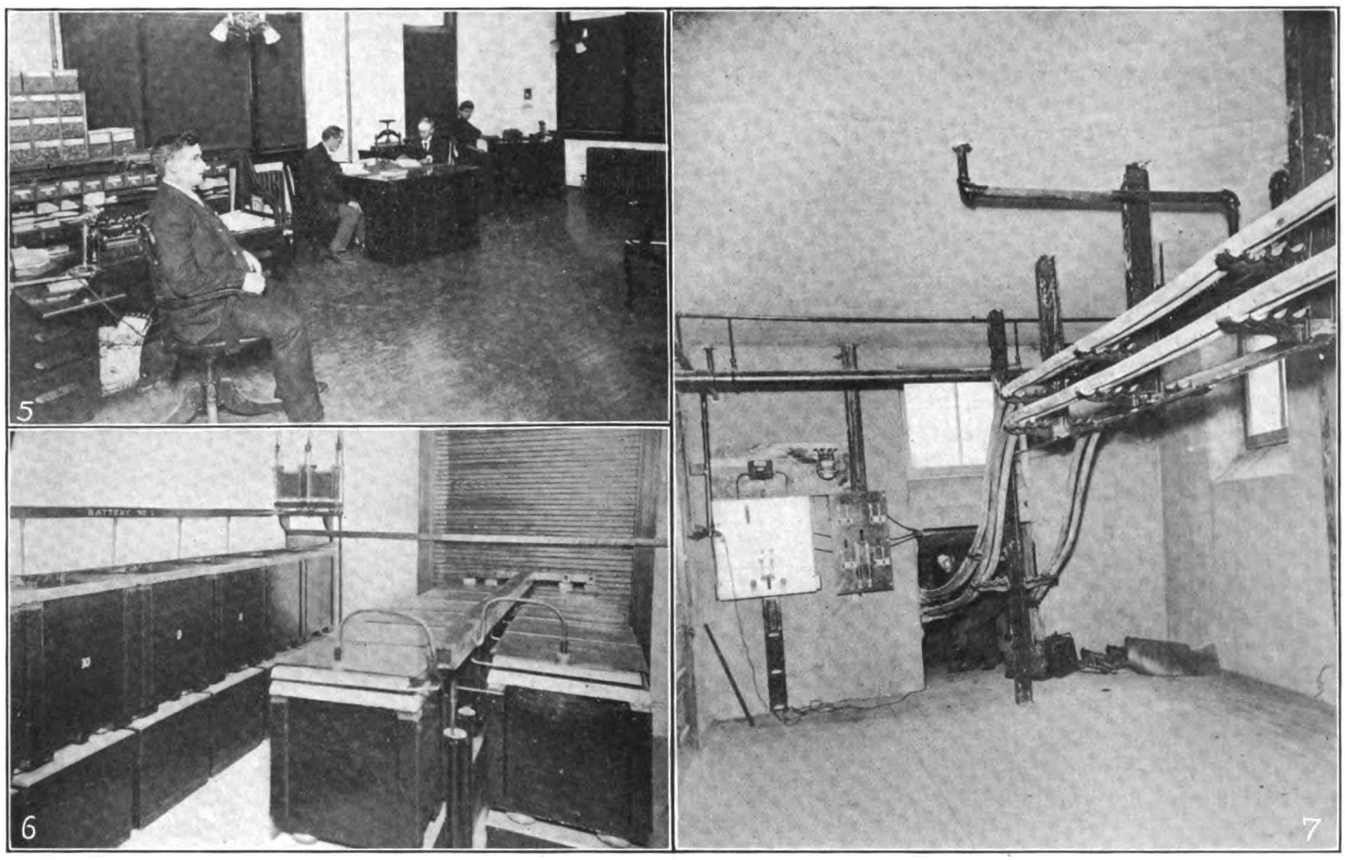


FIG. 5.—MANAGER'S OFFICE. FIG 6.—STORAGE BATTERY ROOM. FIG. 7.—CABLE TUNNEL AND STOREROOM.

The University of Illinois.

Few people realize the rapid growth of the University of Illinois in its engineering work. A recent count shows 293 undergraduate students in electrical engineering alone. There are more than 1,100 in all branches of engineering, and over 4,000 in the entire university.

A meeting of the university branch of the American Institute of Electrical Engineers was held in the electrical engineering laboratory on December 5. The paper by Dr. C. P. Steinmetz entitled "Transformation of Electric Power into Light" was read and the discussion opened by Professor A. P. Carman. The paper by Dr. Clayton H. Sharp entitled "New Types of Incandescent Lamps" was read and the discussion opened by Professor H. P. Wood. The Milwaukee convention paper entitled "The Self-Synchronizing of Alternators," by Morgan Brooks and M. K. Akers, was read and demonstrated by Mr. Akers.

Digitized by Google

THE MEASUREMENT OF RECEIVED ENERGY AT WIRELESS STATIONS.

BY GREENLEAF W. PICKARD.

In no branch of the electrical engineering of to-day is the need for accurate energy measurement more pressing than in wireless telegraphy, nor has less been accomplished than in this direction.

When the art was in the empirical stage, the assumption was made that the received energy was well nigh infinitesimal; that in this respect wireless telegraphy differed from all other modes of electrically communicating intelligence. And, because of this assumption, the most extraordinary claims have been made for wireless receivers, or oscillation detectors. In the literature of the past five years, one repeatedly finds the various detectors referred to as instruments of remarkable sensitiveness, surpassing all previous physical apparatus in this regard.

As a matter of fact, the writer's measurements have shown that in neither the amount of energy received, nor the sensitiveness of the detecting means, does wireless telegraphy differ materially from telephony. As will be shown later, the received energy over the longest distances at present covered is hundreds of times greater than the amount required to operate a telephone receiver.

Almost the only measurements of received energy on record are those of Duddell and Taylor made over comparatively short distances with the aid of a thermogalvanometer. While this instrument, or better, the Fessenden hot-wire barretter, is capable in skilled hands of yielding excellent quantitative results, the sensitiveness falls far short of that required for the longer ranges over which wireless communication is now commercially accomplished.

During the past year the writer has developed an extremely simple method of measuring the energy received at each discharge of the distant station, the only limitation being the sensitiveness of the detector employed. As a result, if the energy received at each discharge is over 0.0005 erg, it may be readily and accurately determined.

Briefly, the method consists in balancing the discharge of a small condenser against the received signal, the condenser discharge being received upon the same circuit, and having the same periodicity as the received energy. Knowing the potential and capacity of the condenser when balance is obtained, the energy is accurately known.

In Fig. 1 the circuit required for this measurement is shown. A, S, L, T, G is the ordinary receiving circuit, the tuning inductance L being adjusted to give the maximum response in the telephone receiver R, which is connected to the detector D through the secondary of the oscillation transformer T. By throwing the switch S to the left, and depressing the key K_1, a single discharge of the condenser C may be thrown into the receiving circuit. If the capacity of the condenser is made that of the antenna A, and, as is usually the case, the inductance of the antenna is small in comparison with

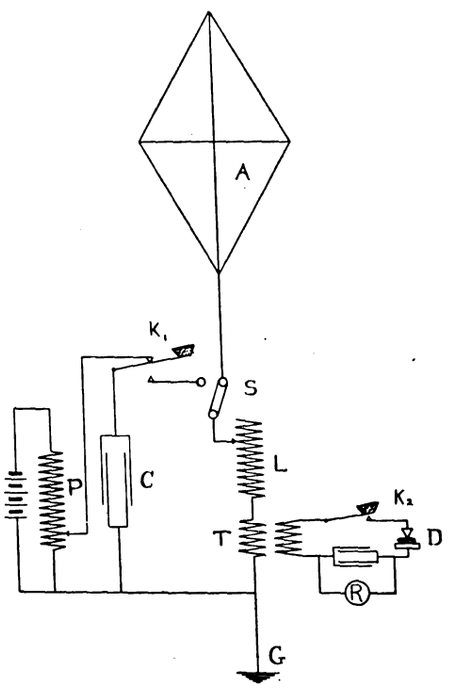


FIG. 1.—DIAGRAM OF CONNECTIONS OF APPARATUS FOR MEASURING THE ENERGY OF ELECTRIC WAVES IN WIRELESS TELEGRAPHY.

that of L and T, the periodicity of the discharge will obviously be that of the distant station. It will further be seen that inasmuch as the potential to which the condenser is charged is small, being at the most but a few volts, the sparking distance in air is extremely small, and the velocity of an ordinary key closure is sufficient to metallically complete the circuit, from the time the spark discharge starts, in much less than a microsecond. Therefore, the dissipation losses in the spark discharge affect only a small portion of the first half period of the oscillations, and are in consequence very small, the chief source of damping being the energy absorption of the detector circuit.

While it is possible to use any form of detector that responds to the root-mean-square value of a wave-train, a preferred form is a thermoelectric detector, consisting of a thermojunction between a metal point and a silicon surface. This form of detector requires no battery in circuit, as it operates solely by regeneration of the joulean heat of the oscillation at the contact into a short pulse of direct current in the telephone receiver. As this detector will give an audible signal in the telephone receiver on so small an amount of energy as 0.00045 erg, it compares favorably with the electrolytic detector in sensitiveness, and permits the measurement of received energy in the most extereme cases met with in long-distance wireless telegraphy.

The technique of the measurement is simple, and in many cases does not even involve the cooperation of the transmitting station, save that it be sending signals of some sort. With the switch S thrown to the right, the observer waits until he hears a dot, or series of dots, each consisting of a single discharge. The switch is then thrown to the left, and a dot or series of dots is made by the key K_1. By repeating this process, and varying the potential of the condenser by the potentiometer P, the intensity of the dots produced by the condenser discharge may be made to balance those sent from the distant station. Then, knowing the capacity of the condenser, and the potential to which it was charged,

$$W = CV^2$$

or,

$$W\ (\text{ergs}) = \left(C\ (\text{microfarads})\ V^2\ (\text{volts})\right)10$$

In many cases, where sixty-cycle alternating current is employed at the transmitting station, the ordinary Morse dot, produced by a short pressure of the key, is in reality a series of discharges. In such event it is necessary that the operator at the sending station should tap the key in such way that each tap gives but a single spark.

Failing in the cooperation of the sending operator, and having no single spark dots, excellent measurements may still be made by the isolation of a single spark in a long dash. This is readily accomplished by a key K_2 inserted in the detector circuit. Opening this key, and then sharply tapping it, a closure of the detector circuit lasting only some 0.005 to 0.01 second is obtained. This usually results in the capture of a single spark, and a resulting single click in the telephone receiver, which may be balanced against the condenser discharge as before.

An excellent example of a wireless station which can easily be measured by

Digitized by Google

this method is the Marconi installation at South Wellfleet, Mass. The dots from this station are always single discharges, and can, therefore, be directly balanced against the condenser discharge. In Fig. 2 the result of a long series of measurements, both day and night, is shown. The receiving antenna was distant ninety miles, and consisted of a lozenge-shaped fan of copper wire, suspended nearly horizontally at an elevation of fifty feet from the ground. Its measured electrostatic capacity, which was also that of the condenser used in the measurement, was 280 micro-microfarads.

The plotted results show that from day to day the received energy varies widely. While it is not the purpose of this article to discuss the theory of this visitation, it may be pointed out that the energy received in the daytime is not materially less than that received by night. In Fig. 2 the day observations are distinguished from the night by being in outline, while the night measurements are shown as full black discs. Evidently, while for a distance of ninety miles there is some varying source of dissipation that at times reduces the received energy to less than one-third of its maximum value, the effect of daylight can not be held responsible for this loss.

It will readily be seen that this method lends itself admirably to testing wireless detectors, the amount of energy at any desired frequency that will give a just audible dot being easily measured. In this connection it is interesting to note the extreme inefficiency of even the best forms of wireless detectors regarded as translating devices.

A high-resistance telephone receiver, of the type usually employed in connection with wireless detectors, will give a clearly defined dot, when a condenser of 0.015 microfarad capacity, charged to a potential of 0.00123 volt, is directly discharged through its windings. This corresponds to 0.23×10^{-6} erg. The most sensitive detector at present in commercial use is the electrolytic, and this, a periodicity of 500,000 cycles, requires 364×10^{-6} erg for the same response. Therefore, the efficiency is approximately 0.06 per cent. It is extremely unfortunate that the telephone receiver is inefficient at high frequencies, or it would be far better to discard the detector, leaving only the telephone receivers in circuit. The low efficiency of wireless detectors points clearly to the importance of investigation in this direction, for, with a fairly efficient detector, a great increase of present day ranges could be obtained.

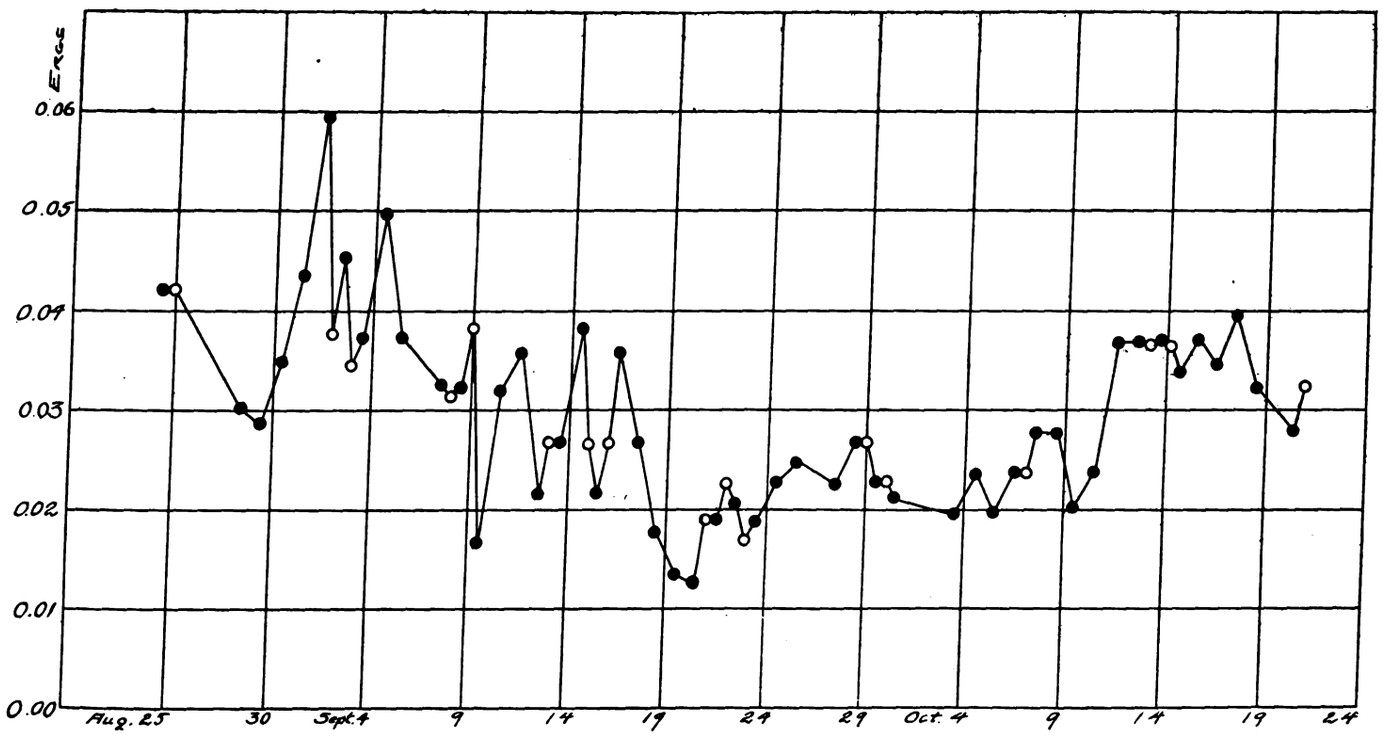


FIG. 2.—RECORD OF MEASUREMENTS OF ENERGY SENT OUT BY ELECTRIC WAVES IN WIRELESS TELEGRAPHY.

Another New Telephone Company for Chicago.

A new telephone company, which will probably be known as the Independent Telephone Company of Chicago, is to be incorporated, the initial movement being the installation of an independent telephone system in Chicago, Ill. Among the men interested in the company will be Martin W. Littleton, Brooklyn, N. Y.; J. D. Powers, Louisville, Ky.; E. L. Barber, who is heavily interested in independent telephone companies in the Middle West; Roland R. Conklin, director of the National Bank, of Cuba; Samuel M. Jarvis and John M. Shaw, president of the Atlantic Telephone Company. This company and another to be formed for the same purpose will have a capitalization of $20,000,000. It is stated that arrangements have been made for laying wires in the Chicago subway, the telephone franchise for which has been secured by the above-named interests. The president of the independent company will probably be Roland R. Conklin, and the vice-president, E. L. Barber.

New Head of Smithsonian.

Professor Henry Fairfield Osborn, of New York city, was elected on December 4 secretary of the Smithsonian Institution to succeed the late Professor Samuel T. Langley. Professor Osborn is the first vice-president of the American Museum of Natural History of New York, and is regarded as one of the foremost scientists in America. He is also widely known as an eminent palæontologist and educator.

Digitized by Google

THE TELEPHONE SITUATION IN CHICAGO.

FROM A CHICAGO CORRESPONDENT.

The telephone situation at Chicago contains elements of national interest.

In two years the ordinance of the Chicago Telephone Company expires. "In order to enable the building of a new system in time to be in operation when the present system goes out of existence an ordinance should be granted to the Manufacturers' Telephone Company now" is the essence of the argument by which the telephone agitation is brought to a crisis at the present time.

The Manufacturers' Telephone Company is an organization at the head of which is Levy Mayer, of the firm that secured the original charter for the Automatic Telephone Company, later organizer of the Adjustment Company, which undertook to secure rebates from the Chicago Telephone Company for money paid it over and above the $125 per year charged for unlimited service, and more recently the "pro bono publico" advocate of lower telephone rates and total abolition of the Bell monopoly. His agitation of the telephone topic has aroused public interest to fever heat and enabled him to amalgamate all the local opposition which the company has in a new company which offers to furnish Chicago with 25,000 telephones in one year and 50,000 in two years to take the place of the 130,000 the present company supplies, and entirely separate from the automatic service in which a Wall street syndicate is announced to be about to invest $20,000,000, increasing that service from 7,000 or 8,000 subscribers to 100,000, and which company, it is rumored, has been selected by the various independent interests as the avenue through which they will enter Chicago.

As the Manufacturers' company is the centre of the excitement, it is necessary to analyze it before entering upon the general subject of the telephone in Chicago.

It appeared on the scene in the form of an ordinance submitted to the common council. This ordinance was sent to members of the council accompanied by a letter upon stationery of the Illinois Manufacturers' Association, and signed by John M. Glenn, secretary of the association. Other letters were sent out upon the association's stationery attacking the Chicago Telephone Company.

With copies of these letters in his possession a correspondent of the ELECTRICAL REVIEW called on the most prominent Chicago members of the Illinois Manufacturers' Association to ascertain why the association had taken up the telephone situation in Chicago. It was found that such prominent members of the association as the Otis Elevator Company, the Simplex Railway Appliance Company, Carson, Pirie & Scott, Farwell & Company, Sprague, Warner & Company, Fuller & Fuller and Clow & Sons entirely repudiated the action of Secretary Glenn, that thirty or more of them had signed a protest against such action, and several of them gave the ELECTRICAL REVIEW signed interviews which they authorized for publication, and which are quoted herewith. It was also found that some 260 Chicago members of the association had signed the petition asking for a renewal of the Chicago Telephone Company's ordinance.

The Otis Elevator Company, when asked for an interview, signed the following for publication:

"OTIS ELEVATOR COMPANY.

"CHICAGO, ILL., Nov. 21, 1906.

"We are members of the Illinois Manufacturers' Association. I was a member of a committee from the Union League Club which attended a meeting of the directors of the Illinois Manufacturers' Association at the Mid-Day Club in the First National Bank Building to protest against the use of the Manufacturers' Association's name in connection with the telephone question in the city of Chicago, as we believe this to be a matter which the people of Chicago, through their various local organizations and their city government, can adjust equitably for all concerned. . . .

"As the independent telephone companies have not as yet effected the organization of a telephone system which will give us access to such cities as New York, or which will enable Chicago business houses to reach independent telephone subscribers generally in the various places in Illinois, Wisconsin, Indiana, Iowa, etc., without an entire change of mechanical equipment, the investment of large additional capital, and the general substitution of the new service for the old, we do not feel that Chicago should even consider the possibility of abolishing the present Bell telephone service. We are large users of that service, having two trunk lines for our own use, for which we pay at the usual rate, and four trunk lines for the use of our customers, for which they pay the bill, thus enabling us to have the benefit of six trunk lines without paying for any part of the service beyond that which we use ourselves.

"As far as competition is concerned the city of Chicago has already granted opportunity for the independents to come into the city under the provisions granted by the charter of the automatic, which charter provides for the use of either automatic or the manual service, and which the principal independent interests have signified their intention of using as a means of admission to this city. . . .

"We believe Mayor Dunne is entirely right in enquiring fully into all the facts and figures of the telephone service, and endeavoring to give Chicago the benefit of the best service at a fair rate.

"We do not believe that the people who supported him for mayor are in favor of granting a charter that will demoralize the telephone system of the city of Chicago through discontinuance of the present service and turn a public utility over to men who are not experienced in that line.

"We have signed a protest against the use of the Manufacturers' Association's name in that connection because we do not sympathize with the undertaking, and believe that the present company is furnishing service that is as good as we could reasonably expect in a city of such rapid growth, and at rates which, under the new ordinance, will represent the application of equity in the interests of both the business and general public.

"Our experience with two telephone systems in the city of Cleveland leads us to favor one system only. Two systems means doubling the inconvenience and expense of the service and dividing its value.

"Read and approved for publication.

"(Signed) E. A. RUSSELL,
"Treasurer Otis Elevator Company."

Another signed interview also shows the drift of sentiment among members of the Manufacturers' Association:

JAMES B. CLOW & SONS.

"CHICAGO, November 22, '06.

"From our experience I believe we have a better telephone service in Chicago than in any other large city I have visited. I do not own any stock in the Chicago Telephone Company, but I have considered the subject only as a citizen and a subscriber. I know that in New York and other large cities where we have branch offices the service is not as good as that in Chicago, and we are satisfied to pay a fair price for good service.

"We are members of the Illinois Manufacturers' Association and consistently oppose the position taken by certain officers of the association in organizing a telephone company. . . .

"Few seem to realize what the Chicago Telephone Company has done for this city. It has accomplished more than any other concern I have known to keep up with the demands upon it for extensions. If any ordinary manufacturing concern had been called upon to extend its plant as rapidly as the Chicago Telephone Company it would in all probability have been forced into bankruptcy. The city of Chicago has not been able to keep up with the growth of the city. It has not been able to pave the streets, lay water mains or sewers fast enough to take care of its increasing population. The telephone company has kept up with the growth of the city, and in addition has extended its lines and its service to every new suburb as fast as required, and it has spent millions of dollars giving the city the best possible equipment and service.

"Authorized for publication.

"(Signed) W. E. CLOW."

William V. Kelly, of the Simplex Railway Appliance Company, signed the following for publication:

"It would seem that the efforts of the Illinois Manufacturers' Association in telephone matters are largely confined to Levy Mayer and Mr. Glenn. I did not know the association was actively interested in a telephone company. I do not know of any meeting at which the statements made by Mr. Glenn were authorized or at which the association was committed to an endorsement of the Manufacturers' Telephone Company."

S. S. Gregory, attorney for the Automatic syndicate which has been announced as about to spend twenty millions expanding that service in Chicago, said that Mr.

Digitized by Google

Mayer did not represent him or his interests.

President Conklin, of the Illinois Independent Telephone Association, said Mr. Mayer did not represent his association and that he did not think he represented the Wisconsin Association.

Secretary McMeal, of the newly formed Telephone Manufacturers' Association, said that the association was not represented by Mr. Mayer. This is a powerful organization that will endeavor to promote the interests of independent telephony, holding its first meeting at the Auditorium, December 7th. Mr. McMeal added that he did not doubt the Chicago Telephone Company would be able to secure a charter.

Secretary Brown, of the Civic Federation, said he believed the Chicago Telephone Company was the one to solve the telephone question in Chicago and came out strongly advocating one company and measured rates.

President Wheeler, of the Illinois Tunnel Company, said there would be but one company and that the mayor would not charter another independent telephone company.

The mayor said he favored letting the Bell company and the independent company fight it out and prove by the test of time which is better able to serve the city and then buy that one, under municipal ownership sanctioned meanwhile by the legislature. He favors one company, as the "telephone is a natural monopoly," and said that if a new company came in it would have to pay the Chicago Telephone Company a fair price for its equipment.

"Do you know who represents the independents—Mr. Mayer or some of the others?"

"I can not say."

These things are important because the telephone debate in Chicago seems to hinge pretty largely on the admission of the independent telephone companies, and the mayor is authority for the statement that they are already provided for in the automatic charter which will give them entry to the city and permit them to use the manual service if the automatic does not prove satisfactory for a large exchange.

The hearings are going on almost daily and teem with exciting episodes. The Manufacturers' company is being used to pound down the rates of the Chicago Telephone Company, which does not seem to object to being pounded down to a basis that will be entirely reasonable, but objects to the Manufacturers' company being made dictators of rates. In fact, the Chicago company has submitted an ordinance that provides for universal introduction of the measured basis among business houses in place of the unmeasured service, and its contention that this is the only fair basis (pay-for-what-you-get) is meeting with endorsement by the leading business houses who would seem at first glance to be most affected by the change, but who are beginning to realize that measured rates will really benefit them, for they will increase the popularity of the service and thus increase the subscribers, and also that business concerns that have been restricting themselves to as few telephones as possible while they cost so much per instrument will now be able to have all the instruments they need at so much for each call, and thus accommodate the hosts of customers who have been so often greeted with the busy call under the present system.

As Chicago introduced the five-cent-nickel-in-the-slot system, and four-fifths of its subscribers use that service without protest and are demanding increased service faster than the company can supply it, the company has an overwhelming argument in its favor and will doubtless be able to make its point. It has 130,000 subscribers and about 5,000 or 10,000 more in sight. It has offered to give five-cent service all over Chicago. It has reduced the general rates fully thirty-three per cent. It has taken the councilmen to its exchanges to prove to them that the new company couldn't duplicate any such a system in ten years, and the councilmen who went are convinced that this is true.

But the Manufacturers' company, though it has accomplished the purpose for which the newspapers backed it, namely, to secure reduced rates, still holds the centre of the stage, demanding an ordinance that will cut Chicago off from the long-distance service of the American Telephone and Telegraph Company, cut it off from New York, Washington and all other cities that are still exclusively Bell, and additionally cut off over three-fifths of the present local subscribers from any service at all.

These things will make the telephone situation in Chicago very interesting for some time to come.

Saturday's meeting of the council committee developed several very interesting features. General Manager Hibbard, of the Chicago Telephone Company, under cross-examination by Mayor Dunne, demonstrated why the Bell service can not be opened up to independent companies wishing to enter Chicago without compelling such companies to enter into a contract with it by which the contracting company will be obliged to furnish equipment and service enabling the successful long-distance use of the system. He proved conclusively that no municipality can control the operation or equipment of outside companies any more than a state can control the railroads outside its borders.

In the case of the companies operating in harmony with the Bell, there was absolute control of the service all along the line, as for instance, from Chicago to New York—thus enabling the Chicago company to locate and compel correction of any deficiency or insufficiency of equipment or service to the end that every item entering into the complicated proposition of long-distance service should be brought to a standard.

"I was very much interested in Mr. Hibbard's elucidation of the telephone system," said Chairman Young of the committee, to the REVIEW representative after the meeting. "He showed us clearly that without every part of the system being under harmonious control you can not get satisfactory service. I was particularly taken with the way he showed that long-distance service is not like railroad service, for when one uses the long-distance service he instantly ties up an enormous amount of property along the whole line. I am more and more impressed each day with the magnitude of this question. It is the biggest thing we have to handle here in Chicago, and the most vitally important. It takes precedence just now of the traction problem, for whatever Chicago does will affect every city in the Union and have its influence not only upon hundreds of millions of dollars invested or to be invested in telephony, but also tend to benefit or injure every person in business which in anyway centres at Chicago. We shall get the best experts we can and let them help us find the facts and figures upon which to base our action."

Mr. Young has made a study of rates in different cities, and recently the committee published his report in a pamphlet. While the sessions of the committee become excited with the attacks of Mr. Mayer upon the Bell, and the retorts of Judge Payne, and while the experts and the alleged experts pour oceans of technical testimony over the long-suffering councilmen, he remains quiet and dignified, never taking any part in the debate, except to aid in extracting information for well-considered future action. Mayor Dunne has already gone on record as saying he did not care who got the ordinance as long as the best and cheapest service was given the city, and persisting that he should be given the benefit of the services of an impartial expert. The committee has fallen into line with this idea and is asking for suggestions as to the best experts in the country.

Judge Payne said his company was well pleased to have the whole matter referred to experts, for the further the committee went into details and found out facts, the better for the Bell.

Digitized by Google

BOOK REVIEWS.

"Elementary Experimental Magnetism and Electricity." William Allanach. New York. Longmans, Green & Company. Cloth. 266 pages. 5 by 7½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.20.

A guide for an elementary course such as is offered in the public schools or in evening classes for artisans and others. The treatment is experimental, a method which assists greatly in holding the interest of the students, though it is apt to leave them with a rather confused mass of information not arranged in any logical way, if it be not supplemented by other methods. The ground covered is that usually gone over. The mathematical proofs are simple and should present no difficulty to the student.

"The Grouping of Electric Cells." W. F. Dunton. New York. Spon & Chamberlain. Cloth. 52 pages. 4 by 6½ inches. Supplied by the ELECTRICAL REVIEW at 60 cents.

The chief feature of this work is a demonstration that the rule hitherto taught as a perfectly accurate one for grouping cells for getting the greatest possible current can not be relied upon to give the best grouping in all cases. It is shown that the current obtainable with the best regular group may be less than given by some irregular group. Two rules are given, one for grouping cells so as to get the greatest possible current, and the other for finding the smallest number of cells that will send a given current through a given external resistance. The treatment is, of course, purely analytical.

"The Practical Engineer Electrical Pocketbook and Diary." 1907 edition. Manchester, England. Technical Publishing Company. Limited. Flexible leather. 474 pages. 3½ by 5½ inches. Price, 1s. 6d.

This is a small pocketbook containing a good deal of useful information pertaining to electrical science and practice. The various electrical units and laws are defined and explained, in most cases the authority for the statement being given. There are the usual tables of resistance and electrical constants and a brief description, some details of the apparatus used being given, though these pertain mainly to English practice. Methods of testing are explained and the necessary instruments described, the practice again being English. Different types of electrical machines are described, methods of computing their constants being given. Alternating currents receive a brief treatment. The mechanical features of electrical design are taken up. There are many descriptions of electrical devices such as lamps of different types, motors and motor-controlling apparatus. The book contains the usual tables of mathematical and physical constants and the rules governing the use of electrical apparatus in Great Britain.

"Electricity as Applied to Mining." Second edition, revised and enlarged. Arnold Lupton, G. D. Aspinall Parr and Herbert Perkin. New York. D. Van Nostrand Company. Cloth. 320 pages. 6 by 9 inches. 190 illustrations. Supplied by the ELECTRICAL REVIEW at $4.50.

In the preparation of this book a professor of mining engineering, a professor of electrical engineering and a mine manager have cooperated to produce a work giving the leading truths and the main principles of electricity and electrical engineering, and to show how they should be applied to mining work. The first part of the book is devoted to a discussion of the principles of electricity and magnetism, a description of various types of primary and secondary batteries, and of electrical machinery of various types. The significant features of these devices are dwelt upon and there is a brief discussion of the engineering features of a generating station. The question of distribution and transmission, the calculation of conductors, a discussion of methods of installing electrical systems and of methods of applying motors to driving various mining machinery, follow in logical order. The method of treatment throughout is simple and one easily followed by those who have not made a particular study of electrical theory. An appendix contains special rules for the installation and use of electricity in force in Great Britain.

The Telephone Manufacturer's Association.

Announcement is made of the organization at the Auditorium, Friday, December 7, of the Telephone Manufacturer's Association, the object of which is the promotion of independent telephony.

The organization committee is made up as follows: president, I. G. Ihmsen; secretary, H. B. McMeal; treasurer, J. P. Craeroft.

The following companies are said to be represented: Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.; Dean Electric Company, Elyria, Ohio; North Electric Company, Cleveland, Ohio; Vought-Berger Company, La Crosse, Wis.; Standard Telephone and Electric Company, Milwaukee, Wis.; Swedish-American Telephone Company, American Electric Telephone Company, Monarch Telephone Manufacturing Company, Farr Telephone and Construction Supply Company, and Western Telephone Manufacturing Company, Chicago, Ill.; Acme Telephone and Electric Company, Albia, Iowa; Sumter Telephone Manufacturing Company, Sumter, S. C.; Williams-Abbott Electric Company, Cleveland, Ohio; Chicago Telephone Supply Company, Elkhart, Ind.; Century Telephone Construction Company and Ericsson Telephone Manufacturing Company, Buffalo, N. Y.; Automatic Electric Company, Chicago, Ill.

New York Electrical Society.

The two hundred and sixty-fourth meeting of the New York Electrical Society will be held at the Edison Auditorium, 44 West Twenty-seventh street, New York city, Wednesday, December 19, at 8 P. M. A. O. Benecke, of the American Instrument Company, Newark, N. J., will deliver an address on "Electrical Measuring Instruments." Mr. Benecke will discuss the mechanical and electrical problems involved in the consideration of the permanent magnetic field; the action of the damping frame; the winding of the moving coil; the relation between controlling force, torque and weight of the moving system; the pivoting of the moving coil; the difference in the requirements for voltmeters and ammeters; series resistances and shunts; the shielding against external magnetic fields, and the possibilities of the instruments in respect to accuracy and sensibility. The lecture will be illustrated with lantern slides.

Brilliant Electric Company to Build New Factory.

It is announced that the Brilliant Electric Company, of Cleveland, Ohio, manufacturer of the well-known Brilliant incandescent lamps, will erect a modern lamp factory at Conneaut, Ohio. The company has enjoyed a phenomenal growth during the past year, the increase in business being from 300 to 500 per cent. The general offices will probably remain in Cleveland, but a modern suite of offices will be equipped for the engineering and manufacturing departments at the new factory. Already advertisements have been placed in the Conneaut local papers asking for a large number of employés, to form a nucleus for the new manufacturing force. It is expected that the new plant will be in operation by about June 1, 1907, with an initial floor equipment of 50,000 square feet.

Strike at the Works of the General Electric Company.

There is no alarm felt by the General Electric Company over the strike affecting about 2,000 employés, members of the Industrial Workers of the World. Recently three draughtsmen employed in the switchboard department were discharged for incompetency. Failing to secure their demands for reinstatement of these men, the disaffected members quit on Saturday afternoon. By Wednesday the strikers had returned to their positions, leaving the three to seek places elsewhere. There was considerable dissatisfaction among the workmen over the trouble caused by the unreasonable attitude of these three men, and the Federation of Labor refused to support the strike.

Digitized by Google

THE EVOLUTION OF GAS POWER.[1]

BY F. E. JUNGE.

The conservation of the world's natural resources, both by economic methods of production and by scientific means of transformation, tends toward the stability of modern industry and is essential to the life and prosperity of future generations.

Great savings in the world's supply of fuel materials can not be made unless recourse is had to the elimination of traditional methods of production which have largely stood in the way of economical progress, and to the adoption of novel means of generation which effect the transformation of fuel energy into mechanical power in a more direct and efficient way. To the achievements already realized in this direction, there has lately been added one that even a few years ago would have been deprecated by the conservative engineer as a more or less fantastic and impossible dream, namely, the gasification of inferior grades of fuel, the utilization of waste products, and their direct conversion into useful power in gas engines.

Who can help admitting that the employment of gas power has actually become a factor of consequence in the world's total energy output when it is considered that in Germany, a small country of four-fifths the size of Texas, there are to-day in the iron and coal industry alone in active service or in contemplation 136 gas-blowing engines with 161,300 horse-power, 200 gas dynamos with 206,300 horse-power, eleven gas engine roll drives with 17,000 horse-power, and forty-seven coke oven dynamos with 40,000 horse-power, besides four engines with 1,500 horse-power, for other purposes, or a total of about 400 large gas engines with a combined capacity of 420,000 horse-power.

As in the case of every other technical innovation the early period of growth of a novel method of energy making must needs be sporadic and must encounter competition in order to gain strength together with progressing expansion. Isolated inventions even if commercially sound will fail unless technical science and the development of appliances are correspondingly advanced.

Various attempts to improve on the working process as carried out in standard engines (as by prolonged expansion, compounding, and water injection) have proved to be entries on the wrong side of the balance sheet. The drawbacks common to all of these so-called improvements are increased bulk, weight, first cost, and negative work expanded. The best method of prolonging expansion is by high compression of the dynamic charge before combustion. The most economical way of reducing heat losses through the exhaust is by utilizing the same for raising steam in an exhaust boiler. As high as 160 pounds per square inch can in this way be generated and used for factory heating or other purposes. Generally ten per cent or more of the total output can be recovered from the exhaust of gas engines. Even the interesting experiments of that distinguished authority, Dugald Clerk, in which he tried to improve on the working process by increasing the density of the charge before compression, have failed to effect any considerable advantage. The additional neutral gas he used, though it reduces temperatures all around, tends to retard the influx of heat, and thereby promotes after burning and heat loss through the exhaust. The combustion process pure and simple, as used in the standard types of engines (the Nuremberg, the Koerting, the Oechelhauser, the Cockerill, the Westinghouse, the Reichenbach, etc.), gives the highest economic efficiency attainable with the Otto cycle.

Another practical drawback, and one that can not be overcome by the highest engineering skill because inherent in the cycle, is the lack of overload capacity in gas engines and the fact that the range of economical load is limited to only a fraction of the total. This is by no means as small as is usually held. Another unfortunate characteristic of the gas engine is its lack of overload capacity. This often militates against its adoption and is especially felt when operating urban and interurban railway plants. It can be compensated either by a storage battery of sufficient capacity, or by an auxiliary steam turbine system as proposed by Stott, or by the installation of spare gas engine units with a corresponding equipment for gas storage or instantaneous generation. There is no prime mover that lends itself better to the latter application, especially as since the employment of compressed air, gas engines can be started quite as easily as steam engines.

Since the majority of failures of gas-power plants have been due to the fact that the engines selected were too small for the maximum duty which they were expected to perform, the rating of gas engines should be standardized and the public should be advised by the manufacturers that for a service with heavy overloads, such as occur, for instance, when driving rolling mills, the capacity of gas engines must be considerably larger than that of steam engines.

Though the ideal after which we are striving is still far from what we have actually attained, it would be wrong to conclude that the present type of gas prime movers is not on a high level of excellence, not only as an economical, but as a reliable machine. Just as the steam turbine can not be regarded as having reached its highest state of perfection and yet is a commercial engine of the greatest possibilities, so it is with the gas engine. After having passed out of the costly experimental state and after having reached a condition of standard design, its manufacture is now as profitable to the engine builder as its application is to the power consumer.

The variety of earlier forms has now been reduced to two classes—(1) the double-acting-tandem four-cycle engine and (2) the double-acting two-cycle engine. The single-acting type of each is only applicable in the smaller sizes. Each type has its disadvantages and each its special field of application. The four-cycle is used for general power work and the two-cycle for blowing service and wherever variable and low speeds are essential. There is a tendency toward the employment of higher speeds in large gas engines, in order to reduce the first cost also of the generator. Therefore, since the peculiar process of charging with an open exhaust limits the two-cycle engine to speeds of from eighty to 100 as a maximum, this type is at a disadvantage. It would lend itself better to the building of vertical engines. Vertical engines promise great savings in manufacture and, of course, in floor space. They must be developed in order to compete with steam turbines in space economy, and also for purposes of ship propulsion.

Of the various methods of regulation applicable in large gas engines, namely, the quality, quantity and combination system, the last-named (as developed by Reichenbach and Mees) is superior to all, because it reduces the calorific value and the quantity and therefore the compression of the mixture at the lower loads less than do the others. Therefore, more regular and efficient combustion is secured with decreasing load and lean mixtures, especially

[1] From a paper read at the meeting of the American Society of Mechanical Engineers, held in New York, December 4-7.

Digitized by Google

when the point of ignition is automatically advanced.

Regarding the latest thermal performances of internal-combustion engines, attention is called to (1) a fourteen-horse-power Manienfelde alcohol motor and a seventy-horse-power Diesel oil engine showing on test an indicated thermal efficiency of 41.7 per cent; (2) a twenty-horse-power Gueldner gas engine running on city gas with 42.7 per cent, and (3) a 500-horse-power Borsig-Oechelhauser coke-oven gas engine with 38.6 per cent. These figures refer to approximately full-load conditions. Therefore, one horse-power indicated in the cylinder of the best gas engines so far on the market requires the expenditure of only 1,490 calories or 5,900 British thermal units. The economic efficiency of the latest types of gas engines, based on the actual output of available work, is therefore between the limits of thirty-two and thirty-three per cent.

In large power plants the item of fuel cost is composed, besides the price for the coal, of the expense of handling it between the car and the ash pile, including sufficient fuel storage capacity to guarantee permanence of production during all emergencies, and especially against interruptions in the supply service, such as are occasioned by strikes, railroad accidents, car or locomotive famines, etc. It is obvious that with the reduction of the fuel bill to one-third, the interest on the amount of capital locked up in the coal stored, and in the storage equipment, as well as the cost of operation and upkeep, are correspondingly reduced. With the same investment the gas-power plant can tide over periods of fuel shortage and keep up production when the steam competitors would have to shut down.

The question of fuel valuation which comes up when studying the comparative cost of power plants and their economics has still another aspect. The present attitude is that the cheaper the fuel the less profitable it is to use gas power in a plant. If, therefore, a gas-power plant can not effect a saving in the cost of labor, supplies and repairs over what is obtained with steam, there will be a definite economic limit fixed which is determined by the price of fuel, and beyond which there is apparently no hope for gas power. Curves have been plotted showing diagrammatically the comparative cost of a gas and a steam installation. When first plotted they were equal for coal in the neighborhood of $2 per ton. A year later it was shown that the two cost lines crossed at a point corresponding to a value of coal of $1 per ton. It has been suggested that a further reduction in the price of gas-power machinery may eventually tend to effect a crossing of the two curves at the zero point of the cost of coal. This would mean that when fuel can be had for nothing both plants can deliver power at the same cost.

There is so much being said just now about the realization of ideas in industrial pursuits that it is surprising to find in the conservation of fuels no trace or effect of such doctrine. All power plants are designed with the ultimate object of being producers of wealth for the present owners and with no regard for future activities. But even when guided by purely material motives, it is well to remember that the valuation of property is subjected to great fluctuations brought about by the rapid expansion of industries and the development of new branches.

The gas producer in its present form is a comparatively modern creation. Developed from the regenerative furnaces such as were employed, among others, by Siemens in the process of steel making, they found early attention in England and France. These earlier producers were of the pressure type. In them steam and air were blown through an incandescent fuel bed, and the gas thus generated was stored in a holder. Their sphere of application was considerably reduced by the invention of the suction producer, which was first developed by Benier in France and by Koerting in Germany. Its apparent advantage consists in that the gas-making apparatus is under suction instead of under pressure, since air and steam are drawn through the fuel bed by the aspirating action of the engine piston. No extra coal-fired boiler is required for raising steam. This performance is left to the sensible heat of the gases leaving the producer. The bulky gas-holder is also eliminated.

Suction gas plants are very simple, safe and reliable in action, and have found an extensive field of adoption in Europe and also a limited sphere of usefulness in this country. The lower grades of American fuels present characteristics less suitable for gasification than are possessed by the European coals.

Of all the various industries which have been benefited by the evolution of gas power, the iron industry has been the most favored, since the blast-furnace as the potential source of energy not only serves to convert the raw materials into pig iron, but also produces gas as a valuable by-product. This can be used for producing the power that is required in the power plant proper, and besides leaves available a considerable surplus for other uses.

It is a well-known fact which need not be here developed in detail that of the total quantity of gas generated in a blast-furnace plant about fifty per cent is required within the plant. This includes losses at the furnace top and in pipings, *viz.*: for driving blowing engines, heating blast stoves, operating the cleaning plant and generating electric energy in the central station, while the rest, representing an amount equal to twenty-five horse-power per ton of pig iron produced every twenty-four hours is available for outside purposes or sale. Modern combined works often possess their own collieries and coke-oven plants, which represent an additional source of available power.

In modern by-product ovens the quantity of gas produced depends on the quality of the coal coked, on its moisture and on the type of oven, and varies considerably in composition during one coking period. Deducting sixty per cent for heating retorts and ten per cent for driving plant auxiliaries, there remain available for every ton of coal coked in twenty-four hours, from five to six horse-power for other uses. The third source of energy, the gasification of culm piles, will liberate from every ton of culm charged in the producer in twenty-four hours about twenty-five horse-power, after deducting losses through deterioration, etc.

That the total amount of useful power that can be gained by scientific transformation from the first two sources alone is no negligible quantity will be seen when applying the above figures to American conditions. With an annual coke production of 35,000,000 tons in the United States, and utilization of the coke-oven gases in regenerative ovens, there can be liberated with modern gas engines in the neighborhood of 1,500,000 horse-power, if a best consumption of 8,000 British thermal units per brake horse-power is assumed. With an annual pig iron production of 25,000,000 tons the surplus blast furnace gases will generate in the neighborhood of 3,000,000 horse-power in gas engines.

A third application which the surplus power has found in Germany, and which recommends itself for adoption especially in this country, is to drive electric railways for the transportation of raw materials and finished goods throughout the

Digitized by Google

commercial distribution sphere of iron and steel works.

Technically considered, this problem is very attractive, since the particular application affords a nearly constant outlet for the surplus power all year round, because the production of iron and the consumption of energy are balancing each other. When depending on unstable outside markets, we always have to introduce into the calculation a coefficient of safety. With two blast furnaces, we can only figure on the available surplus power of one furnace as forming the basis for a guarantee to an outside consumer since a fluctuation in the iron market may require the banking of one furnace. Also the plant load factor of the proposed application becomes higher than when current is supplied to a neighboring city for lighting purposes.

In Germany it was planned some time ago to build a high-speed electric railway from Berlin to Vienna and to use the various iron smelting plants and collieries located along the road as substations for supplying electric energy to the line. But it was found that there was in most cases an adequate consumption of surplus power in the neighboring districts of these plants, so that there was not enough energy left available for realizing this project. In this country there are in certain localities vastly greater possibilities for operation in the direction indicated.

It is difficult to obtain correct figures on the total savings that can be effected in the production of iron by the application of gas power, but from fifty cents to one dollar per ton of pig iron made have been recorded in various continental works.

In central electric stations which are located where no energy is available from near-by iron smelting plants or coal mines, the gas producer takes the place of the blast furnace and coke oven as the potential source of energy. Especially is the production of electric power at reasonable rates of importance for very large cities where the price of real estate in the centres of districts is high, and for isolated communities, country houses, and farms which are located outside the commercial radius of metropolitan or other central stations. The distribution of town gas for individual power purposes, while not so much restricted to central location within the city, can not, without loss, be extended over wide territories. Moreover, at the present price of illuminating gas, it can not compete in the field of power production with the independent suction gas plant even if the latter use such high-grade fuels as anthracite and coke.

Suction plants will work in the smallest sizes as economically as in the larger, and, of course, vastly more so than the largest and best-equipped steam plants. They occupy very little space and may be installed in the basement of apartment and other houses without being at all dangerous or difficult to handle. Starting from cold does not require more than from ten to fifteen minutes. The smoke nuisance, which is sometimes so objectionable in cities, is completely eliminated for all grades of coal that can be gasified. The personal equation is greatly reduced, since the process of gasification is not dependent on the skill of the fireman. Standby losses are also very low compared to steam plants. For small work and very intermittent working oil and alcohol engines are superior, since with them fuel consumption stops entirely as soon as the engine is shut down.

In a recent address, delivered by Professor Riedler-Charlottenburg to the *Verein Deutscher Ingenieure* on the evolution of the steam turbine, the situation was characterized by the following remarkable words: "A development of unprecedented rapidity of one of the most difficult motors in the history of mechanical engineering: a sweeping victory in the power station field: a momentous advance of the highest importance, principally to electrical engineering." If we consider that what was thus described is a new machine which transforms the energy of steam into useful power at a higher degree of mechanical excellence, with a saving in weight and bulk and cost of the prime mover and generator, and with a greater uniformity of turning effort, but with the same low economic efficiency, we are at a loss to give expression to the extreme importance which the evolution of gas power possesses as a factor in the field of industrial economics. It may suffice to draw attention to the fact that this is not the substitution, by a rotary type or prime mover, of a reciprocating engine of the same thermal characteristics, but the complete abandonment of a traditional and wasteful process of energy generation in favor of a direct and efficient method. It has not only extended the capacity of our fuel resources to double and more of their former value, but has also enabled us to profitably utilize material and property which was deemed utterly worthless even a few years ago.

Pupin Telephone Cable Across Lake Constance.

A submarine telephone cable has recently been laid by Siemens & Halske across the Lake of Constance, between Friedrichshafen and Romanshorn, says the *Electrician,* London. The laying of this cable marks a great advance toward the realization of long-distance submarine telephony, as some doubt has hitherto existed as to the possibility of laying submarine cables fitted with Pupin self-induction coils. These coils, which are provided at certain intervals, thicken the lead-covered cable considerably in these places, so that the laying was attended by great difficulties. After the failure of the first attempt in the autumn of 1905 with the ordinary type of cable-laying gear, special new apparatus had to be built to deal satisfactorily with the thickened portions of the cable. The latter were reduced to a certain extent by inserting the coils in a different manner. After all these preparations had been accomplished, a second attempt was made at the beginning of last August. The cable was coiled on a drum about thirty feet in diameter and five feet high, and was led over rollers to the paying-out machine, provided with dynamometer and brake in the usual way. Before the actual laying of the cable took place, experiments were carried out with a length of 550 yards, provided with several coils, which after a few miles' trailing on the bottom of the lake and considerable strain showed no damage. As soon as the laying had begun, a serious fault was discovered which could not be immediately localized. The cable had to be hauled on board, cut from the shore cable, which, however, was found to contain the fault, and operations were started afresh without any further disturbance, so that the work was completed in two hours and one-half. Advantage was taken in the laying of the cable of the extensive experience of Siemens Brothers & Company, and the cable was successfully laid with only one per cent of slack. Directly after the laying, telephonic communication was obtained with Berlin over the new line.

Increased Value of Copper Exports.

According to a bulletin published by the Geological Survey the production of copper in the United States in 1905 exceeded 901,000,000 pounds. The three leading regions of production are Butte, Mont., Arizona and the Lake Superior region. In Idaho and Utah there was a marked increase, while in California and Tennessee there was a decrease. The total production for the world, in long tons, for 1905 was 701,252. The exports of copper in 1905 in its various forms aggregated in value $86,408,731, or nearly double the value of the exports in 1903.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Distribution of Electrical Energy in Street Railway Systems.

A report made to the recent street railway congress, held in Milan, Italy, dealing with methods of distributing electrical energy for street railways, is given here. This was prepared by Emilio Piazzoli, who has obtained reports from ninety-two companies. Of these ninety-two companies eighty-six use the sector system, in which the distributing lines are cut into independent sections. Of these eighty-six seventy-seven prefer to maintain all sections independent of one another, while nine prefer to have them connected. Methods employed in a large number of companies are mentioned, somewhat in detail, and the advantages of the two systems summed up in the following way: When the zones are fed independently one of another the reliability of the system is the greater, for it permits easy localizing of the faults, and if one feeder breaks down that section can be easily supplied from the adjacent ones. It also makes it impossible for breakdowns of one section to influence the neighboring sections. The advantages of the non-sectioned system are: The distribution of the load throughout the system is more uniform, so that there is a better utilization of the copper, and in this way sudden overloads on the cables are avoided. It is thought, however, that these two advantages do not compensate for the inconveniences of the method and the less reliability as compared with the other system. It is suggested that careful and long study should be made of the performance of automatic disconnecting switches, which might be used for cutting out any section on which trouble occurs. If a practical disconnector of this type is found it will permit every system to secure the advantages of both systems of distribution.—*Translated and abstracted from L'Électricien (Paris), October 27.*

The Water Powers of Peru—Their Development and Possible Applications.

Some of the details of the suggested development of Peruvian water powers are given here by Emile Guarini. One town much interested in this proposed development is Mollendo, where there is today no power plant of any description. There is under contemplation a plan to install a steam plant at this city, although the cost of fuel is high. In its immediate vicinity, in the Tambo valley, there are a number of small streams capable of developing 700 horse-power, which can be easily utilized and transmitted electrically. It is suggested that since, in the first instance, efficiency is not of much importance, that a primitive water-wheel of local manufacture, connected to a dynamo, would meet all the present requirements. Mollendo gets its water from the mountains at an elevation of 7,000 feet above sea level. The pipe line is about eighty miles long. This pipe line is of sufficient size to supply 320 horse-power, but unfortunately its construction is not sufficiently strong to enable it to be used for this purpose. The line, moreover, does not run direct to the city, but supplies separate reservoirs at different levels. It will be practicable to place a small generating plant at each of these reservoirs and in this way deliver about 250 horse-power to the city. Although the Tambo valley abounds in small water powers there is only one instance in which they are utilized. This is for a small private plant. The Rimac river is capable of developing at least 100,000 horse-power; while by damming the Chili river near Charcani it will be possible to develop about 100,000 horse-power there. Particulars are given of the proposed plan for utilizing the waters of Lake Titicaca. This might be done by tunneling through the mountains and discharging on the ocean side of the slope, but this would call for a tunnel about thirty-six miles long, which is impracticable. The other way would be by pumping the water over the crest of the mountains. It is estimated that it would be practicable to draw off from Lake Titicaca water sufficient to develop four and one-half million horse-power, and after allowing for all losses there would be 2,000,000 available for sale. A petition has been submitted to the Peruvian congress asking for the appointment of a special commission to make surveys and report upon the feasibility of this development.—*Abstracted from the Engineering Magazine (New York), December.*

Wireless Telephony by Means of Electric Waves.

The system of wireless telegraph recently proposed by Valdemar Poulsen, described in the issue of the ELECTRICAL REVIEW for December 8, in which a continuous train of high-frequency electrical waves is secured by a modification of the singing arc, suggested to E. Ruhmer, well-known from his experiments in optical wireless telephony, that he might utilize such electric waves for a system of wireless telephony. A description of his tests of such a system is given here by Dr. Alfred Gradenwitz. There are two ways in which variations of the electrical waves might be caused, and which might reproduce speech. One is by a change in the intensity of the waves, and the other by a change in frequency. A high-frequency arc of the Poulsen type was set into operation and variations due to a telephone imposed upon it by means of a transformer, the primary of which is connected in the telephone transmitter circuit and the secondary in the transmitting circuit, but not in the oscillating circuit of the arc. To determine the effect upon the arc it was submitted to a rotating mirror test, but the frequency, which was estimated to be about 300,000 per second, was too high for this method to separate the individual variations. When connecting the oscillating circuit inductively with a vacuum tube oscillograph, the ray of the tube was deflected and produced a glowing band of constant width. Speaking into the transmitter produced variations in the luminous intensity of this band with indentations corresponding to the sound waves, thus showing that the high-frequency oscillations were affected in some way by the telephone. Ruhmer was unable to decide which of the two processes mentioned above was realized, but is inclined to suppose that there was a composite effect, depending upon an alteration of both wave-length and intensity. A test of transmission was made by loosely coupling a transmitting antenna to the oscillating circuit. The receiver consisted first of a microphone contact, but this was not altogether satisfactory, and an electrolytic receiver was substituted for it. With the latter, spoken words were transmitted about forty yards with an aerial

Digitized by Google

about five feet in length. Ruhmer believes that by providing a longer aerial he will be able to transmit speech in this way a distance of several miles.—*Abstracted from the American Telephone Journal (New York), December* 1.

A Method of Producing Continuous High-Frequency Electrical Oscillations.

While experimenting with a Wehnelt electrolytic interrupter S. G. Brown discovered that the apparatus could be reversed; that is, by replacing the inductance by a capacity shunting the poles of the cell, the electrode of the smaller surface became the cathode. The electrolyte was a solution of caustic potash. It was also found that the efficiency could be increased by bringing the cathode close to the anode on the surface of the liquid, and measurements of the current passing through the condenser showed that the oscillations rose to many thousand per second. This method is not satisfactory for producing oscillations, because of the rapid destruction of the electrodes. It was found later that the liquid was not essential to the device, and that the spark discharge could be caused to take place between hard carbon or metal electrodes working in air; but, in all cases, some system of cooling the positive electrode was required, otherwise this would be raised in temperature above a critical limit, and an arc would form and the oscillations cease. This cooling was first effected by standing a portion of the electrode in water. The effect of increased air pressure upon the discharge was tried, and it was found that as the pressure increased the results improved, and *vice versa*. The chief objection to this method was the burning away of the positive electrode, calling for frequent adjustment. To get around this difficulty a disc of metal, preferably aluminum, was revolved slowly. This formed the positive electrode. The negative consisted of a copper block resting against the edge of the disc. Upon passing a direct current at 200 volts pressure through a resistance and a high self-induction, and thence through the disc to the copper block, exceedingly rapid oscillations were produced in a capacity shunting the moving contact. Measurements of the current flowing in this condenser showed by calculation that the oscillations were in some instances of the order of millions per second. A small incandescent lamp consuming one ampere at twenty volts could be brilliantly lit up through a condenser of 0.005 microfarad, although the effective electromotive force across the electrodes could not have exceeded fifty volts. Many experiments with this arrangement were tried, which fully proved the existence of these high oscillations and their continuous production. It was possible to light up an incandescent lamp through a nine-inch brick wall, employing only two loops of wire of one single turn, each enclosing an area of some three square feet and placed on either side of the wall. Oscillations were caused to flow in one loop, and the lamp was placed in the other. The advantage of this method of producing oscillations is that it is self-cooling and self-regulating. Self-regulation is effected by fixing the copper block on one end of a counterbalanced arm so that it can be adjusted to float with a definite pressure on the edge of the disc. The instrument requires little or no attention, and has been worked all day without adjustment and with no appearance of change.—*Abstracted from the Electrician (London), November* 23.

Electric Hauling on the Vienna Railway.

A complete description is given here by Karel Rosa and Vladimir List of the locomotive proposed by the Elektrotechnischen Fabrik Fr. Krîzîk, Prague, Austria, for use on the Vienna Railway. The locomotive is equipped with four motors, each rated at 130 horse-power for one hour. They take current at 750 volts and revolve at 545 revolutions per minute. They are geared in pairs to the two driven axles of the locomotive, each motor of a pair driving through its pinion and a common gear. In this way all thrust on the shaft is avoided, so that it is only subjected to a torsional force. The motor frames are split longitudinally to give access to the armature. There are four poles, each having its own coil. The provision for ventilation is exceptionally good. The motors are connected in pairs in series and are supplied from a three-wire, 1,500-volt overhead system, the track being used as the neutral line. The motors are started by connecting all four in series across one side of the system, one of the two collecting devices being disconnected at this time. After the resistance has been cut out one pair of motors is then short-circuited, throwing the other directly across this side of the system. The other pair of motors is then connected to the other side of the supply system. The collecting device is of the pantagraph type, with a roller which presses against each wire. The switches are operated mechanically and are provided with magnetic blowouts. Compressed air for operating the brakes and track-sanding device is supplied from a compressor driven by a double motor, each half wound for 750 volts. The controller is operated by a large hand wheel placed in the locomotive cab in the rear of the switching devices, so that their operation may be closely watched. Tests of the motors proposed for the locomotive show a very flat efficiency curve which reaches eighty-eight per cent with an output of 120 horse-power.—*Translated and abstracted from Elektrotechnik und Maschinenbau (Vienna), November* 11.

On the Relative Activities of Radium and Thorium Measured by the Gamma Radiation.

Recent work by Boltwood and Dadourian shows that about one-half of the radio-thorium in radioactive materials is abstracted in the chemical processes of preparing the commercial salts of thorium. This fact was established independently by two observers, one measuring the alpha activities of the minerals, and the salts; the other comparing the activities of their respective emanations. To complete this research A. S. Eve has carried out a similar investigation, using, however, the gamma radiation method. The object of the experiment was not to verify the work of the experimenters mentioned above, but to ascertain if the method employed gave results in good agreement with the other two. This was found to be the case. The work consisted in determining the ratio of the gamma activities of radium and thorium when both are in radioactive equilibrium, and in ascertaining the relative amounts of radio-thorium and thorianite and thorium nitrate, respectively, by measurement of the gamma radiations. The experiments were made in the usual manner by an electroscope. The substances compared were radium bromide, thorianite and thorium nitrate, the source of each being given. The relative activities as well as the specific activities were determined, and the following results are deduced: The thorium and its products in the thorianite are more active than the thorium and its products in the thorium nitrate in the ratio of two and one-half to one, a result in good agreement with Boltwood. Radium bromide in radioactive equilibrium is more active than an equal mass of thorium oxide in radioactive equilibrium in the ratio of four and one-half million to one. In a previous paper the author suggested that a kilogramme of commercial thorium nitrate might form a convenient standard for gamma ray measurement. The recent investigation demonstrates that this suggestion was not a good one, since the radio-thorium would be continually increasing in such a standard, and at a rate at present unknown. The only feasible plan of providing standards seems to be by comparison with a sealed standard of radium bromide of known weight and purity.—*Abstracted from the American Journal of Science (New Haven), December.*

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

ADVERTISING ELECTRICITY—PART II.

BY FRANK B. RAE.

ORGANIZATION OF SOLICITORS.

The soliciting force is the backbone of any campaign of business-getting by an electric light company. The most ardent advocate of advertising, if he be honest, will not endeavor to gainsay this, and only the most ignorant of amateurs w presume to expect any very real results from a publicity campaign which has not the assistance and cooperation of aggressive, tactful and well-schooled solicitors.

The central station manager without advertising experience will immediately protest that these same solicitors could secure the business independent of any advertising effort. Very true. But the advertising will enable the solicitors to get more business in less time. It is a matter of economy and common sense to employ whatever means will make for quicker, easier selling. The object of advertising is merely to create opportunities for the sales force; to awaken interest in the commodity offered; to educate prospective users to an appreciation of its advantages, and finally, to bring them to the point where it is both expeditious and easy for the salesman to secure contracts. It is not the aim of advertising to usurp the functions of the salesman, only to make his work easier, to the end that he shall write a greater amount of business upon more favorable terms and in less time.

ORGANIZATION OF SOLICITORS.

The organization of a soliciting force is a matter so wholly dependent upon local conditions that it would be futile to lay down any cast-iron rules. Circumstances may prescribe one solicitor or fifty. They may make it essential to call upon the specialist or the manufacturer's representative. However, there are a few fundamental principles which should underly this organization, whether the force consists of one man or many. These principles may be stated somewhat thus:

(a) The division of responsibility should be carefully marked, to the end that each individual shall realize to the fullest extent his duties to the company and be held in strict account for his success or failure in procuring business.

(b) All information concerning business which is being actively solicited, as well as complete data on the entire prospective business of the city, should be so arranged and in such form that the solicitor can not "carry his business under his hat." In other words, such system should be installed as will make available at all times full and complete information as to the status of every prospect. It should be possible to take any solicitor off the job and substitute another without confusion or misunderstanding between the company and the parties being solicited.

(c) Such reports should be required as will absolutely and instantly show just what each solicitor is accomplishing.

In a company where a single man attends to the business-getting, the accomplishment of the second and third obje is obviously much more difficult than when a large organization is at work, but on this very account it is imperative that the one-man company shall employ every means to protect itself and its business from incompetence or dishonesty. It must be remembered that, at the prices currently paid to men engaged in this work, it is impossible to secure in every case thoroughly first-class and honorable men. System is the only protection, and the smaller the company the more necessary is a safeguarding system.

PERSONNEL OF FORCE.

In an organization of moderate size, the personnel of the soliciting force may properly include a contract agent and from two to twenty solicitors. The contract agent should himself be competent to solicit successfully any class of business, and while he may employ specialists in power, sign and illuminating engineering work, he should be the type of man, who at any cost can maintain his position as the final arbiter; who can, when the occasion demands, step in and close difficult contracts. He should be a man who, by absorption, study or experience is thoroughly familiar with local conditions. He should be a man with politic instincts, a good "mixer," and a trained diplomat. But foremost and finally, he should be a business-getter—that is the sole test of his value.

It may be remarked by the reader that such men are extremely difficult to secure, but this is not so true as might be believed at first glance. It must be borne in mind by the manager of a lighting company that exact technical knowledge is not essential to the successful sale of any commodity—even electricity—and while it is essential that the contract agent have a fair working knowledge of electrical practice, such knowledge can be gained by the right sort of man in a comparatively short time. It is the man that is needed, not the technician; and if evidence is required on this point, we might suggest that the best salesmen and salesmanagers in any line do not necessarily graduate from the manufacturing departments, but are developed in the commercial departments, acquiring there a sufficient working knowledge of their product, and the correct methods of marketing it, to win them success as commercial diplomats.

Under the contract agent, specialists may well be employed. A power solicitor is generally essential, and such a man must combine accurate knowledge of power conditions and manufacturing practice with a fair amount of salesmanship, plus that what may be termed "guessing ability." Upon such a man falls the responsibility of frequently "sizing up" a shop almost at a glance and making a definite proposition to the proprietor thereof for the furnishing of his power. Few small manufacturers or proprietors of small shops have the patience or time to go deeply into their power problems and such business is more easily secured by the solicitor whose running knowledge admits of quick and accurate decisions. While such a "sizing up" is in reality little more than mere guesswork, the power solicitor should have, as a basis of his guessing, sufficient knowledge and experience combined to make his estimates correct twelve times out of thirteen. Unless he can do so, he is not the man for the position.

Another specialist may be in charge of store lighting installations. To such a man a fairly complete knowledge of illuminating practice is absolutely essential. It must be remembered by the central station manager that the time-worn complaint "it costs too much" is caused,

Digitized by Google

not so much by the cost per kilowatt of current, but by the number of kilowatts absolutely wasted every month in the average installation. The day is past when the lighting companies can afford to "overload" their customers. Experience teaches that agitation for lower rates and municipal ownership inevitably follows the practice of securing false profits through inefficiency. To make installations at once complete and economical is the duty of the solicitor in charge of the store lighting. And the more conscientiously he works in the interest of the lighting company's customers for the purpose of giving them efficient installations, the better he serves, and the more valuable he is to the company.

A third specialist may be given charge of window lighting, display lighting and sign soliciting. Such a man depends for his success upon his ability to make practical suggestions to prospective customers regarding clever and unusual decorative installations. He should be a close student of window trimming; he should have stored away in his brain many unique ideas for effective and decorative schemes of window lighting, and should be able to present these ideas either by word or in sketch, in a manner to instantly interest his client.

The balance of the soliciting force would be engaged in residence work and in handling the poorer class of store installations. These men need not have a very profound knowledge of illuminating, but it is obvious that the more information along these lines they do possess, the more effective their work will be for their company.

In handling this force, a thorough, and at the same time simple, system is essential—a system whereby both the contract agent and the manager of the company may at any moment be completely in touch with the work of all solicitors. Such a system has for its object an accounting of the solicitors' time and expense; a record of the condition of each prospect, and a record showing the amount and desirability of business secured by each solicitor. Further, it should show the cost to the company of all business secured, such cost being computed in gross, and per kilowatt, per horse-power or candle-power equivalent, as the custom of the company demands.

EDUCATION OF SOLICITORS.

It is self-evident to the central station manager that the more knowledge a solicitor possesses, the more enthusiasm he brings to his work, the more valuable will he be to his company. For his part, every ambitious solicitor understands the truth of that hard-worked adage, "To earn more, learn more." The trouble appears to be that the average solicitor is lacking in ambition, while the generality of managers fails to realize the very obvious necessity for schooling solicitors in the art of selling, in the science of illumination and in general central station practice. The company which will show the greatest returns upon its investment in solicitors is the company which first realizes this necessity and acts accordingly. The company must not expect the solicitors to take the lead in such matters. A sixty-dollar-a-month man is not likely to be goaded forward by any irresistible ambition; rather, he must be boosted up the tree of knowledge by main strength. We may deplore the conditions of our lesser brethren, but we may as well acknowledge the truth—a good many men are lazy and it is only by constant bribery, cajoling and abuse that they can be forced to do much more than draw their pay.

Perhaps the most successful method of educating and enthusing the soliciting force is by means of regular meetings. At these both the manager and contract agent will find it necessary to take the leading part. The men must be encouraged to express their views of business-getting prospects, to boast of their accomplishments. Every possible device must be employed for instilling into them an esprit de corps and a desire to study and hustle. It has been found effective to invite to speak before such meetings some prominent man with a genius for saying trite things in an inspiring manner. The principles of a political meeting should prevail; the objects being to promote loyalty to the party, enthusiasm for party leaders and determination to get out and work for the good of the cause.

Next to well-conducted meetings, may be counted the reading of inspirational periodicals and books. The technical press has a very high place in the education of solicitors and no opportunity should be lost by the head of a soliciting force to see that his men are given every opportunity for studying them. Catalogues of manufacturers should also be available. Text books on power and illumination should always be at hand. Quite naturally the success of such methods lies with the manager or contract agent. He is the prime mover and upon the amount of energy he develops will depend very largely the dynamic force thrown out by his assistants.

On the subject of actual salesmanship, I hesitate. Much maudlin drivel has found its way into print on this subject of salesmanship; and also, and occasionally, a few words of sound common sense. It is very possible to reduce the art of selling to a few fundamental principles and to construct from these something which may approach a scientific formula for getting business; but it must be remembered that all such formulæ are inaccurate in that they include two unknown quantities—two personal equations, those of the salesman and his prospective customer. Nevertheless, salesmanship is something which can be taught and learned. The problem which confronts the lighting company is, whether the cost of such education will be returned in increased business. The experience of several large companies would indicate that it will.

The contract agent, however, can not personally undertake to carry on the work of minutely instructing the solicitors in all the principles and practice of salesmanship. He must as a rule turn them loose to rise or fall according to their latent abilities. There are certain peculiar considerations in central station business, however, which he may well insist upon at meetings and in his daily talks. All reference to technicalities should be avoided. The central station solicitor is selling illumination, not light. He is selling advertising, not signs burning a certain number of lamps. He is selling motive force, not horse-power or kilowatts. The customer should neither know nor care about kilowatts. In short, the business of the central station is to sell results, and the less said about the technical means used in accomplishing these results, the better for all concerned.

THE DISPLAY ROOM.

The display room should properly be considered in connection with the soliciting force as a means toward increased business. It should be apparent that the object of such display is to show electrical appliances and to demonstrate their operation. That this end is not gained once in a dozen times is through lack of realization of these primary objects.

The public is deplorably ignorant in matters electrical. Not one man in fifty knows what causes an electrical heating appliance to heat. Not one woman in a hundred will believe that it is not dangerous until its safety has been demonstrated. Most people judge a motor by the quality of its japanning. Electric vibrators, heating pads, sign flashers and dozens of other devices are absolutely mysterious. This apparatus should be

Digitized by Google

explained minutely and in words of one syllable. Not only should it be explained; it should be demonstrated. People like to see the wheels go round. Some managers do not realize that their display room is neglected, the appliances rusty, dusty and shop-worn. They have not learned to be merchants. The writer once inquired concerning a device on exhibition at the show-room of one of the half-dozen leading central stations of the country, only to find that it was out of order. How reassuring this incident would have been to a prospective purchaser of the device! To find it out of order in the lighting company's show-room would assuredly argue against its working continuously and satisfactorily for him.

Where displays are made in a window it is best that they be restricted to very few appliances and that show-cards be used liberally. Tell the public what the device is—what it will do—what it costs to operate—what it costs to install. A sewing-machine motor in itself means nothing to a housewife; but hook that motor to a machine, connect it to a circuit so that it may be instantly demonstrated, and affix a show-card telling that it costs $15, operates at the same expense as two lamps, that it eliminates backache, is foolproof and is guaranteed on a money-back basis for one year, and you have "got her going." The object of the display room is to educate the public to an increased use of electric energy, but this object can never be attained by stocking up with a variety of machinery which, under the most favorable circumstances, demands more explanation than almost any other merchandise.

Not alone should the display room be designed to show off electric appliances to bill payers, the passing public and the casual caller, but it should be used without stint by solicitors. The power solicitor, arguing with a prospective customer over the installation of individual motor drive, should be in position to take his man to the display room and demonstrate to him the advantages of the direct connection with some such a tool as a drill. It can readily be figured out that drills operate on an average only a small part of the day. Why should the manufacturer continue through the entire day to turn over heavy, wasteful shafting and belts when, by individual motors, he can restrict this power consumption to the few hours the tool is in operation? At this point the solicitor should close the circuit, push a piece of material under the drill, bore a few holes, throw it off and show the prospect just how little this operation has cost. Seeing is believing.

Or let us presume the solicitor to be talking to a merchant about signs. In the display room he can be shown the various makes of signs, their merits and demerits. It can be demonstrated to him by meter test that the sign offered is not expensive and by examining its construction he can see for himself that it will last forever. Let him see it, feel it. Any salesman on earth can become four times as enthusiastic with the actual object of sale in his hands. He can demonstrate forty different advantages, which would entirely slip his memory if talking from a catalogue. The display room enables the solicitor to cut out scintillating generalities and talk "brass tacks."

In connection with bringing prospects to the office for the purpose of demonstrating apparatus, there is a further advantage—it affords an oportunity for the customer to become acquainted with the company, its officers and its methods of doing business. It is policy for the solicitor to introduce his prospect to the contract agent or manager. He should be made to feel that he is doing business with a firm of decent business men, not a soulless corporation; that he is negotiating for a desirable commodity, not being talked into a contract by an agent whose bread and butter depend upon his glibness. A friendly handshake by the manager and an expression of the hope that the company and the solicitor may be of service to the prospect, will do more towards cementing the friendship between a lighting company and its customers than forty printed advertisements or four hours of solicitor's talk.

The Boston Rejuvenation of the Sons of Jove.

The second Boston rejuvenation of the Sons of Jove was held at the Revere House, Boston, Mass., Friday evening, December 7, and was in every way a success. Forty candidates presented themselves for degrees, which were conferred under the direction of Frank Booth, Jovian statesman. Immediately following the initiation a banquet was served, followed by addresses from the various Jovites. Music and entertainment were given by those of talent among the gathering.

The following officers took part: Jupiter, W. F. Hessel; Vulcan, George H. Moseman; Hercules, Harry W. Bliven; Mars, George W. Bates; Pluto, Charles F. White; Neptune, V. C. Wetmore; Imps, Albert Mann, T. H. Bibber and "Aleck."

New York City May Grant a Telephone Monopoly.

The board of estimate and apportionment of New York city has referred to Corporation Counsel Ellison the matter of granting the New York and the New York & New Jersey Telephone companies a monopoly of the telephone business in New York city. The request for the granting of this monopoly followed a proposal by the Atlantic Telephone Company for a franchise for its automatic system. The Atlantic company offered to give a five-cent service for all boroughs, with an unlimited service at $12 per annum. This proposition has since been modified to give more advantageous terms on extension instruments. John G. Carlisle, general counsel for the Bell companies, has filed an argument contending that the city has the right to grant a franchise for a monopoly in the telephone business. This is the point on which the corporation counsel has been asked to give an opinion.

The Telharmonium at the Automobile Club Dinner.

It is the practice of the Automobile Club to introduce at its annual dinner some novelty for the entertainment of its guests. The feature of last Saturday evening's musical programme was the performance in the dining room at Sherry's, while a series of moving pictures were being shown, of telharmonic music, the artist at the keyboard at the telharmonium station at 39th street and Broadway pressing the keys which started electric currents along the wires. These on reaching the receiver in the dining room produced the tone, the music being not a reproduction—as many imagine—but an original effect.

Although the Telharmonic Company has not yet installed all the dynamos and all the keyboards necessary for giving complete orchestral effects, it has been encouraged to begin the service of music from its central station by the appreciation shown of the tone qualities now obtained, many of which are familiar, and many of which are new to the world. Its transmission to Martin's one month ago was then the only one in the city, and now it is being transmitted, on occasion, to the Hotel Imperial, and installations are being, or are about to be made in a large number of the leading hotel dining rooms and restaurants, and in many private houses. It is estimated that from the single keyboard at 39th street music can be produced in 25,000 stations simultaneously.

Digitized by Google

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The "American" Water Softener.

The accompanying illustrations show several of the details of the water softener and purifier, manufactured under the Bruun-Lowener and other patents, by the American Water Softener Company, 1011 Chestnut street, Philadelphia, Pa. While the apparatus is standard in its details, each plant is especially designed to meet local conditions and guaranteed to give definite results at a given cost.

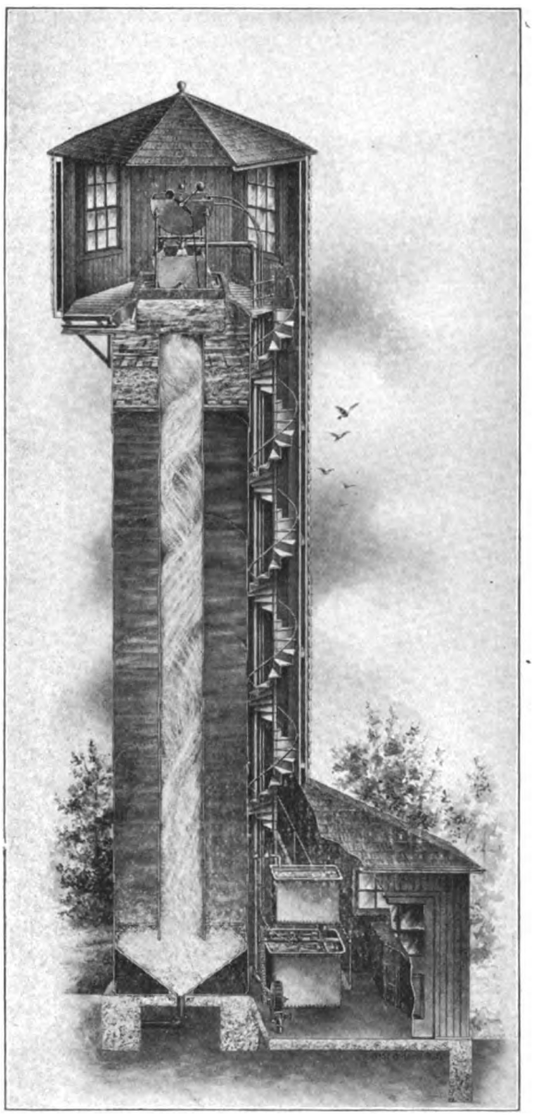


FIG. 1.—SECTIONAL VIEW OF SOFTENING SYSTEM.

The laboratory of the American Water Softener Company is completely equipped with every apparatus for the analytical study of water, and is under the charge of one of the officers of the company, who is an expert chemist. Samples of water are carefully analyzed, and the amounts of chemical necessary for treatment are determined. The water is then treated with these amounts and again analyzed, allowing a guarantee on cost of treatment and results to be given. By a simple testing apparatus furnished with each installation any variation in the quality of the softened water is readily determined, and the necessary adjustment made. Fig. 1 is a sectional view, showing the principle of the American water softener system. The crude water supplied at the ground floor operates a small motor without waste, rises to the measuring and mixing mechanism at the top of the settling tank, where a certain definite percentage of reagent is automatically added; then is delivered with a whirling motion to the downtake, precipitating and coagulating the scale-forming solids, impurities and matter in suspension.

The precipitate which does not settle in the passage down the downtake drops out during the very slow rising in the increased area of the uptake, leaving practically no work to be done by the filter. The clear, purified water then flows by gravity to the storage tank.

Fig. 2 is a ground-floor view showing the mixing tanks and water motors. The mechanism for mixing and handling the softening solution is situated at the ground-level. In the upper tank fresh burned lime is slaked in sufficient amount for twelve hours' operation. After slaking the valve is opened and the lime milk dropped into the lower tank through a screen which removes the foreign matter. Soda ash in the proper amount is then added, and the whole solution thoroughly stirred and kept in constant motion by an agitator. The shafting operating the agitator also operates the pump. The pump, drawing the solution through a fine strainer, raises it to the chemical tank at the top of the tower. Any surplus is returned to this lower tank by an overflow pipe. The power for running the mechanism is furnished by a water motor.

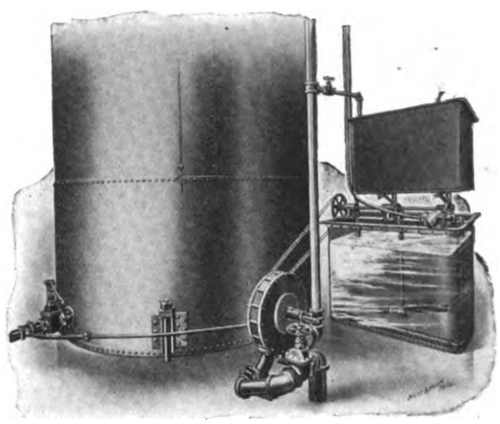


FIG. 2.—MIXING TANKS AND WATER MOTORS.

The water enters the motor, revolves it, and then passes out through the pipe on the opposite side and up into the oscillating receiver. Since the motor is of the direct and positive type and a free exhaust is unnecessary, there is no waste of water. With an effective water pressure of three pounds sufficient power is furnished by the motor. The solution tanks are made of such proportions as to contain from twelve to twenty-four hours' supply.

Fig. 3 is a view of the upper mechanism, showing the tipper and solution reservoir. The softening solution is pumped from the ground level through the small uppermost pipe to the chemical reservoir tank. The crude water flows through a large pipe into a chamber of the oscillating receiver.

Digitized by Google

As this chamber is filled, the centre of gravity moves until the equilibrium is lost and the receiver tips, pouring its contents in the tank and at the same time bringing the other chamber of the receiver beneath the orifice of the supply pipe.

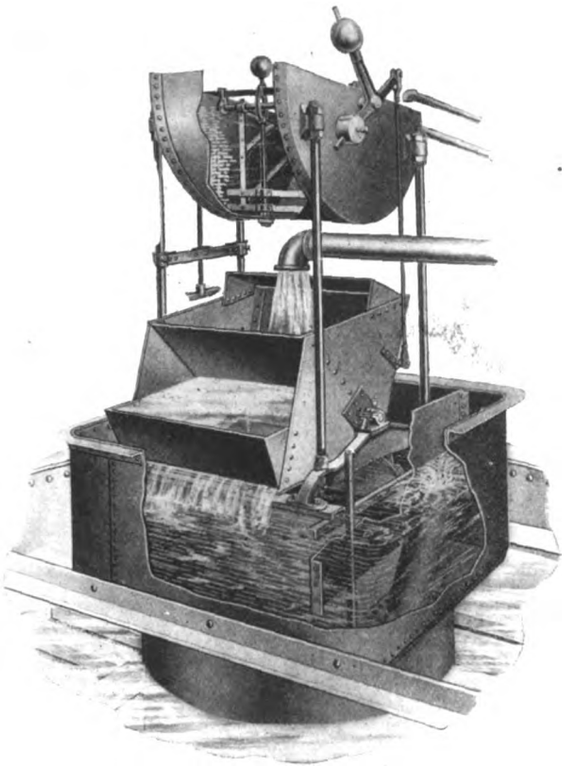


FIG. 3.—TIPPER AND SOLUTION RESERVOIR.

Above the receiver is the semi-circular reservoir tank containing the softening solution, in the bottom of which is a valve, through which the solution falls into the oscillating receiver. This valve is operated at each oscillation of the receiver, delivering a definite, constant amount of solution at each oscillation. The lift of the valve is quickly and easily regulated for any required amount of softening solution. The oscillator is always operated by the same amount of water, and the valve, with the constant head of solution in the tank, always feeds exactly the required amount of solution, whether there is one or ten oscillations per minute. Fixed to the under side of the oscillating receiver is a paddle, which acts to prevent too violent movement of the oscillating receiver and more thoroughly mixes the water with the softening solution. The chemical tank has a stirring device to keep the chemicals in constant motion. This agitator is operated by means of the rod and rocker arm connected with the receiver.

The water, upon leaving the oscillating receiver, passes to the bottom of the small tank under the division plate and into the compartments containing the pipe, thus preventing any pulsations in the main settling tank and thoroughly mixing the softening solution with the water. The angle at which this pipe is set causes the water to shoot in such a manner that it is given a whirling motion in passing down through the cylindrical downtake.

In small plants in which it is advisable to run the solution directly into the upper tank periodically the quantity of solution fed at each opening of the valve would decrease as the height of the solution diminished. In order to overcome this a tank divided into two parts has been evolved. This is shown in Fig. 4. The paddles are made of a scoop shape, and, at each oscillation of the tipper, carry a quantity of the solution into the valve compartment in excess of that discharged, the excess flowing back. Thus there is a constant head above the valve discharging solution which causes the amount of softening solution delivered at each oscillation to be exactly the same.

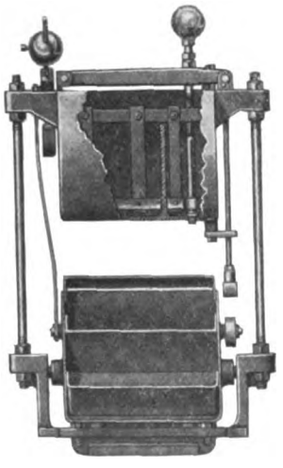


FIG. 4.—SOLUTION TANK FOR SMALL PLANTS.

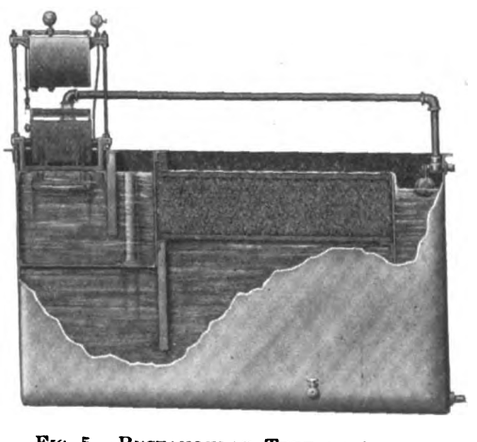
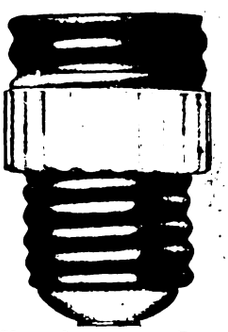


FIG. 5.—RECTANGULAR TYPE OF APPARATUS FOR SMALL PLANTS.

For industrial purposes, where a smaller quantity of water is wanted, a rectangular type of softener may be employed. The principle is the same. The chemicals of the softening solution are mixed as before, pumped into the semi-circular container above the tipper, and the water is fed to the tipper in the same way. The only difference is that instead of the high-circular downtake and tank for settling the water flows under a partition from the compartment in which the tipper discharges up to a chamber, in which it rises to flow through a downtake pipe into a settling chamber which is divided into two parts by a partition with an opening at the bottom; then up through a filter to the storage compartment. The height of the water in the storage compartment regulates the flow of crude water into the softener by means of a float and valve. The rectangular type for small plants is shown in Fig. 5.

250-Volt Indicating Plug Fuse.

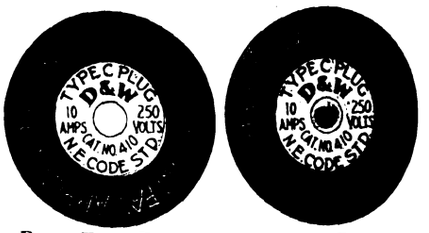
The D & W Fuse Company, Providence, R. I., has placed on the market a 250-volt indicating plug fuse designated as the type C, National Electrical Code Standard. This is an Edison plug fuse embodying the merits of the company's cartridge fuse,



250-VOLT INDICATING PLUG FUSE.

including its well-known "Bull's-Eye" indicator. This indicating feature is a new one with 250-volt plug fuses.

The accompanying illustrations show the full size of the plug fuse and the appearance of the fuse before and after blowing. An important feature in the construction of this fuse is the possibility of its being readily renewed by returning to the factory, reducing the cost of maintenance. The company announces that with this fuse it has been able to meet all of the rigid requirements called for by the National Board of Fire Underwriters, in recognition of which it has received the approval of the board, and the fuse is now listed among the board's approved electrical fittings for October, 1906.



PLUG FUSE BEFORE AND AFTER BLOWING.

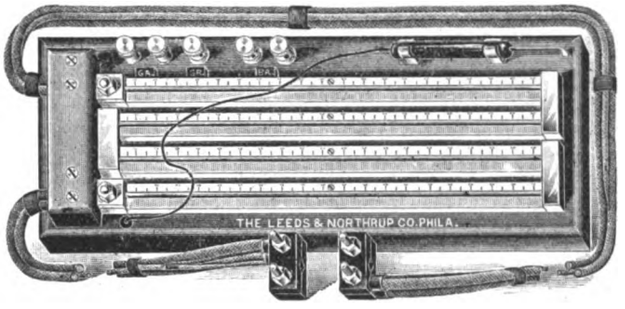
Digitized by Google

A New Slide-Wire Bridge.

The location of faults in circuits made up of low-resistance conductors, such as power cables, involves the reduction to a minimum of all contact resistance both external to the apparatus used for such purposes and in the apparatus itself.

The importance of small contact resistances is evident from the fact that all such resistances will enter as an error in the measurement. If, for instance, a contact resistance should amount to .001 of an ohm and the cable be of such size that .001 of an ohm equals the resistance of twenty feet of the cable, there would be an error in locating the fault by this amount. Most of the errors in localizing faults by the loop method are due to the resistances of the connections being disproportionately high.

The Leeds & Northrup Company, of Philadelphia, has placed upon the market a slide-wire bridge, which has embodied in its design a construction which the maker states eliminates all errors due to lead wires and their contact resistances, and which is shown in the accompanying illustration.



NEW SLIDE-WIRE BRIDGE.

The bridge wire is made large, so that it will easily carry a large current, and thus give a good sensibility for locations even on cables of large cross-section. The wire is subdivided into a thousand divisions, each of which is one-sixteenth of an inch.

The errors due to the resistance of leads and contacts are avoided by providing the two ends of the bridge with eight feet of flexible cable of a large cross-section. At the leads are heavy contact blocks for clamping on to the end of the cable to be measured or they may be connected directly to the switch in which the cable terminates.

The galvanometer contact is made at the clamps at the end of the flexible cable, so that the cables are included in the bridge wire and are allowed for in the calibration of the bridge wire.

The arrangement of the connections, including the lead cables and the galvanometer contacts, is shown in the diagram of connections.

The clamps at A and C must be so fastened that the contact resistance will be very small. For the same reasons all contact resistances throughout the loop from A to C must be made negligibly small.

The battery and galvanometer are to be connected in at the binding-posts marked Ba and Ga, respectively, and the binding-post Gr is to be grounded. It will very frequently happen that the ground is to the cable sheath or some other conductor. In these cases the binding-post Gr should be connected to this conductor. Sufficient battery should be used to give a readable deflection on the galvanometer for a small movement of the contact on the bridge wire.

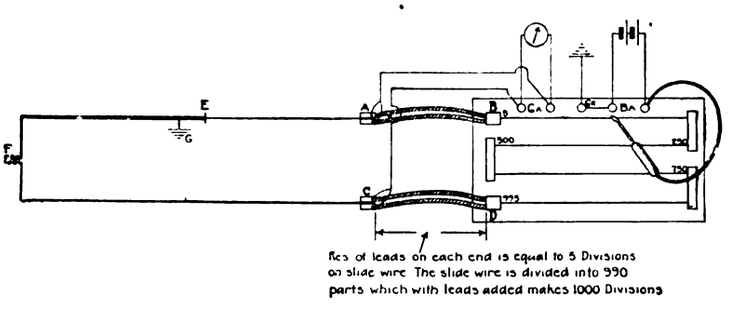


DIAGRAM OF CONNECTIONS.

The fault is located by the usual Murray formula. If, for instance, the galvanometer shows no deflection when the contact is at 300 on the scale, it would indicate that the fault is at a distance from A equal to $\frac{300}{1,000}$ of the total length of the loop from A to C.

It frequently happens that small faults develop in high-potential cables which have a very high resistance, but which are nevertheless likely to break down and result in damage and which should be located. It is usually impossible to locate these faults until they have been partially carbonized. This must be done by connecting a sufficiently high potential between the cable and the sheath (or whatever it is grounded on) to break down the fault. In order to prevent the breaking-down process from resulting in a serious burn-out, a high resistance must be placed in the circuit which will prevent an excessive current from flowing, or the circuit must be carefully fused. The former procedure is probably the better of the two, as a fuse or overload switch may not act quickly enough to prevent damage. After the fault has been thoroughly carbonized, it can be accurately located.

Faults in loops, where the loop is composed of cables of different cross-sections, can be located with the same accuracy as those in loops of a uniform cross-section, provided the length and cross-section of each section of the cable are known. An example will illustrate the method.

In the diagram, assume the section of cable AE to be 550 yards of 25,000 circular mils; EF, 500 yards of 40,000 circular mils, and FC, 1,050 yards of 30,000 circular mils. These lengths must be reduced by calculation to equivalent lengths of one size, and for this purpose it is best to select the largest size.

Five hundred and fifty yards of 25,000 circular mils equal 880 yards of 40,000 circular mils; 500 yards of 40,000 circular mils equal 500 yards of 40,000 circular mils; 1,050 yards of 30,000 circular mils equal 1,400 yards of 40,000 circular mils.

This makes the total resistance of the loop equivalent to 2,780 yards of 40,000 circular mils. If the contact shows a balance for a reading 372.5, this indicates that the fault is at a distance of $\frac{372.5}{1,000}$ of 2,780 = 1,035.5 equivalent yards. Of this 880 yards are in the stretch AE. Consequently the fault is 1,035.5 — 880 = 155.5 yards from E.

New York Central & Hudson River Railroad Storage Battery Equipment.

The Electric Storage Battery Company, Philadelphia, Pa., manufacturer of the chloride accumulator, has installed four of the eight substation batteries contracted for by the New York Central & Hudson River Railroad Company for use in connection with the electrification of the New York terminal. The batteries now in operation are located respectively at Bronx Park, Kings Bridge, Mott Haven and Fiftieth street. The eight substation batteries will have a total capacity of 60,000 horse-power. One of the two exciter batteries contracted for by the same company has also been installed at Port Morris.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

ILLINOIS CENTRAL TO TEST ELECTRICITY—President J. T. Harahan, of the Illinois Central, states that the road will substitute electricity for steam as a motive power in its suburban service as soon as the experimental stage in that means of operation has been passed.

PERMISSION TO BUILD ELECTRIC ROAD REFUSED—The state board of railroad commissioners has denied the application of the Rochester, Corning & Elmira Traction Company for a certificate of necessity to construct an electric line from Rochester to Elmira, N. Y., a distance of about 120 miles.

NEW POWER COMPANY—Articles of incorporation of the Sierra Power Company, of Los Angeles, Cal., have been filed. The incorporators are: George Chaffey, J. W. Swanwick and Walter M. Rose, all of Los Angeles. The capital stock is $2,000,000, with $500,000 subscribed. This company is organized in connection with the Consolidated Water Company, the papers of which were filed with the county clerk a short time ago.

POWER PLANT ON POTOMAC—A company has been formed, with a capitalization of $1,250,000, for the purpose of building a large water power electric plant on the Potomac river at dam No. 6. Among those interested are Lloyd Lowndes, Cumberland, Md.; Henry P. Bridges,, Hancock, Md.; Frank Henry Hanna, Baltimore, Md., and several New York capitalists. The company will furnish power and light to Hancock, Berkeley Springs and other towns in the vicinity.

NEW HAVEN TROLLEYS—The purchase of the Rhode Island Securities Company by the trolley company of the New Haven road was completed on December 3, and steps have been taken which put the practical operation of the Connecticut Railway and Lighting Company also in control of the New Haven road. These two purchases establish the position of the New Haven as one of the greatest trolley-controlling companies in the country. It will have a trolley service more than 1,300 miles in length, with a gross business of more than $16,000,000 per annum. The Rhode Island Securities Company is capitalized for $20,000,000 stock, of which $12,000,000 has been issued, and $5,000,000 bonds. Of the $12,000,000 stock $10,000,000 was given to the United Gas Improvement Company at the time of the formation of the holding company.

ATLANTIC TELEPHONE COMPANY OFFERS TO INSTALL TRIAL SYSTEM—With a view to demonstrating the advantages of its automatic telephone service, Martin W. Littleton, of counsel to the Atlantic Telephone Company, in a statement issued December 2 offered to install a plant for trial in any section of New York city to be designated by the board of estimate and apportionment. This offered to install a plant for trial in any section of New York city engineer of the board, as to conditions in thirty-six cities where the independent telephone companies had gained foothold. This report was abstracted in the ELECTRICAL REVIEW for December 8, and suggests the securing of definite data from the new companies relative to their ability to carry on a telephone business of the magnitude necessary for New York city before further action is taken in the matter of granting a franchise.

COMPROMISE SAID TO HAVE BEEN EFFECTED IN WIRELESS MERGER—It is announced that an amicable settlement has been effected by Abraham White and the other interests back of the recently incorporated United Wireless Telegraph Company, of stockholders' suits against the DeForest Wireless Telegraph Company and its subsidiaries. Henry B. Snyder, the investment broker and stockholder in the original DeForest company, who brought suit against this corporation and all its constituent concerns because of the alleged unlawful conversion of his 27,000 shares, states that he has made a settlement out of court. Mr. Snyder's counsel, James A. Allen, however, is quoted as follows: "Mr. Snyder and Mr. White have discussed a settlement, but no binding contract has been made between them; that is to say, they have signed a contract, but the terms of this contract are not binding on either party to it. Others interested in the stock standing in the name of Mr. Snyder have refused to consent to the terms which have been proposed. Mr. Snyder's suits were brought for the benefit of other stockholders as well as for himself." Mr. White also sent a letter to John W. Griggs, president of the American Marconi Company, announcing the settlement of stockholders' suits against the DeForest company.

MERGER OF RAILWAY COMPANIES—The Hudson & Manhattan Railroad Company has been formed as a result of a consolidation agreement between the New York & New Jersey Railroad Company, a New York state corporation; the Hoboken & Manhattan Railroad Company, a New Jersey corporation, and the Hudson & Manhattan Railroad Company, another New York state corporation. The Jersey corporation and the New York state corporations form a continuous line of tunnel railroad operating between New York city and New Jersey. The new company will have offices in New York city and Jersey City, and will have a capital of $50,000,000, which is the total of the capital of the corporations consolidated. Of the capital $10,000,000 will be preferred five per cent non-cumulative stock. The directors of the new corporation are: Anthony N. Brady, Albany; E. C. Converse, Greenwich, Ct.; Elbert H. Gary, Frederick B. Jennings, New York city; C. N. King, Brooklyn; William G. McAdoo, Yonkers; John G. McCullough, North Bennington, Vt.; G. Tracy Rogers, Binghamton, and E. F. C. Young, Jersey City. Mr. McAdoo is to be the president of the company, Mr. Jennings the vice-president and Mr. King the secretary and treasurer.

REORGANIZATION OF PACIFIC STATES TELEPHONE AND TELEGRAPH COMPANY—A new company, to be known as the Pacific Telephone and Telegraph Company, will take over by purchase the property of the Pacific States Telephone and Telegraph Company in California, lease its property outside of California, and lease the property of the old Sunset Telephone Company, which has about $2,500,000 bonds outstanding to be retired at maturity. The present authorized capital of the Pacific States company is $20,000,000, of which $17,000,000 has been issued, limiting the possible bond issue to $20,000,000, which the directors felt too small for development during the next eight or ten years. The formation of the new company with an authorized stock issue of $50,000,000, of which about $35,000,000 will be issued at once, will permit the authorization of a similar amount of bonds, to be issued in lots of $3,000,000 to $4,000,000 yearly. During the first four or five months of 1906 the new installations by the Pacific States company averaged 3,300 monthly. It is planned to increase this to 8,000 to 10,000. The Pacific coast already has the greatest telephone density of any part of the United States. Of the 51,000 stations destroyed by the San Francisco fire, 21,000 have been replaced.

OBITUARY NOTE.

MR. WILLIAM A. WHITTLESEY, for a number of years treasurer and general manager of the Pittsfield Electric Company, Pittsfield, Mass., died suddenly at his home in Pittsfield on December 5. Mr. Whittlesey was fifty-seven years old. He is survived by a widow, who was Caroline Tilden, daughter of Henry Tilden, of New York city, and three children. Mr. Whittlesey was state representative in 1896 and state senator in 1897 and 1898.

DATES AHEAD.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.

Northwestern Electrical Association. Chicago, Ill., January 16, 17 and 18, 1907.

Jamestown Ter-Centennial Exposition. Norfolk, Va., April 26 to November 30, 1907.

Digitized by Google

PERSONAL MENTION.

MR. THOMAS EWART, manager of the Marlboro (Mass.) exchange of the New England Telephone and Telegraph Company, has been appointed manager of the company's office at Leominster, Mass.

MR. W. W. McKEE has been appointed chief engineer of the Birmingham Railway, Light and Power Company, of Birmingham, Ala., and began his duties on December 1. Mr. McKee was formerly connected with the Public Service Corporation of New Jersey.

MR. FRANK C. MASON, formerly superintendent of police telegraphs, borough of Brooklyn, New York city, who recently retired on half pay to his country place, Glen Alex Farm, near Utica, N. Y., has been called to act as electrical expert for the corporation counsel's office of the borough of Brooklyn. Mr. Mason will make his headquarters at Glen Alex Farm, his presence in New York only being necessary during the trial of important suits in which the city of New York is interested.

MR. W. W. McKEE has been appointed chief engineer of the division and branches of the Erie Railroad Company, has been appointed master car-builder with offices at Meadville, Pa., vice R. W. Burnett, resigned. Other changes in the mechanical department of the railroad company are as follows: J. J. Dewey, master mechanic, Cincinnati division, is appointed master mechanic of the New York division and branches, with headquarters at Jersey City, N. J., succeeding Mr. Schlafge; C. James, master mechanic of the Rochester division, Avon, N. Y., is appointed master mechanic of the Cincinnati division, Galion, Ohio, in place of J. J. Dewey; D. Van Riper, general foreman, Meadville shops, is appointed master mechanic of the Rochester division with headquarters at Avon succeeding Mr. James; G. A. Moriarty, general foreman of the Port Jervis shops, is appointed master mechanic of the Delaware division, with headquarters at Port Jervis.

MR. JOHN M. KLEIN, of San Francisco, Cal., is visiting his friends in the East, and will make his headquarters in New York city until early spring. Mr. Klein is a native of New York state and came to New York city in 1869, where he entered the employ of the Western Union Telegraph Company as a messenger in its main office. He remained with this company in the construction department until 1876, when he went to California, where he entered the fire-alarm service, remaining in this service until 1879, when he established an electrical supply house which soon became the largest individual concern of its kind on the Pacific coast. His company operated in all parts of the world, and in carrying out the details of this business Mr. Klein has been a world-wide traveler, going even to Alaska and Panama. Mr. Klein retired about two years ago, selling out his business interests in the John M. Klein Electrical Works, Incorporated Becoming tired of a life of idleness, and partly owing to the exigencies of the situation following the great fire, he has decided to again embark in business, and has accepted a position as general manager of the Pioneer Electrical Company, of San Francisco. This concern is capitalized at $10,000,000, ten per cent of which is paid up. Mr. Klein expects to return to San Francisco in April, and hopes to open up an electrical business that will be one of the largest on the coast. He is anxious to help rebuild his adopted city, and will devote all his genius and experience to this new venture. He is well known in Masonic circles, being a Knight Templar, Shriner and thirty-second-degree Mason.

ELECTRICAL SECURITIES.

While there has been considerable indecision evident in the stock market, together with irregularity in trading, a rather wide price movement is the net result of the week's activities. The general sentiment is that the stock market has shown remarkably good resistance to adverse developments. Call rates have gone as high as 36 per cent, or the highest since the 40 per cent of early September. Early in the week J. H. Schiff, head of the banking firm of Kuhn, Loeb & Company, made an emphatic appeal to the Chamber of Commerce, New York city, looking toward the restraint of some institutions which were manipulating rates clearly out of proportion to the value of the money advanced. The increase in the dividend of the New York Central from a 5 to a 6 per cent annual rate, with the increase of the Lake Shore from 8 to 12 per cent and the Michigan Central from 4 per cent to 6 per cent, was a favorable development.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 8.

New York:	*Closing.*
Allis-Chalmers common	16¾
Allis-Chalmers preferred	44½
Brooklyn Rapid Transit	79
Consolidated Gas	138½
General Electric	167
Interborough-Metropolitan common	36⅞
Interborough-Metropolitan preferred	76½
Kings County Electric	143
Mackay Companies (Postal Telegraph and Cables) common	72¾
Mackay Companies (Postal Telegraph and Cables) preferred	68½
Manhattan Elevated	142
Metropolitan Street Railway	106
New York & New Jersey Telephone	126
Western Union	85½
Westinghouse Manufacturing Company	153½

Directors of the Metropolitan Street Railway Company, whose terms have expired, have been reelected.

The regular guaranteed quarterly dividend of 1¾ per cent on the capital stock of the Manhattan Railway Company is payable January 2, 1907, to stock of record December 14, 1906. Books closed December 14 and will reopen December 27.

Directors of the Interborough-Metropolitan Company have declared the regular quarterly dividend of 1¼ per cent on the cumulative preferred stock. The dividend is payable January 2 to stockholders of record December 10.

Directors of the Interborough Rapid Transit Company have declared the regular quarterly dividend of 2½ per cent on the capital stock. The dividend is payable January 2 to holders of voting trust certificates of record December 17. Books close December 17 and reopen January 2.

A regular quarterly dividend of 1 per cent on the preferred shares and a regular quarterly dividend of 1 per cent on the common shares in the Mackay companies will be paid on January 2, 1907, to shareholders of record as they appear at the close of business December 15, 1906. The transfer books will be closed December 17 to 31, 1906, inclusive.

Boston:	*Closing.*
American Telephone and Telegraph	137
Edison Electric Illuminating	225
Massachusetts Electric	69½
New England Telephone	128½
Western Telephone and Telegraph preferred	79

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	69
Electric Storage Battery preferred	69
Philadelphia Electric	8⅛
Philadelphia Rapid Transit	22½
United Gas Improvement	96¼

The Union Traction Company, of Philadelphia, has declared a dividend of 5 per cent in accordance with the agreement by which the concern was merged with the Philadelphia Rapid Transit Company. This is the first of the 5 per cent dividends, the time for the 4 per cent dividend having expired. The rate will continue on a 5 per cent basis for the next two years, after which it will be increased to a flat 6 per cent basis.

Chicago:	*Closing.*
Chicago Telephone	117
Chicago Edison Light	144
Metropolitan Elevated preferred	71
National Carbon common	86½
National Carbon preferred	115½
Union Traction common	—
Union Traction preferred	—

The approximate valuation placed on the tangible and the intangible property of the Union Traction Company and the Chicago City Railway Company by the city of Chicago's commission of engineers is $60,000,000. The negotiations for franchises will be concluded on the basis of this estimate.

Digitized by Google

ELECTRIC LIGHTING.

MOBILE, ALA.—The electric lighting contract has been awarded to the Machinery Sales Company, of Cincinnati, Ohio.

HUNTSVILLE, UTAH—Huntsville is to be lighted by current brought from Ogden canyon. The town will be wired at once for this purpose.

EASTON, PA.—Owing to the poor service given by the city electric plant, the mayor advises the making of a contract with a private concern for the lighting of the streets.

BOSTON, MASS.—The Quincy Electric Light and Power Company has petitioned the gas commissioners for the privilege of issuing $50,000 new capital stock for the payment of its floating debt.

NATCHEZ, MISS.—At a meeting of the board of aldermen the city solicitor was instructed to prepare an ordinance requiring telegraph, telephone and electric light companies to place their wires under ground.

DES MOINES, IOWA—Citizens of the town of Atlantic, by a vote of 534 to 254, have defeated a proposition to sell the city electric light plant, which was built and has been operated for fifteen years by the city at a loss.

MILWAUKEE, WIS.—The board of public works and the council's advisory committee have decided that the capacity of Milwaukee's municipal electric lighting plant should be 3,000 arc lights and 10,000 incandescent lights.

SARATOGA, WYO.—The Saratoga Light, Heat and Power Company has purchased machinery to replace that recently destroyed by fire, and Saratoga will again be equipped with electric lights within the next three months.

AUBURN, N. Y.—The Citizens' Lighting Company has purchased the plant of the old gas company on Water street. It is the intention of the Citizens' company to build a large power plant, in order to extend its business of furnishing electric light and power.

ROCKAWAY, N. J.—The borough of Rockaway has decided to purchase the plant of the Rockaway Electric Light and Power Company and to operate it as a municipal property. The cost will be about $25,000. It is expected the transfer will be made about January 1.

ALBANY, N. Y.—The town board of Coeymans has granted a franchise to the West Shore Electric Company to erect and maintain a lighting plant in the town. The company has been organized with the following directors: John M. Briggs, Charles Van Hoesen, Henry W. Baldwin, Arthur Hart and Herbert Layman.

GREENVILLE, S. C.—The Greenville-Carolina Power Company has placed its plant in operation. The company will develop between 3,000 and 5,000 horse-power, and all of this has already been contracted for. The company is capitalized at $300,000, and the majority of the stock is held in Greenville. A. G. Burman, of Greenville, is president.

DAYTON, OHIO—The Merchants' Heat, Light and Power Company has been awarded a contract by the Board of Public Service for the lighting of both the auditorium and the city hall by electricity. The contract is for a period of five years and the rate specified will be five cents per kilowatt-hour. Nernst lamps will be used in both buildings.

FLORENCE, COL.—The mayor has appointed a special committee to investigate and report on the cost of erecting and operating a municipal electric light plant. The Arkansas Valley Electric Company has a franchise in the city which has twelve years to run. The city owns a water system which can furnish sufficient power to generate more than enough current.

CLINTON, MASS.—Work will soon be started on the new power plant of the Boston Heat, Light and Power Company, at Still river, in the town of Harvard. The promoters hope to have the power-house for the electric plant in operation by next July. The electric plant will be housed in a brick building, 120 by 97 feet. The construction work will be under the supervision of Superintendent Fred L. Fullam.

ALBANY, N. Y.—The common council of Little Falls has granted a franchise to the Hudson River Electric Power Company, of Albany, which will permit it to do a general electric business in Little Falls. The company will begin operations at once and until such time as its lines from Spier Falls are completed to that city, current will be sent from its steam station at Utica.

TACOMA, WASH.—H. J. Fuller, special engineer for the city, says that the adoption of a producer-gas plant will solve the city's electric light problem. Equipment to produce 5,000 horse-power, he states, can be installed for approximately $500,000. Electric current could be produced with it, if properly managed, he affirms, for one-half cent a kilowatt-hour, or two-thirds of what the city is now paying and two-fifths of what the power companies are asking.

BERGEN, N. Y.—At a meeting of the village board it was voted that the village enter into a written contract with the Genesee County Electric Light, Power and Gas Company, of Batavia, to light the streets of the village for five years at the rate of $750 a year. It was also voted to enter into a written contract with the company to supply electric power to the pumping station in the village for a term of ten years at $500 a year.

READING, PA.—The West Reading Power Company will shortly begin operations on its new plant on the site of the Shanaman Mill property, recently purchased, on the west side of the Schuylkill river. The company is now negotiating for several additional acres of land, to be used for siding purposes. A connection will be constructed from the Belt Line. The siding will extend to the proposed power-house which, it is expected, will be ready for service early next year.

TERRE HAUTE, IND.—The board of public works has refused a franchise to the Rush Company, which proposes to supply the cities of southeastern Indiana with electric light and electric power from a water power plant, to be established in White river, below Vincennes. The refusal is based on the demand of the company that the contract for street lighting be let several years in advance. Evansville, Vincennes and other cities are considering similar applications for franchise.

JOHNSTOWN, PA.—At the annual meeting of the directors of the Citizens' Light, Heat and Power Company it was decided to spend about $30,000 in improvements to the plant on Vine street, and in the extension of the lines in various sections of the city. A battery of boilers will be installed in the near future. The stockholders reelected the following board of directors: Charles S. Price, James G. Ellis, Scott Dibert, William R. Thomas, Joseph Morgan, James Quinn, Charles F. Kress, Joseph Freidhoff, John H. Waters and John D. Roberts. Later the board met and reelected Charles S. Price, president; James G. Ellis, vice-president, and C. G. Campbell, secretary and treasurer.

GRAND JUNCTION, COL.—It is stated that C. A. Baker, of Denver, and a number of other gentlemen who are interested in the construction of an immense electrical power plant at Green river, Utah, are making arrangements to extensively market their power. The new plant is to be one of the finest electrical power plants in the West when completed. It will cost in the neighborhood of $100,000. The promoters of the plant expect to find the most profitable market for their current in Bingham, where thousands of dollars' worth of electrical mining machinery is being installed. The power will be generated by Green river and transmitted to Bingham, Salt Lake and other places.

NEWARK, N. J.—At a public hearing given recently by the special committee, appointed by the common council, to discuss plans for the erection and operation of a municipal lighting plant, the United Electric Company, through its president, Thomas N. McCarter, submitted a proposition, agreeing to furnish 2,000-candle-power arc lights for the entire city for five years at a cost of $70 per light per annum, the agreement to take effect at the expiration of the present contract with the city, September 1, 1908. The present rate charged by the United Electric Company is $95 a light. The communication further stated that the company would furnish thirty-two-candle-power incandescent street lamps at $16 per light per annum, and all public building lights at five cents per kilowatt-hour.

Digitized by Google

TELEPHONE AND TELEGRAPH.

WATERVILLE, ME.—The New England Telephone and Telegraph Company is rebuilding its line between Waterville and Augusta.

SLEEPY EYE, MINN.—The telephone exchange at Sleepy Eye is being replaced by the Minnesota Central Telephone Company with a common-battery system and cable distribution.

LYNNVILLE, TENN.—The Cumberland Telephone and Telegraph Company is now engaged in putting in a new exchange at Campbellsville, several miles west of Lynnville, which is to be completed by January 1.

RULO, NEB.—The Southwest Nebraska Telephone Company has completed its new copper long-distance toll line, and now has direct connection to all points in Nebraska and with St. Joseph, Kansas City, Atchison and Topeka.

COLD SPRINGS, MINN.—A new exchange, with cable distribution, has recently been opened at Cold Springs. Fifty subscribers have already been connected by metallic circuits by the Minnesota Central Telephone Company.

LAMBERTON, MINN.—The Minnesota Central Exchange has been rebuilt, all subscribers being put on metallic circuits. The overhead wires have been replaced by cable distribution. Seventy-five new rural subscribers have been connected.

WAYNESBURG, PA.—The council has granted a franchise to the Greene County Telephone Company permitting the erection of poles and wires on the borough streets. This company is closely affiliated with the Pittsburg & Allegheny Company.

COLUSA, CAL.—The Home Telephone Company, financed by local capital, will commence construction work at an early date. Material has already commenced to arrive, and when the system is completed will be equipped with the latest telephones. The company has obtained Glenn and Colusa county franchises.

ST. LOUIS, MO.—The Bell Telephone Company has begun the erection of an exchange building at the corner of St. Louis avenue and King's highway, to cost about $60,000. The building is to occupy a lot thirty-five by 107 feet, will be constructed of brick and terra-cotta, and be fireproof. It will be three stories high, with a deep basement.

MINNEAPOLIS, MINN.—The Northwestern Telephone Company contemplates extensive improvements for the coming year. It is intended to give the out-of-town systems throughout the Northwest a thorough overhauling, and in Minneapolis a 9,000-line switchboard will be installed in the central office. In all, the company's officials say, more than $2,500,000 will be spent in improvements.

OAKLAND, CAL.—Designs have been completed for the new Piedmont district building of the Pacific States Telephone Company, and the work of erecting the new exchange will be commenced as soon as the contract can be let for the work. As soon as the new building is completed the entire service in Piedmont will be handled from the new exchange and the prefix "Piedmont" will take the place of "Oakland" on all the numbers in that district.

SPOKANE, WASH.—The Rocky Mountain Bell Telephone Company is extending its lines. Besides completing the line to Spokane, and almost completing the Bonners Ferry composite line, which may be used for telegraph and telephone purposes, connecting Cœur d'Alene with Iola, Elmira, McArthur, Naples, Moravia and Bonners Ferry, it has begun another line to Harrison by way of Fourth of July canyon. These improvements are expected to greatly facilitate business between these points. The service heretofore has been insufficient to meet the demands.

CLEVELAND, OHIO—Ground will be broken shortly for the building of the new "Glen" exchange of the Bell Telephone Company. The building will cost complete with its equipment in the neighborhood of $150,000. The switchboard will have an ultimate capacity of 9,600 lines, supplying service to 15,000 subscribers throughout the northeastern section of the city and Collingwood. The company's new "East" exchange will soon be in readiness for service and in addition plans for a new "Marlo" to be built at Detroit and Highland avenues are being prepared. The completion of these new exchanges will give to the company ten modern fireproof buildings and will make its real estate holdings in Cleveland foot up very close to a million dollars.

NEW INCORPORATIONS.

PIERRE, S. D.—Pierrepont Telephone Company, Pierrepont, Day county. $10,000.

FRANKFORT, KY.—Shelby County Telephone Company, Shelby county. $120,000.

JEFFERSON CITY, MO.—Columbia Electrical Company, of St. Joseph. Increased from $6,000 to $30,000.

GADSDEN, ALA.—Little River Power Company. $100,000, fully paid in. R. A. Mitchell, of Gadsden, president.

KANKAKEE, ILL.—Champaign & Kankakee Electric Railroad. The proposed line to extend from Champaign, Ill., to Chicago Heights. $100,000.

COLUMBUS, OHIO—Stubbs-Mook Electric Company, Cleveland. $5,000. Incorporators: M. A. Mook, J. S. Stubbs, M. B. Mook, H. J. Baker and D. E. Mook.

MADISON, WIS.—Milwaukee Western Electric Railway Company, Milwaukee. $5,000. Incorporators: George W. Schermuly, H. J. Janzer and William Ross.

HELENA, MONT.—Missoula Light and Water Company. $400,000. Incorporators: A. H. Wethey, W. M. Bickford and J. K. Heslet, of Butte, and C. F. McBroom, of Spokane.

LINCOLN, NEB.—Spring Ranche Telephone Company, Spring Ranche, Clay county. $800. Incorporators: W. F. McReynolds, L. J. Dana, P. C. O'Brien and William Ashby.

SOUTH McALESTER, I. T.—The Chickasha Electric Railway Company. $100,000. Officers: Scott Jones, president; W. T. Colsen, vice-president; Alger Melton, secretary, and C. L. Greer, treasurer.

COLUMBIA, S. C.—Suburban Transit Company. To build a number of suburban lines to the outskirts of Columbia. $5,000. Officers: Julius H. Walker, president; J. S. Moore, vice-president, and Bruce W. Ravenel, secretary and treasurer.

COLUMBUS, OHIO—Cleveland, Alliance & Mahoning Railroad. To be built from Cleveland to a connection with the Stark electric railway at Alliance, with an east and west line extending to a connection with the Mahoning and Shenango lines into Youngstown. $10,000, to be increased.

AUGUSTA, ME.—Alabama Interstate Power Company. Organized at Portland for the purpose of developing the power of rivers, lakes and streams, or other bodies of water. $3,000,000. Officers: president, James E. Manter, of Portland; treasurer, Clarence E. Eaton, of Portland.

ALBANY, N. Y.—The Fenimore Electric Light Company, of Sandy Hill. To carry on operations in the village of Sandy Hill, Washington county, and the town of Moreau, Saratoga county. $10,000. Directors for the first year: James F. Bush, William H. Donaldson and Erskine C. Rogers, of Sandy Hill.

RICHMOND, VA.—Lorton Telephone Company, of Lorton, Fairfax county. To run a telephone line 100 miles long in the counties of Prince William, Fairfax and Alexandria. Capital to be between $1,000 and $50,000. Incorporators: Howe Totten, president; D. Morgan, William R. Ward, F. H. Elmore and B. O. Holt, all of Fairfax county, Va.

PROSSER, WASH.—Prosser Traction Company. To build and operate an electric railway through the streets of Prosser and an interurban line to the proposed North Coast railway station, a mile and a half across the river, northward to Euclid, seven miles northwest, and eventually to the Columbia river on the east. $150,000. Incorporators: Frederick Finn, J. W. Callicotte, G. A. Todd, George E. Boomer and F. A. Jenne.

RICHMOND, VA.—The Richmond & Henrico Railway Company, Richmond. To purchase the Citizens' Rapid Transit Company, a corporation chartered under the laws of Virginia, for the construction, maintenance and operation of a street railway and viaduct in the city of Richmond, under an ordinance of the city of Richmond, approved March 10, 1902. $10,000. Incorporators: W. S. Forbes, president; W. F. Jenkins, vice-president; W. P. Forbes, John C. Hagan, secretary and treasurer, respectively; S. L. Kelley, John J. Blake, Edward L. Ryan, all of Richmond.

Digitized by Google

ELECTRIC RAILWAYS.

NEWARK, OHIO—The franchise of the Newark, Utica & Mount Vernon Electric road has been granted by the county commissioners. It is for twenty-five years.

PALMER, MASS.—Good progress is being made on the electric railroad between Palmer and Fiskdale. Rails have been laid from the Monson line at Tennyville to Fentonville, and a long section on the eastern end has been built.

MIDDLEPORT, N. Y.—Work has been stopped on the trolley line of the Buffalo, Lockport & Rochester Railway Company between Middleport and Lockport, and will not be resumed until March, due to the company's inability to keep men during the winter.

CHESTER, S. C.—Chester has granted a franchise to a northern company to begin the construction of a street railway. Lines will be run through the principal streets of the town, which is located on the Southern Railway, midway between Chester and Columbia.

STATESVILLE, N. C.—The street railway franchise asked for some time ago by L. C. Wagner, Isidore Wallace and D. F. Jenkins, of Statesville, has been amended and granted by the board of aldermen of that town. The limit of the franchise is three years from next January.

NEW HAVEN, CT.—At the annual meeting of the Berkshire Street Railway Company at Pittsfield, Mass., the following were elected directors: C. S. Mellen, C. F. Brooker, D. Newton Barney, William Skinner, Robert W. Taft, Nathaniel Thayer, Edwin Milner, R. D. Gillett and H. W. Ely.

HUNTSVILLE, ALA.—A new electric car system is in prospect at Huntsville. The backers of the project are eastern capitalists. It is understood that a franchise will soon be asked for, and that streets not used by the Huntsville Railway, Light and Power Company will be used by the system. The new company, it is said, proposes to develop the city.

WALLA WALLA, WASH.—The Walla Walla Valley Traction Company, which is building the Walla Walla street-car system, now has its suburban line to Freewater and Milton built to State Line, which is about half the distance to Freewater. A temporary bridge has been constructed across Walla Walla river, and the work of laying the track is progressing rapidly.

OSSINING, N. Y.—Ground has been broken for the new street railway system of the Hudson River & Eastern Traction Company, which recently obtained a franchise in Ossining. Mr. Stratton's company is capitalized for $2,000,000. Eventually it will connect Peekskill, Ossining and other Hudson river towns with White Plains by means of a line to Sherman Park, where it will form a feeder to the Harlem Railroad.

CANON CITY, COL.—Frank D. Heath, president of the Great Western Coal Company, whose principal offices are in Canon City, has purchased from F. S. Granger all his interest in the Canon City & Royal Gorge Interurban Electric Railway Company for $25,000. The deed conveys to the purchaser the right of way, franchises and all other property of the company, the value of which it is difficult to estimate, although it is believed to be largely in excess of the price paid by Mr. Heath.

MILWAUKEE, WIS.—The Milwaukee Western Electric Railway Company, another corporation which is to seek entrance to Milwaukee and build a suburban line, has been incorporated by G. W. Schermuly, of Chicago; H. J. Janzer, of Philadelphia, and William Ross, of the Milwaukee Engineering Company. The company proposes to make no application for admission to the city before it has begun construction work upon the suburban line. It is proposed to run the line to Wauwatosa, Hartland, Pewaukee, Oconomowoc, Ashippon, Hustisford, Juneau and Beaver Dam.

PENNSBURG, PA.—The upper Perkiomen valley is to have electric railway facilities. The interests controlling the Schuylkill Valley Traction Company have organized the Lederachsville & Pennsburg Electric Railway Company, and will build a road connecting at Lederachsville with the line now under construction from Trooper to Souderton. The latter will connect at Trooper with the Schuylkill valley road from Chestnut Hill through Norristown to Pottstown. From Lederachsville the new road will run through Sumneytown, Greenlane, Red Hill, Pennsburg and East Greenville to Palm.

YOUNGSTOWN, OHIO—The newly incorporated Cleveland, Alliance & Mahoning Valley Electric Railway Company has closed a deal for the purchase of the old line of the Baltimore & Ohio Railroad between Ravenna and Newton Falls. It is said that the property was obtained at a low price. From Newton Falls the line extends to Leavittsburg, where inter-traffic arrangements will be made to cover Warren and Youngstown. The track between Ravenna and Newton Falls was never torn up by the Baltimore & Ohio company, which operates a few local trains over it daily, and much of the proposed new electric line therefore is already built.

WAXAHACHIE, TEX.—At an adjourned meeting of the city council the Central Texas Traction Company, of Dallas, was granted a franchise to build, maintain and operate an interurban railway system over the streets of Waxahachie. The company has ninety days from the passage of the ordinance to accept it. A forfeiture clause requires the road to be completed within two years after the acceptance of the ordinance. J. F. Strickland, of Dallas, is president of the company. It is the purpose to build an interurban line from Dallas to Waxahachie and thence on to Ennis. It is also understood that Stone & Webster are having a survey made from Dallas to Waxahachie. They will probably ask for a franchise at an early date.

VALLEJO, CAL.—Another interurban electric railroad project has been incorporated in Solano county. The new company is known as the Vallejo & Northern Electric Railroad, and announces its intention of building a road seventy miles long from tidewater at Vallejo to Napa Junction, through the American canyon to Cordelia and to Vacaville and Dixon, and thence on to Winters, where it will have its terminal. A branch road is to run into Suisun and Fairfield. Melville Dozier, of Oakland, is the principal projector of the new road and has been surveying and buying rights of way for the road for the past several months. The other incorporators are T. T. Gregory, George Lackie, John C. Veitch and Francis Kinsey. The company is incorporated for $2,500,000, of which $70,000 is paid in.

TROY, N. Y.—At a meeting held in former Governor Black's office recently the Troy, Rensselaer & Pittsfield Company, having a charter for a proposed electric road between Troy and Pittsfield, Mass., changed hands. It is the intention to make connection at the Massachusetts line with the Pittsfield trolley system. The officers of the purchasing company are: president, A. W. Paige, of Bridgeport, Ct.; vice-president, W. H. Sterling, of Brooklyn, N. Y.; secretary, Alexander McKeogh, of New York; treasurer, H. L. Merritt, of Montclair, N. J. The charter for this road was obtained several years ago and has existed simply on paper. It was said by one of the directors that $58,000 was paid by the new people, who are now in control of the Albany & Hudson Railway, which will be one of the principal factors in furnishing the route.

WASHINGTON, D. C.—The Sandy Spring Railway Company has announced its general plans for the construction of an electric railroad from Chevy Chase Lake to Ellicott City, Md. This company was chartered by the Maryland legislature at its last session, and it is understood to have made subscriptions to the stock of the company sufficient to start the building of the road. The line, if built, will connect with the Capital Traction Company's lines in Washington, and with the United Railways lines in Baltimore, at Ellicott City, making a continuous passage by trolley from one city to the other. The route of the proposed railroad passes through Kensington, Sandy Spring and Ashton and near Wheaton, Norbeck, Olney, in Montgomery County, also near Highland, Clarksville, St. Charles College, and the Frederick turnpike, in Howard County. The company now announces the sale of $500,000 in bonds to provide a portion of the funds for building and operating the line until it is on a paying basis. The officers and directors of the company are: Charles F. Brooke, president, Sandy Spring, Md.; B. H. Warner, vice-president, Washington, D. C.; Allan Farquhar, treasurer, Sandy Spring, Md.; R. H. Phillips, secretary and manager, Washington, D. C.; Spencer C. Jones, Rockville, Md.; Harold Hading, Ellicott City, Md.; Gist Blair, Silver Spring, Md.; Walter A. Johnson, Kensington, Md., and W. C. Robinson, Baltimore, Md.

Digitized by Google

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1506 describes and illustrates a new line of electric hoists

THE H. W. JOHNS-MANVILLE COMPANY, New York city, announces that owing to the increase of business in the city and vicinity of Baltimore, Md., a branch office has been opened at No. 315 Equitable Building, Baltimore. This office will be in charge of W. F. Baird, formerly connected with the Philadelphia branch of the company.

C. J. TOERRING COMPANY, Philadelphia, Pa., is now well established in its new factory at Twenty-first and Toronto streets. C. J. Toerring, president of this company, advises that the company's business has greatly increased since its removal, and that never in its history has it had such a large number of orders on hand as at the present moment.

THE PHILADELPHIA STORAGE BATTERY COMPANY, Philadelphia, is now manufacturing storage batteries for commercial and pleasure vehicles, with factory and offices at Emerald and Tioga streets. Frank S. Marr, president of the company, was for many years president of the Helios Manufacturing Company, manufacturers of storage batteries and arc lamps. E. Earle Everett, superintendent, was formerly with the General Vehicle Company, and is a practical battery man. Edward Davis, treasurer, was formerly vice-president of the United Telephone Company.

THE BLAKE SIGNAL AND MANUFACTURING COMPANY, 246 Summer street, Boston, Mass., announces that last month it signed contracts for its signals with various railroads in the East and Middle West amounting to over $12,000. The interurban roads using a telephone system of train despatching are beginning to realize what a valuable supplement the Blake signals may be to their telephone systems. This system of signals enables the despatcher to stop a car at any telephone point for orders, saving much time and also adding to the safety of operation.

THE CHASE-SHAWMUT COMPANY, Newburyport, Mass., announces that the claim has been made recently that it is using tubing made of asphaltum paper in its enclosed tubes, rather than fibre, as advertised by the company. Samples of this tubing have recently been sent to an analytical chemist in Boston, who, after exhaustive tests on these samples and on fuses of the company's manufacture bought in the open market, reports that the tubing is vulcanized fibre of good quality. The Chase-Shawmut Company announces that it will be pleased to furnish copies of these reports to any one who is interested.

J. ALLEN HAINES, INCORPORATED, 324 Dearborn street, Chicago, Ill., is now an organization conducted as a western branch for the following concerns: American Electrical Heater Company, manufacturers of electrical heating apparatus; Wire and Telephone Company of America, manufacturers of "Romeid" interior telephone wire, rubber-covered wires, magnet wire, bare copper wire, etc.; Stanley & Patterson, Incorporated, manufacturers of bells, annunciators and electrical specialties; Clifton Manufacturing Company, manufacturers of tapes, compounds and conduits; Electric Cable Company, manufacturers of insulated wires and cables and insulating compounds; Bishop Gutta-Percha Company, manufacturers of rubber and lead-covered wires and cables of every description; Dayton Electrical Manufacturing Company, manufacturers of ignition apparatus, storage batteries and generators.

THE D & W FUSE COMPANY, Providence, R. I., has published a new catalogue devoted to its non-arcing fuses and safety devices for lighting, heating, power, railway, signal, telephone and telegraph circuits. The design and construction of these devices are taken up in detail, and a chapter of instructions given in the forepart of the book. The devices are illustrated and price lists for different capacities given. There are twenty-one pages devoted to plates giving dimensions and capacities of various fuses, cutouts and terminals. These plates are very useful to designers and contractors in making up specifications for and laying out switchboards and switch panels. The book forms, on the whole, a very instructive and interesting contribution to the literature of safety devices. The company will be pleased to send this catalogue, which is designated as No. 12, to any one interested upon request.

Record of Electrical Patents.

Week of December 4.

837,277. ELECTRIC FURNACE. Kristian Birkeland and Samuel Eyde, Christiania, Norway. Filed November 10, 1904. The electric arc is dispersed by a magnetic field.

837,296. ELECTRIC WELDING APPARATUS. Weston M. Fulton and John S. Brown, Knoxville, Tenn., assignors to the Fulton Company, Knoxville, Tenn. The work is passed between revolvable electrodes.

837,304. ATTACHMENT FOR MOUTHPIECES OF TELEPHONE TRANSMITTERS. Joseph G. Kitchell, New York, N. Y. Filed November 21, 1905. The mouthpiece is surrounded by a cup providing a dead-air space.

837,349. PENDANT OR LIKE SUPPORT FOR ELECTRIC LAMPS. Hubert C. Smith, Erdington, near Birmingham, England. Filed May 12, 1906. Adjustable supporting cords are attached to the reflector.

837,369. ELECTROPNEUMATIC BRAKE. Edward A. Wright, Edgewood Park, and Walter V. Turner, Wilkinsburg, Pa., assignors to the Westinghouse Air Brake Company, Pittsburg, Pa. Filed March 20, 1905. An electrical method for controlling the valves of a pneumatic-brake system.

837,396. ELECTRIC CONTROLLING SYSTEM. Urias J. Fry, Milwaukee, Wis., assignor of one-half to George M. Basford, Mount Vernon, N. Y. Filed April 9, 1906. An electrical railway-signaling system.

837,411. REGULATING DEVICE FOR ELECTRIC METERS. Robert C. Lanphier, Springfield, Ill., assignor to Sangamo Electric Company, Springfield, Ill. Filed December 13, 1905. An adjustable air-gap is provided in the main magnetic circuit.

837,413. TELEGRAPH TRANSMITTER. Charles W. Leiser, Salt Lake City, Utah. Filed August 30, 1905. A transmitter with a laterally oscillating lever.

837,425. COMMUTATOR. Stanley S. Seyfert, South Bethlehem, Pa., assignor of one-half to William S. Franklin, South Bethlehem, Pa. Filed February 20, 1905. Inductors are introduced into the armature leads in such a way that they neutralize one another except during the period of commutation.

837,440. RECEIVING DEVICE FOR BOND-DETECTORS. Harris A. Watson, Sylvania, Ohio. Filed April 13, 1905. An induction coil is placed around the body of the telephone receiver.

837,457. TELEPHONE TRANSMITTER. Fred W. Fahrenfeld, Rochester, N. Y., assignor to the Simplex Telephone Equipment Company, Rochester, N. Y. Filed August 31, 1905. Means are provided on the bridge for attaching the conductors.

837,469. TELEPHONE RECEIVER. Stephen C. Houghton, Syracuse, N. Y., assignor to the Wire and Telephone Company of America. Filed February 18, 1905. The heel of a permanent magnet of the horseshoe type is embraced by a support.

837,470. HAND TELEPHONE. Stephen C. Houghton and Frank M. Potter, Jr., Syracuse, N. Y., assignors to the Wire and Telephone Company of America. Filed October 5, 1905. The telephone receiver contains a pair of electromagnets attached to the upwardly extending arm of a permanent magnet.

837,498. INDICATING ELECTRIC-SWITCH COVER. Charles G. Perkins, Hartford, Ct., assignor to the Perkins Corporation, Hartford, Ct. Filed January 26, 1906. The metallic shell and insulating lining are perforated by a central opening only.

837,512. ELECTRIC HOSE SIGNALING APPARATUS. William G. Seeley, Brookline, Mass. Filed November 27, 1905. A pair of electrical conductors is woven into the hose.

837,522. AUTOMATIC APPARATUS FOR CONTROLLING AND OPERATING THE POINTS OF ELECTRIC RAILWAYS AND TRAMWAYS. William H. Turner, Rowland E. Dixon and Thomas B. Stewart, Leeds, England. Filed July 27, 1906. The switches are thrown automatically by current taken from the trolley wire.

837,534. TELEPHONE APPARATUS. Garrison Barcock, Rochester, N. Y., assignor to the Simplex Telephone Equipment Company, Rochester, N. Y., a corporation of New York. Filed August 31, 1905. A switch is provided on the receiver.

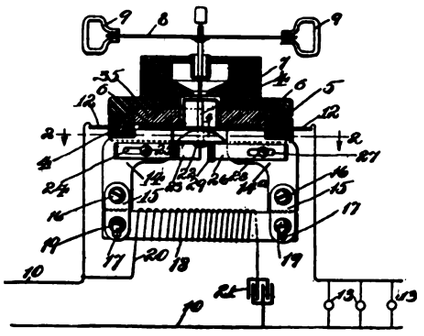
837,567. SECONDARY-BATTERY PLATE. Frank C. Hood, Philadelphia, Pa., assignor to John D. Allen, Philadelphia, Pa. Filed February 20, 1906. A grid of corrugated lead tape.

Digitized by Google

837,594. TELEPHONE-MOUTHPIECE SAFETY GUARD. Edward Stempel, San Francisco, Cal. Filed October 20, 1905. A metallic guard ring to be attached to a retransmitter.

837,599. TEST CLAMP. John H. Williams, East Cleveland, Ohio. Filed March 8, 1906. A clamp with a point for piercing the insulation.

837,616. WIRELESS-TELEGRAPH SYSTEM. Henry H. C. Dunwoody, Washington, D. C. Filed March 23, 1906. The receiving device consists of carbon and silicon.



837,411.—REGULATING DEVICE FOR ELECTRIC METERS.

837,634. ELECTRIC SWITCH. George P. McDonnell, St. Louis, Mo., assignor to American Electric Company, East Orange, N. J. Filed November 9, 1905. A slotted rotary disc is provided with a segmental block mounted in the slot upon which a brush rests.

837,635. BELL-RINGING CIRCUIT. George P. McDonnell, St. Louis, Mo., assignor to American Electric Company, East Orange, N. J. Filed November 20, 1905. A bell circuit is shunted across a portion of a resistance.

837,636. BELL-RINGING CIRCUIT. George P. McDonnell, St. Louis, Mo., assignor to American Electric Company, East Orange, N. J. Filed December 28, 1905. A method of reducing the voltage of a system for ringing the bells.

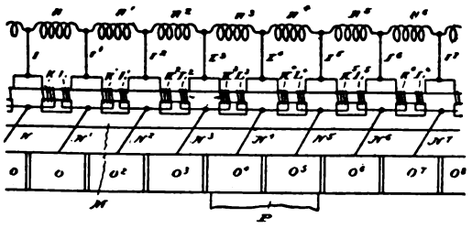
837,638. LAMP SOCKET. William H. Nichols, Bennington, Vt., assignor of one-half to Elmer Ellsworth Larrabee, Bennington, Vt. Filed September 23, 1905. A key socket.

837,654. FINISHING OR GUARD RING FOR ELECTRIC CONDUITS. Albert I. Appleton, Chicago, Ill. Filed June 26, 1905. A rounded guard ring screwed on the conduit.

837,670. ELECTRIC SIGNAL. Harold W. Eden, Detroit, Mich., assignor to P. R. Manufacturing Company, Detroit, Mich. Filed February 5, 1906. The bell hammer is carried on a pivot.

837,671. FRAME FOR ELECTRIC BELLS. Harold W. Eden, Detroit, Mich., assignor to P. R. Manufacturing Company, Detroit, Mich. Filed February 5, 1906. The magnet support is provided with a number of layers of insulating material.

837,672. ELECTRIC BELL. Harold W. Eden, Detroit, Mich., assignor to P. R. Manufacturing Company, Detroit, Mich. Filed December 26, 1905. The bell hammer is held in insulated bearings.



837,425.—COMMUTATOR.

837,673. ELECTRIC SIGNAL BELL. Harold W. Eden, Detroit, Mich., assignor to P. R. Manufacturing Company, Detroit, Mich. Filed December 26, 1905. The hammer is shunted by a resistance.

837,674. ELECTRIC SIGNAL. Harold W. Eden, Detroit, Mich., assignor to P. R. Manufacturing Company, Detroit, Mich. Filed December 26, 1905. The current is broken by a compound lever action.

837,675. ELECTRICALLY ACTUATED SIGNAL BELL. Harold W. Eden, Detroit, Mich., assignor to P. R. Manufacturing Company, Detroit, Mich. Filed July 18, 1906. A method of attaching and insulating the current-carrying post.

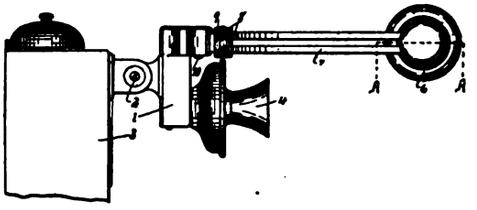
837,682. PROCESS OF IMPROVING THE MAGNETIC QUALITIES OF IRON-SILICON-MANGANESE ALLOYS. Robert A. Hadfield, Sheffield, England. Filed August 21, 1906. An iron-silicon-manganese alloy, low in carbon, is heated to a temperature above its critical point and cooled.

837,693. GROUND CONNECTION FOR TELEPHONE WIRES. Charles Lanz, Knoxville, Pa. Filed October 10, 1905. The ground wire is coiled around a rod to which it is sweated.

837,701. ELECTRIC MOTOR. David Mendelson, Brooklyn, N. Y. Filed March 24, 1906. An oscillating motor for signal purposes.

837,749. INSULATOR. Louis Steinberger, New York, N. Y. Filed December 11, 1905. A metallic member imbedded in insulating material provides a point of attachment for the conductor.

837,771. SELF-RESTORING TROLLEY. James T. Andrew, Montgomery, Ala. Filed September 7, 1905. A helically grooved drum returns the wire to the wheel.



837,469.—TELEPHONE RECEIVER.

837,773. CLEANING STORAGE BATTERIES. Jonas W. Aylsworth, East Orange, N. J., assignor to Edison Storage Battery Company, Orange, N. J. Filed September 8, 1904. The surfaces of an alkaline battery are subjected to a hot, weak alkaline solution.

837,836. TROLLEY HEAD FOR ELECTRICAL TRAMWAY SYSTEMS. Garnet B. Holmes and Arthur D. Allen, Wellington, New Zealand. Filed March 26, 1906. A swivelling trolley head.

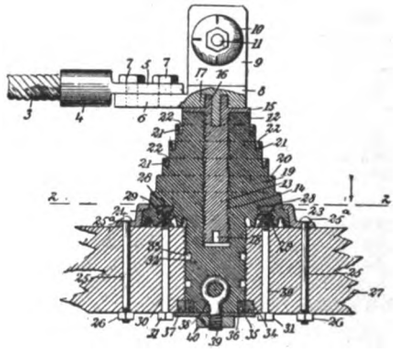
837,853. ALTERNATING-CURRENT MAGNETIC APPARATUS. David Larson, Yonkers, N. Y. Filed November 15, 1905. The pressure of a friction brake is controlled by an electromagnet.

837,854. ALTERNATING-CURRENT MAGNETIC APPARATUS. David Larson, Yonkers, N. Y. Filed November 22, 1905. A friction brake controlled by a simple electric motor.

837,857. RAILROAD SIGNAL. Ernest C. Lombard, Peoria, Ill. Filed September 22, 1906. An electromagnetic railway-signal system for automatically placing torpedoes.

837,889. MEANS FOR COMMUTATING MOTOR AND OTHER ELECTRIC CURRENTS. Stanley S. Seyfert, South Bethlehem, Pa., assignor of one-half to William H. Jacobs, South Bethlehem, Pa. Filed February 6, 1904. Independent windings on an armature are connected to a pair of brushes through an inductance for reducing the short-circuit current.

837,894. TELEPHONE SYSTEM. Johan A. Avén, Stockholm, Sweden, assignor to Deutsche Telephonwerke R. Stock & Company G. M. B. H., Berlin, Germany. Filed August 22, 1905. A system enabling a number of operators to have access to the same trunk line.



837,749.—INSULATOR.

837,897. CONNECTOR FOR STORAGE BATTERIES. Absolam F. Clark, Philadelphia, Pa., assignor, by mesne assignments, to William J. McGonigle, Philadelphia, Pa. Filed May 12, 1903. Renewed September 11, 1905. The connector is protected by a lead covering.

837,901. WIRELESS TELEGRAPHY. Lee De Forest, New York, N. Y. Filed February 14, 1906. A vacuum receiver, one electrode of which is mercury.

837,903. INSULATED RAIL JOINT. Marquis D. Hanlon, Wilkinsburg, Pa. Filed April 4, 1906. A method of insulating rail joints.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 25. NEW YORK, SATURDAY, DECEMBER 22, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK

PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO

WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON

NEW ENGLAND OFFICE, ... 95 MILK STREET

LONDON

EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
- Suitable Methods of Illumination . . . 1003
- Conductivity and Magnetism . . . 1004
- The Physical Meaning of Power-Factor . . . 1004
- The Victoria Falls Power Scheme . . . 1005

Rotary Converters *versus* Motor-Generators, by Miles Walker . . . 1006
Annual meeting of the Electrical Committee of the Underwriters' National Electric Association . . . 1009
BOOK REVIEWS . . . 1009
The Use of Electricity in the Mines of Alsace . . . 1009
The Hydro-Electric and Steam Equipment of the Athens (Ga.) Electric Railway Company . . . 1010
An Enquiry into the Operation, Efficiency and Construction of a Typical Modern Industrial Producer-Gas Power Plant, by J. R. Bibbins. 1013
A Memorial to Faraday . . . 1018
Electrical Mining Notes, by Sydney F. Walker . . . 1018
Chicago Electrical Trades Exposition . . . 1019
Engineers and Their Work, by Sir Alexander B. W. Kennedy . . . 1020
Electrical Trades Society of New York . . . 1021
Illuminating Engineering Society . . . 1022
Comparative Cost of Cooking with Various Fuels . . . 1024
Boston Grants Independent Telephone Franchise . . . 1024
Meeting of the Provisional Organization Committee of the Cooperative Electrical Development Association . . . 1025
American Institute of Electrical Engineers . . . 1025
The Chicago Traction Situation . . . 1025
The Independent Telephone Company of Chicago . . . 1025
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 1026
METHODS OF GETTING NEW BUSINESS—"Advertising Electricity," III, by Frank B. Rae, Jr . . . 1028
Illuminating Engineering Society of New England . . . 1029

INDUSTRIAL SECTION:
- Automatic Starting Compensator for Induction Motors . . . 1030
- Educating the Public to a Better Knowledge of Illumination . . . 1030
- An All-Copper Ground Connection Clamp . . . 1031
- Electric Fixtures . . . 1031
- Sixty-five Mile Interurban Line in Texas . . . 1031
- A New Telephone Instrument . . . 1032

CURRENT ELECTRICAL NEWS . . . 1034
RECORD OF ELECTRICAL PATENTS . . . 1039

Copyright, 1906, by Electrical Review Publishing Co.

SUITABLE METHODS OF ILLUMINATION.

Much has been said of late about the proper methods of illumination and the ways in which we should endeavor to obtain it. We have, it is true, allowed this art to lag sadly behind others—in fact, it has been almost entirely neglected. Those who have given some thought to the matter have worked rather in the dark and not approached it in a scientific way. Now the subject is receiving a good share of attention. It is being attacked from all sides, and we are learning from experiment the effects of different sources of light, how they should be treated for the best result, and how any desired result may be obtained. A clear exposition of our present knowledge was made at the meeting of the New York section of the Illuminating Engineering Society by Dr. Charles P. Steinmetz, who for an hour and a half kept the interest of his audience during a discussion of the physical and physiological phenomena connected with light and the proper methods to be followed to obtain any desired character of illumination. Dr. Steinmetz's wide knowledge, which seems to include something from every branch of science and something about every art, enables him to throw upon these matters an exceptionally clear light and to bring to the subject a great deal of interest.

One of the most interesting points made in this lecture was that calling attention to the differences brought about by the different methods of illumination. As a general thing, illumination should be more or less uniform, sharp contrasts being avoided. Uniformity may be obtained by diffused light or by directed light. The former case is marked by the absence of shadows, and the latter by sharp shadows. Neither method is alone entirely satisfactory, the best results being obtained only when they are combined. This is because the eye, while it is dazzled by sharp contrasts, sees by comparison and there should be provided the necessary gradations, which enable it to distinguish objects.

The eye further sees also by colors, so that the necessity of shades is not so great where the color effects are more marked. These are truths which have only recently been recognized.

Another phase of the illumination problem is that of adapting the various characters of light which we now have to the conditions which they suit best, or, rather, to apply in every particular case that type of illuminant which is most effective. For example, in a shop the light should be yellow, because green is not reflected from dark walls. In the parks the reverse is true, because here the reflecting surfaces are green. Further, for inspection work a light may be selected which makes defects more apparent, and a green light is generally better for this.

We now have illuminants giving us a wide range of character,

Digitized by Google

both as to color and intrinsic brilliancy. The art of producing light, while in some ways backward in that it is hampered by an inefficient method, still is well advanced in other ways—in fact, it is much more advanced than is the art of illumination. It remains for the illuminating engineer to make the most of the various lamps now at his disposal. The efficiency of the lamps will undoubtedly be improved from time to time; in fact, the last year has been productive of a great step forward. But, for the present, this is really a secondary matter as compared with the proper use of the lamps we have.

CONDUCTIVITY AND MAGNETISM.

One of the most puzzling studies in physics has been that of conductivity of materials, both for electricity and heat. Heat is supposed to be the vibratory motion of the molecules of a substance; but electricity is something different. According to the old ideas of electricity the various phenomena met in the study of electrical conduction were puzzling, to say the least. The resistance of a metal increases with temperature, that of electrolytes as a rule decreases, while that of some solid bodies, such as carbon, decreases. Then there is the effect of magnetic field in decreasing—in some cases increasing—the electrical conductivity. That this problem is in some way closely allied to the conductivity of heat was pretty well recognized, but we had no way of picturing to ourselves just what was going on.

The electron theory, fortunately for those who advocate it, meets many of these difficulties, and offers an explanation which can be understood. According to this theory, electrical conductivity is brought about by the actual flow or movement of electrons along the conductor in a direction opposed to our positive current. Every molecule has associated with it one or more of these electrons, but, just as is assumed in the electrolytic theory of dissociation, only a few of these electrons will at any moment be dissociated from their atom, and, therefore, free to move. This being the case, the more widely separated the molecules—as, for example, by heat—the less will any particular electron be under the influence of neighboring molecules, and the more firmly will it be held by its own. Therefore, under such conditions, there will be fewer electrons free at any moment to take part in conduction, and the resistance to flow should be greater, as we know it is.

Further, if the flow of electricity be due to these little negative particles, their motion will be affected by a magnetic field, as was discovered by Hall. If a current be passed through a thin sheet of metal placed in a strong magnetic field the sides of this metal, which are at the same potential when the field is absent, show a difference of potential as soon as it be set up. Further, this deflection of the electron stream, interfering with it as it does, should increase the electrical resistance, as it does.

An effect similar to the Hall effect, just mentioned, is found when studying a flow of heat, a difference of temperature appearing under the effect of a magnetic field where before there was none. This is also explained according to the electron theory by the fact that if heat is due to the motion of molecules, and is transferred from one to the other, there is no reason why the electrons themselves should not take part in this action. Any force, then, which interferes with the flow of electrons must, to some extent, interfere with the flow of heat, and this has been found to be the case. Moreover, these two effects are intimately connected, for when a difference of potential is found, due to the magnetic field, there is also a difference in temperature, and, *vice versa,* a difference in temperature is accompanied by a difference in potential. These are ideas suggested by the electron theory as proposed by Lorentz, but as yet there is only a little experimental evidence dealing with the subject, which is a rather difficult one to investigate. From time to time, however, some light is thrown on the matter, and fortunately for the electron theory this is generally in accord with it or can be viewed so as not to appear at variance. In the *Physikalische Zeitschrift* for November 1, two notes appeared, dealing with different phases of this subject. L. Grunmach, in a study of electrical resistance in magnetic fields, presents results dealing with a large number of metals. The values in most cases are comparatively small, the effect produced by a magnetic field of 16,000 centimetre-gramme-second units being only a fraction of a per cent. Bismuth is an exception, but the behavior of bismuth in magnetic fields has been known for some time simply for this reason, the resistance changes being very much greater than those of other metals. An interesting feature of Grunmach's investigation is that which shows the behavior of the ferro-magnetic metals.

The other note deals with the ratio of thermal and electric conductivities. According to the electron theory, as has been pointed out, the ratio of the thermal to electric conductivity of a material is significant. M. Reinganum has investigated this ratio for various metals, and finds that when plotted as ordinates on a base representing atomic weights that the elements may be divided into two classes, the paramagnetic metals lying above a line, the diamagnetic below. Bismuth, however, is an exception, but this is explained by assuming that the exceptionally great volume of the bismuth atom reduces the electrical conductivity.

It might be mentioned that paramagnetism is explained by assuming that the electrons associated with paramagnetic metals have comparatively large orbits, which enable them to be oriented by an external magnetic force.

THE PHYSICAL MEANING OF POWER-FACTOR.

The student of electrical engineering has a powerful tool put in his hands in the mathematical process of dealing with harmonic motion. All alternating-current theory is based upon the idea of simple harmonic forces. It is true that it is well recognized in practice that this condition seldom prevails; but it is, in many cases, very closely approximated to, and in all cases the results obtained by this method of treatment may be modified so as to give values which are accurate enough for all purposes. To-day we know a great deal more about the modifying reactions and forces which are encountered in our electrical supply

Digitized by Google

systems and devices, and have thus been able to extend the mathematical theory so as to allow for them.

Another great advantage to the student is the use of graphics—diagrams representing the relations of the various forces and quantities under consideration. These present to him a picture of a foundation, upon which he can build up his ideas and from which he can deduce results. These two methods of graphical analysis and the algebra of harmonic motion are essential to all students desiring more than a superficial knowledge of alternating currents.

It is the general practice, therefore, to introduce the student to the subject through these two methods—in fact, in no other way can he so clearly arrive at an understanding of the subject. But the instructor should always point out the limitations of the methods, and he should show that as soon as the phenomenon departs from a simple harmonic motion the methods must be modified accordingly, or the results which they give should be interpreted with the modifications in mind; otherwise discrepancies and misleading conclusions are apt to be drawn.

An example of this kind is sometimes met in determining the power-factor. In the simple mathematical treatment the power-factor is defined as the cosine of the angle of the phase difference between electromotive force and current. It is shown that by multiplying together the effective values for current and electromotive force and introducing the cosine of the angle of phase difference as a factor that the true power is obtained. In the graphical treatment this definition results directly from the method. The power is, of course, the product of either one of the vectors by the projection of the other one upon it, and this projection is equal to the projected line multiplied by the cosine of the angle.

If, now, the curves be not sinusoids, a difficulty in determining the power-factor in this way will be met. It may be found that although the two curves cross the axis at the same point that the power, as measured by a wattmeter, will be less than that given by the product of the effective values—that is to say, although there is no phase displacement the power-factor is less than unity. Some have sought to avoid this inconsistency by considering this phase displacement as that separating the maximum points of the two curves, but here again the same trouble may be encountered; and, moreover, one curve may present two or more maxima. The trouble is simply one of definition, and disappears if a proper one be made. If, in the first place, the power-factor be defined as the ratio of the true to the apparent watts, there is no difficulty. Then it may be shown that with simple harmonic curves this ratio is always equal to the cosine of the angle of phase displacement. Moreover, when defined in this way power-factor has a physical meaning, while if one adhere to the mathematical definition one is frequently in a quandary. What, for example, is the power-factor of an unbalanced polyphase system? Taken as a ratio of true to apparent watts, there is no uncertainty.

This subject—the physical meaning of power-factor—is very interestingly discussed in the *Journal of the Franklin Institute* for December by Professor Albert F. Ganz, who shows peculiar wave forms obtained from various electrical devices now in use, which illustrate very nicely the necessity for a clear understanding of the physical meaning of power-factor.

THE VICTORIA FALLS POWER SCHEME.

The various phases of the proposed development of Victoria Falls, on the Zambesi river, South Africa, have been followed with much interest by the engineering world. At first there was a feeling of awe at the stupendous undertaking, but this gradually disappeared as more definite information rapidly decreased the available horse-power of the falls. The problem is nevertheless one of great magnitude, because the power which it is sought to develop there is not disposable in the neighborhood, but must be carried some 700 miles to be sold. Various have been the schemes discussed in connection with this, one being the series direct-current system, used to a limited extent in Europe. More recently the statement made in the European press, that the development which would first be sought would be one of only 30,000 horse-power, has brought the problem down to rather ordinary dimensions, except, of course, with respect to the length of the transmission line.

The most recent information dealing with this scheme was given out a short time ago in London. The plans proposed are merely tentative, and may, and probably will, be greatly modified before being put into execution. The company owning the concession purposes first to build a steam power-plant at the Rand. The output of this is to be built up until about 20,000 horse-power is being sold; then the company will be ready to go ahead with the hydraulic development. The plans for the latter contemplate a 30,000-horse-power hydraulic station near the falls, although, by digging a moderate canal, this could be doubled, because of the rapid fall of the Zambesi river. From the power-house power is to be transmitted at 150,000 volts, three-phase, on wires placed at the corners of fourteen-foot equilateral triangles. The distance between the wires, it is hoped, will reduce the loss between them, and to reduce this still further, aluminum conductors are to be used, possibly of such design as to increase their external diameter.

With such an expensive transmission system a method of improving the load-factor at the delivery end must be considered. That now proposed is to load motors at the receiving station with pumps, regulating the pumps to maintain the load constant. These pumps are to raise water from a low-level reservoir to one 600 feet above it. During periods of heavy load this water will be allowed to flow back and thus tide over the station.

The plans as proposed are rather indefinite for criticism, though to jump from something over 50,000 to 150,000 volts is a pretty big stride. The hydraulic storage battery is also a novel feature which must be very carefully studied before reliance is placed upon it. But to jump from 200 to 700 miles is also a big step which will doubtless necessitate some departures in engineering, which at first sight appear startling.

Digitized by Google

ROTARY CONVERTERS VERSUS MOTOR-GENERATORS.[1]

BY MILES WALKER.

The use of apparatus for converting from alternating into direct current is increasing every day. At present over sixty per cent of all the alternating current power generated is transformed into direct current before it is used. The present tendency in the design of power distribution systems is to make the power stations of very large capacity, and distribute over wide areas. This necessitates the generation of alternating current power, so that in the future we may expect the bulk of our direct-current supply to be obtained from converting machinery.

In order to compare the advantages of the rotary converter over the motor-generator for the various classes of work it is necessary to take into account a great number of features, and for this purpose I have made out a table in which the advantages and disadvantages are set out in columns.

The four types of apparatus which are in commercial use at the present time are the rotary converter, the motor-converter, the synchronous motor-generator, and the asynchronous motor-generator. I have included in the table the permutator, the electrolytic rectifier, and the mercury vapor rectifier—not because they are at present serious competitors, but because they may at some future time become competitors. We may, however, mainly confine our attention to the first four.

Beginning with the question of starting, the usual practice with large rotary converters is to employ starting motors, because experience has shown that this method of starting is exceedingly simple and satisfactory. Where, however, there is any objection to its use, it is possible to start up either on the direct-current side or on the alternating-current side. For low-frequency rotaries, starting up on the alternating-current side without starting motors and without synchronizers can be recommended. Where it is necessary to cut down the starting current to the lowest possible minimum, ball bearings may be used with safety up to the 500-kilowatt size. Ball bearings have been installed at Leeds, England, on 325-kilowatt rotaries, and have proved satisfactory. One of these rotaries will easily start on one-fifth of the voltage of supply, and the maximum current on starting up does not exceed one-third of full-load current on the high-tension side. For larger sizes, if it were necessary for any special reason to start up on the alternating-current side, special provision can be made in the design of the rotary to limit the starting current to a very small amount. One reason which has been brought against the use of rotary converters in traction work is that, if, owing to failure in the generating station, there is a general shutdown, it is much more difficult to start up again than it is to start up with induction motor-generators which can be started without synchronizing. This objection can be met by using self-starting rotary converters, such as are installed at Leeds and at other places. A self-starting rotary may have attached to it a small exciter in order that its polarity may with certainty be brought up the right way in the first instance. In starting up after a general shutdown with a rotary of this type, all that is necessary is to see that it is disconnected from the direct-current bus-bars, the starting switch is then closed, and the rotary comes into synchronism in about half a minute. After the voltage is adjusted to the right figure, it can be immediately thrown on the direct-current bus-bars. This is in all respects as simple as the starting up of an induction motor-generator set. The position of the motor-converter in the matter of synchronizing is the same as the rotary. There is supplied with the motor-converter a little instrument which indicates when the current in the rotor is at the minimum; after the starting switch has been closed, the current in the rotor rises and falls, depending on the change of frequency. It is just as difficult to hit off the right time for throwing in the motor-converter by observing this instrument as it is to hit off the right time for throwing in a rotary converter by means of a synchroscope, and the time taken is the same under the same conditions, and depends somewhat on the skill of the operator.

The synchronous motor-generator of course can be started either by means of a starting motor or on the direct-current side, or can be made self-starting on the

	Starting.	Synchronized.	Parallel Operation. A. C. Side.	Parallel Operation. D. C. Side.	D. C. Voltage. Variation with A. C.	D. C. Voltage. Variation with Frequency.	D. C. Voltage. Hand Adjustment.	Compounding.	Commutation.	Overload Capacity.	Risk of Breakdown on H. T. Side.	Power-Factor.	Efficiency with Transformers 1,000 K. W.	Attention.	Floor Space.	Cost.
Rotary converter	Starting motor. Start D. C. side. Self-starting	Yes. Automatic	Good	Good	Yes. Automatic regulator	No	Yes	Yes	Excellent	Very great	Small	Unity	94½%	1	1	....
Motor converter (Peebles-la Cour)	Self	Yes	Good	Good	Yes	No	Yes	Yes	Good	Fair	Greater	Variable	92½%	....	1¾	....
Synchronous motor-generator	Starting motor. Start D. C. Side. Self-starting	Yes	Fair	Good	No	Yes. Bad	Yes	Yes	Fair	Fair	Greater	Unity	90%	2	2¼	....
Asynchronous motor-generator	Self	No	....	Good	No	Yes. Bad	Yes	Yes	Fair	Fair	Greater	Variable	89%	1	2¼	....
Permutator	Starting motor	Yes	....	....	Yes	No	....	....	?	....	Small	....	95%	....	½	....
Electrolytic rectifier	....	No	....	....	Yes	No	....	....	....	....	Small	....	....	....	....	....
Vacuum rectifier	....	No	....	....	Yes	No	....	....	....	....	....	....	High ?	....	....	....

[1] From a paper read before the Manchester section of the Institution of Electrical Engineers of Great Britain, December 4.

Digitized by Google

alternating-current side when suitably designed.

In this connection it should be pointed out that when suitable switching arrangements are made, it is just as safe and as easy to start up a rotary on the direct-current side as it is to start up a motor-generator in this way. The objection which has been raised to starting up a rotary on the direct-current side is that in adjusting the speed for the purpose of synchronizing with the alternating-current side, the field current has to be altered, and it does not necessarily follow that at the time of synchronism the alternating-current voltage of the rotary is equal to the alternating-current voltage on the bus-bars. If the alternating-current switches are closed under these conditions, a very large current might flow from the alternating to the direct-current side or the reverse. The following arrangements, however, have been made to meet this difficulty, and are successfully employed on large rotaries in New York. The alternating-current switches are electrically controlled. By a small addition to the direct-current circuit-breakers, the current which operates the alternating-current oil switches is made to pass through a tripping coil which trips the direct-current circuit-breaker a fraction of a second before the alternating-current circuit-breaker is closed. With this arrangement a rotary converter can be run up as a direct-current motor, its speed adjusted until the rotary is in step with the high-tension bus-bars, the electric control switch for the oil switch is then operated, and the rotary taken off the direct-current bus-bars a fraction of a second before it is placed on the alternating-current bus-bars.

The induction motor-generator, of course, does not require synchronizing at all.

PARALLEL RUNNING.

We now come to the question of parallel running. There is a prevalent opinion that a fifty-cycle rotary converter hunts; this is true of a badly designed rotary converter, but is not true of a properly designed machine when working under reasonable conditions, such as can ordinarily be found in the substations of towns. I have seen a 250-kilowatt, fifty-cycle rotary running in the Polygon substation, Manchester (where the variation of frequency and voltage are admittedly very considerable) in parallel with motor-generator sets in a highly satisfactory manner; there was not the slightest suspicion of hunting. The rotary took its load with the motor-generators, and was in every way perfectly stable. The parallel operation of a fifty-cycle rotary converter when properly designed is in every respect satisfactory, and the statement to the contrary is based only on experience with antiquated machines. The parallel running on the alternating-current side of a rotary converter is really considerably better than the parallel running of a synchronous motor-generator set, because the rotating part being lighter, the speed can be more easily changed to meet the sudden changes of frequency. In case of a heavy load, the rotary has an enormous advantage, because the heavy load makes very little difference to the mechanical turning moment called for, whereas with a motor-generator, the turning moment is proportional to the load. In the case of a rotary, the work is done by the transformers. It is hardly felt by the running machine, which merely acts as a conductor. The disadvantage of the synchronous motor-generator in this respect is to a certain extent shared by the Peebles-Lacour motor-converter. It is not true that the motor-converter has a greater synchronizing power than the rotary. The synchronizing current taken by a rotary is only limited by the resistance of the line and the small resistance and self induction of its armature, whereas the synchronizing current of a motor-converter is limited by the self induction both of the stator and rotor of the induction motor end. With regard to the parallel running on the direct-current side, all types stand on the same footing.

There are really four different questions to consider in connection with the variation of voltage. There is the question how far the direct-current voltage varies with the alternating-current voltage; there is the question how far the direct-current voltage varies when the frequency varies; also how far it is possible to obtain hand adjustment of the voltage through any required range; and there is the further question of automatic compounding when load comes on.

As to the variation of the direct-current voltage with the alternating-current voltage the table shows exactly what the position is. The direct-current voltage and the alternating-current voltage of both the rotary converter and the motor converter vary together. The simple motor-generator has an advantage in this respect in that the direct-current generator is entirely independent, and so long as it is running at constant speed and load gives a constant voltage. In cases where the alternating-current voltage is unsteady and it is required to preserve a constant direct-current voltage, the motor-generator will be the simplest apparatus to employ, but the superior efficiency of the rotary converter will sometimes make it worth while to introduce automatic voltage regulators, so that a steady direct-current voltage can be maintained, notwithstanding variations in the alternating-current supply. Automatic regulators have been designed which will hold the direct-current voltage constant within half of one per cent, notwithstanding the variation of the alternating-current voltage through a range of ten per cent. When we consider how the direct-current voltage varies with the frequency, we see that the positions of the rotary and the motor-generator are reversed. The direct-current voltage of a rotary is not dependent upon the frequency, whereas with the motor-generator a change in the frequency of one per cent will often make a change in the direct-current voltage of two per cent.

It is possible to carry out hand adjustment of voltage through wide ranges on all four classes of apparatus. In the case of a rotary converter there are four methods by which the adjustment of voltage can be obtained.

The simplest method is to build the transformers feeding the rotary with a high inductive drop. The rotary then behaves very much as a shunt-generator. By increasing the excitation we increase the voltage; by decreasing the excitation we decrease the voltage. The only drawback to this method is that the power-factor varies as the voltage is varied. As it generally happens that it is at heavy loads that we require to raise the voltage, a leading current is rather a good point, as it helps out the lagging current taken by any induction motors on the system, and tends to raise the voltage of the generators. Moreover, anywhere in the neighborhood of normal voltage the power-factor is near unity. It is only when we reduce the voltage below normal that the power-factor comes over to the lagging side.

The second method for obtaining hand adjustment of the voltage is to put an alternating-current booster on to the shaft of the rotary, and change the alternating-current voltage supply of the rotary by varying the field of this booster. In the rotary converters recently supplied by the British Westinghouse Company to Bristol, Bradford and Moscow, this method has proved in every way satisfactory. For instance, at Bristol the rotaries are designed for either lighting from 460 volts to 500 volts, or for traction with automatic compounding from 500 to 570 volts.

In addition, this booster enables us to

Digitized by Google

preserve complete control over the power factor, notwithstanding any change in the voltage. In all cases where a very wide range of voltage, say up to twenty-five per cent, is required, the booster method is to be preferred to the self-induction method. We may take ten per cent range in voltage as being the practical limit in this latter case, though by special arrangements it can be extended to fifteen per cent.

The third method is by connecting an induction regulator between the transformers and the rotary. One of the objections to the use of these regulators is that they require cooling by an air blast; this, however, is not a serious objection where air-blast transformers are used. In cases where an air blast is available, the induction regulator is to be preferred to the alternating-current booster, if the number of poles on the rotary is very great. It will be understood that the number of poles on the booster must be the same as on the rotary. Where the number of poles is as great as thirty the induction regulator, in which the number of poles can be made as few as we like, makes a cheaper and more compact machine.

The fourth method of adjusting the direct-current voltage is to bring taps from the transformers either on the high-tension side or on the low-tension side, and change the working tappings by means of a dial. It used to be said that this method was only advisable up to the 250-kilowatt size of rotary converter, but the Westinghouse Company has recently improved its methods of making dials dealing with large currents at high voltages, so that it is difficult to say what the limit in size now is. There will, of course, always be an objection to any system in which tappings from the transformer are brought to a dial, on account of the possibility of accidental short circuits. This method, therefore, should not be put forward unless there were special circumstances which make it advisable.

All four classes of converting apparatus are the same in the matter of automatic compounding. It is just as easy to obtain a compounding effect of ten per cent between no load and full load on a rotary converter as it is on a motor-generator. This compounding can either be carried out by putting a series coil on the field of the rotary and self-induction in the transformers feeding it, or by adding a series coil to the alternating-current booster fixed on the shaft.

There are some cases where a reversed compound winding is useful; for instance, where it is intended to run rotary converters in parallel with shunt-generators, the transformers should be designed with considerable self-induction, and a reversed series winding put on the rotary converter. This gives the rotary all the characteristics of a shunt machine. When the load comes on, the voltage falls, and by arranging a suitable German silver shunt, the characteristics of the machine may be made to imitate very closely the shunt-generators with which it is to run in parallel.

On all direct-current machines good commutation is a most important feature. It is common knowledge that the problem of commutation on a rotary converter is very much easier than on direct-current machines, as there is very little field distortion by the armature current, so that excellent commutation can be obtained through very wide ranges of load. Even up to three and four times full load, current can be collected from a rotary converter without excessive sparking or flashing over, and up to 100 per cent overload can be commutated sparklessly. The great overload capacity of the rotary converter is due not only to its good commutating qualities, but to the fact that the copper losses in the armature are small on overloads.

The consideration which is most important to a station engineer is freedom from breakdown. For smallness of risk of breakdown, the rotary converter and its transformers is superior to any other converting machinery, because in the first place there is no high voltage on the running machine, and in the second place there is only one running machine to break down, instead of two. A well-insulated transformer is very much less liable to break down than any kind of high-voltage armature. Even if one of the transformers does break down the load can be carried on the other two.

As is well known, the power-factor of a load of rotary converters can be adjusted to any desired figure by varying the excitation. In ordinary traction work, where the rotaries are compounded, the power-factor varies with the load and it is usually arranged that on full load there is a leading power-factor on the high-tension side between ninety-nine per cent and ninety-six per cent. This gives a slight leading component which of course is desirable on full load.

The rotary converter and motor converter are much the same in the matter of adjustment of power-factor, the main difficulty being that the induction part of the motor-converter always has a high self-induction, and therefore with changing load and changing frequency the power-factor will always be beyond the control of the operator, whereas with a rotary converter, where it is important to preserve unity power-factor at all loads, the self-induction in the transformers can be made extremely small, and an alternating-current booster can be added in those cases where variation of voltage is required, so that the power-factor is always completely under control without regard to the particular voltage at which it is required to run.

The synchronous motor-generator set is the same as the rotary converter in this respect, that the power-factor is completely under control in all circumstances.

The asynchronous motor-generator set has a lagging power-factor less than unity.

The rotary converter has a substantial advantage in respect to efficiency over any other type of converting apparatus. It is not true that the motor-converter has all the advantages of a motor-generator, and as high an efficiency as the rotary. In comparing the efficiencies of different machines it is very important to consider the basis of their ratings. When a substation is supplying a town load it is always necessary to have enough machines running to avoid catastrophe in the case of sudden unexpected demands. The efficiency of the substation will greatly depend upon how many machines are running, and how near to full load they are working. If the station is provided with rotary converters, it is in most cases perfectly safe to have all the rotary converters fully loaded and allow them to be overloaded before a new machine is thrown in. This is because the rotary converters can take fifty per cent overload for an hour or two in case the load should be unexpectedly increased. Moreover, they can take 100 per cent overload without any commutation troubles for a time sufficient to synchronize and throw in additional machines. When dealing with motor-converters or motor-generators, which are not able to take such excessive overloads without danger, the station engineer is not justified in normally running his machines up to such a high point. He must, except for the very steadiest loads, always have some capacity in hand to meet sudden demands and give him time to throw in other machines. In making a fair comparison of the year-round efficiency of different types of converters it would not be unfair to take the efficiency of the rotary at full load and the other types of apparatus at three-quarter load. In the table, however, I give efficiencies without regard to this additional advantage on the

Digitized by Google

part of the rotary. I compare machines designed with the same liberality and same factor of safety in insulation and mechanical strength.

In the amount of attention required to keep a machine clean and in good running condition the rotary converter is just twice as good as its competitors. There is only one machine to keep clean instead of two, and, moreover, the easy commutation enables the carbon brushes to run for years with only the slightest wear.

In the matter of floor space the rotary is again at the head, provided the transformers can be placed in a lower or upper story, as is often the case.

In the same factory, with the same class of materials, theoretical considerations show that the rotary converter and transformers should be cheapest to build. The actual market price is governed by a large number of considerations which are out of the sphere of this paper.

Annual Meeting of the Electrical Committee of the Underwriters' National Electric Association.

The annual meeting of the Electrical Committee of the Underwriters' National Electric Association will be held in March, 1907, in New York city. The day and place of the meeting will be announced later.

As usual, the provisions of the National Electrical Code as they now exist will be the principal matter for consideration, and it is requested that any desired change in, or addition to, the Code, be forwarded to C. M. Goddard, 55 Kilby street, Boston, Mass., on or before February 1, 1907, in order that it may be printed in the bulletin, and the committee and other interested parties may thus have opportunity to consider same in advance of the meeting.

Final action on suggestions not received in season for consideration by the committee before the meeting can only be taken by unanimous consent.

As heretofore, the meeting will be open to all interested, and such persons will not only be welcome, but are urged to be present and give the committee the advantage of their experience and advice.

According to the *Bulletin* for December, the net gain for the New York Edison Company, for the year ended October 31, was 924,875 equivalents. For 10,709 new users, these figures were made up of 448,654 incandescent lamps; 6,774 arc lamps; 29,592 horse-power in motors, and some additional apparatus and appliances of a miscellaneous order.

BOOK REVIEWS.

"Turning and Boring Tapers." Second edition. Fred H. Colvin. New York. The Derry-Collard Company. Paper. 26 pages. 5½ by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

This little pamphlet is the second edition of No. 1 of a series of practical papers put out by the publisher. It deals with methods of turning and boring tapers on various machines.

"The Copper Handbook." Vol. vi. Horace J. Stevens. Houghton, Mich. Published by the author. Cloth. 1,116 + 66 pages. 6½ by 9 inches. Supplied by the ELECTRICAL REVIEW: cloth, with gilt top, $5; full library morocco, full gilt, $7.50.

This is an extremely valuable publication exclusively devoted to the copper industry. The sixth volume is issued several months later than usual owing to the sickness of the author last spring. However, matter of much later date has been used than in the preceding issues, so that the book is as nearly up to date with regard to time as its predecessors have been, and is far more bulky and exhaustive in its treatment of the copper industry. The work begins with a chapter on the history of copper, followed by articles on the geology, chemistry, mineralogy, metallurgy and uses of the metal, with eight chapters devoted to condensed descriptions of the known copper deposits of the globe. There are also a useful glossary of mining terms and complete statistics of the copper trade and copper share finances. The major portion of the book is devoted to a chapter describing all the known copper mines of the world, and listing every copper-mining company of importance. This chapter is arranged alphabetically by titles.

"Continuous-Current Dynamo Design." H. M. Hobart. New York. The Macmillan Company. Cloth. 220 pages. 6 by 9 inches. 106 illustrations. Supplied by the ELECTRICAL REVIEW at $3.

In this book the author has brought together a good deal of material which he has published in various technical journals. It is put forward as an aid to students in the design of electrical machinery. A feature is the presentation of eighteen complete machine designs in tabulated form, and in each chapter sufficient data are given to enable the student to calculate the parts of the design of each of these machines with which that chapter deals. There are in all six chapters to the book. The first discusses the conducting circuit of the continuous-current dynamo. The second deals with the magnetic circuit, showing how to compute the magnetizing winding, the iron losses, and the field dimensions. Chapter iii deals with the armature reaction and the calculation of efficiency. Chapter iv is devoted to the proportioning of dynamo parts, the selection of the proper voltages and the computation of reactance voltages. In chapter v the determination of design coefficients is taken up, and chapter vi shows the application of the reverse poles to continuous-current dynamos. In an appendix the data for all eighteen of the machines are brought together in tabular form. The author's method of design is well known, and his treatment of the subject is clear and concise.

The Use of Electricity in the Mines of Alsace.

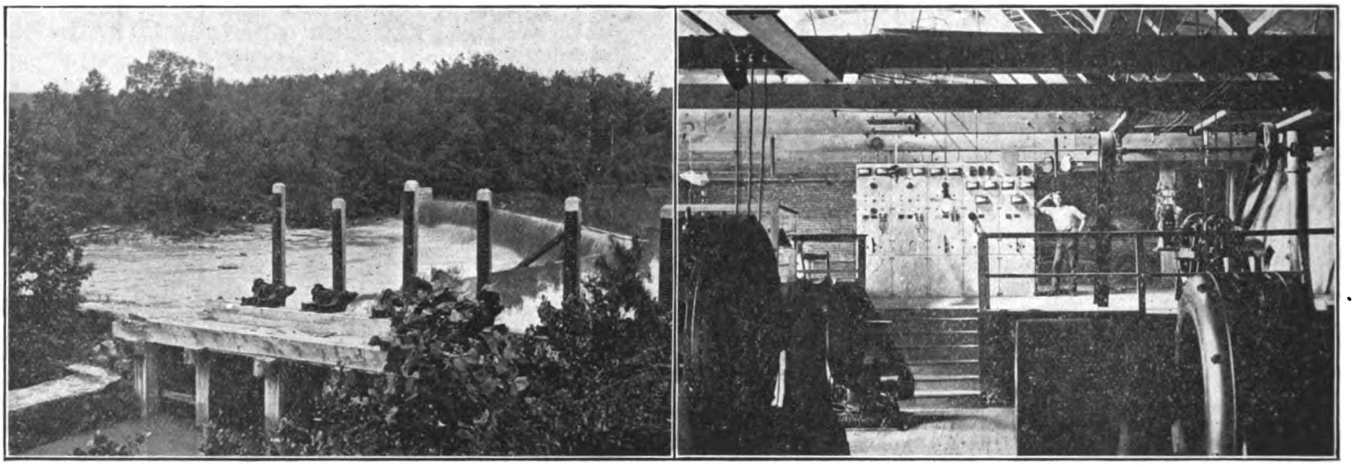
In discussing this subject the effect of the German laws governing the use of electricity in mines upon the mining industry in Alsace, attention is called to the important part played by electrical apparatus. In recent years electrical applications have developed to such an extent that hardly any other system is now used, and the reasons attributed for this are the ease of subdividing energy, of transporting it from a distance without considerable loss, the ease with which the motors may be installed, and the absence of smoke and vapors. Two important installations are noticed as pointing out the magnitude of this work. The Société de Sarre-et-Moselle, at Karlingen, operates a generating station with a total output of 2,600 kilowatts, and has installed some fifteen miles of underground lines for distributing power at 5,000 volts. There are in operation five 500-horse-power motors for hoisting, eight 175-horse-power motors for ventilation, a number of transformers, and 118 smaller motors rated at from one to 100 horse-power. The aggregate power of the motors is 2,000 horse-power, and they are utilized for operating all the machinery in the mine. The mines owned by the Rombach Iron Works have also an important installation. The generating station is driven by gas engines using furnace gas. There are three 250-horse-power centrifugal pumps, two 180-horse-power and one ninety-horse-power pumps, all motor-driven. There are four groups of motor-generators of 400 horse-power each, transforming the three-phase, high-tension current to 750 volts direct current for electric haulage. There are for this purpose three 400-horse-power electric locomotives, two 250-horse-power locomotives, and twelve rated at 100 horse-power. The length of the electric railway system is about twenty-seven miles, fifteen of this being under ground.—*L'Électricien (Paris), December 1.*

Digitized by Google

The Hydroelectric and Steam Equipment of the Athens (Ga.) Electric Railway Company.

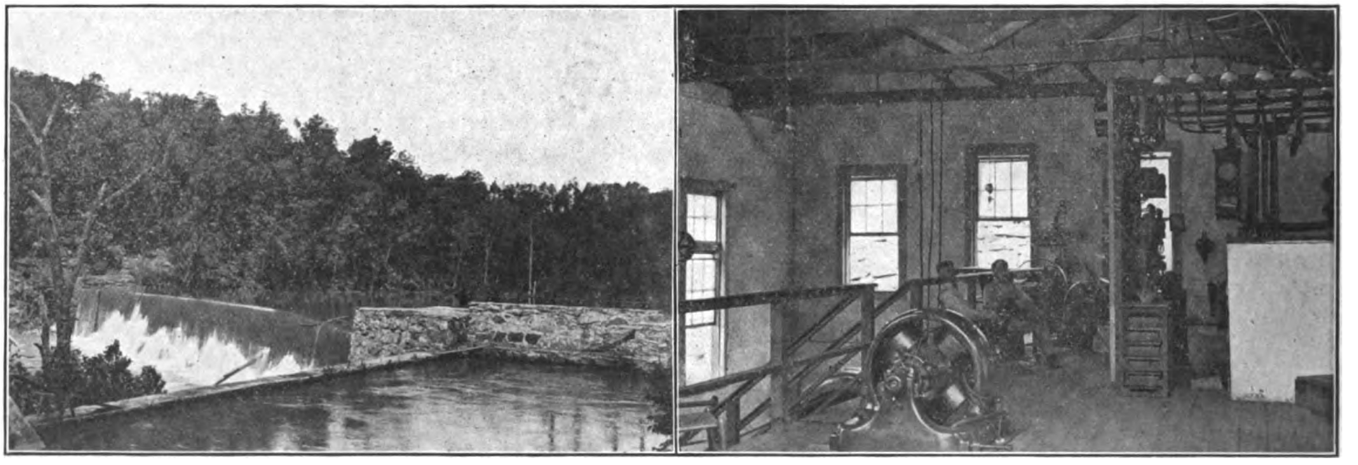
A Story of Modern Electric Railway and Central Station Development.

ORGANIZED in the year 1894, to take over the property of the Athens Railway Company, then in the hands of a receiver, the Athens Electric Railway Company began business in June of that year with five and a quarter miles of track, and a small steam plant containing two seventy-five-horse-power boilers, one 100-horse-power Ball engine, and one eighty-kilowatt Detroit railway generator. Four or five old horse cars equipped with Detroit bevel-geared motors constituted the equipment that had made sporadic efforts to get over the track and convince patrons that if a car was not where it ought to be at a given minute it might reasonably be expected to arrive some time in the future. The organizers of the company not being satisfied with this condition of affairs determined to improve the equipment of the railway and add a lighting department. With this in view they acquired a water power three miles from the city at Mitchell's Bridge, on the Middle Oconee river, the development of which was completed in 1896. The plans called for the erection of a timber dam 400 feet long, averaging twelve feet in height, the mud sill, of twelve inches by fourteen inches heart pine, double-sheet piled, and securely pinned to the rock, the bents of eight inches by ten inches set three feet six inches on centres covered with two-inch rough planks. The face of the dam was laid up with rubble, pointed on the down-river side and the space back of this wall and under the flooring filled with loose rock. Rock abutments of solid masonry anchored the ends of the structure, with head-gates of heart pine to control the flow into the short canal, 200 feet long, leading to the power-house. Below the power-house a natural tail-race, formed by an island in the river, and a crib dam at the power-house end, was blasted out to get additional depth, the difference in the levels of head and tail-water being twenty-one feet.



ATHENS (GA.) ELECTRIC RAILWAY COMPANY—DAM AND HEADGATES, AND INTERIOR VIEW, STATION NO. 1.

One end of the stone and brick power-house, seventy-five by fifty feet, spans the tail-race, thirty-six feet wide, the wheel-cases resting on twenty-inch I-beams, carrying the centres fifteen feet above tail-water.

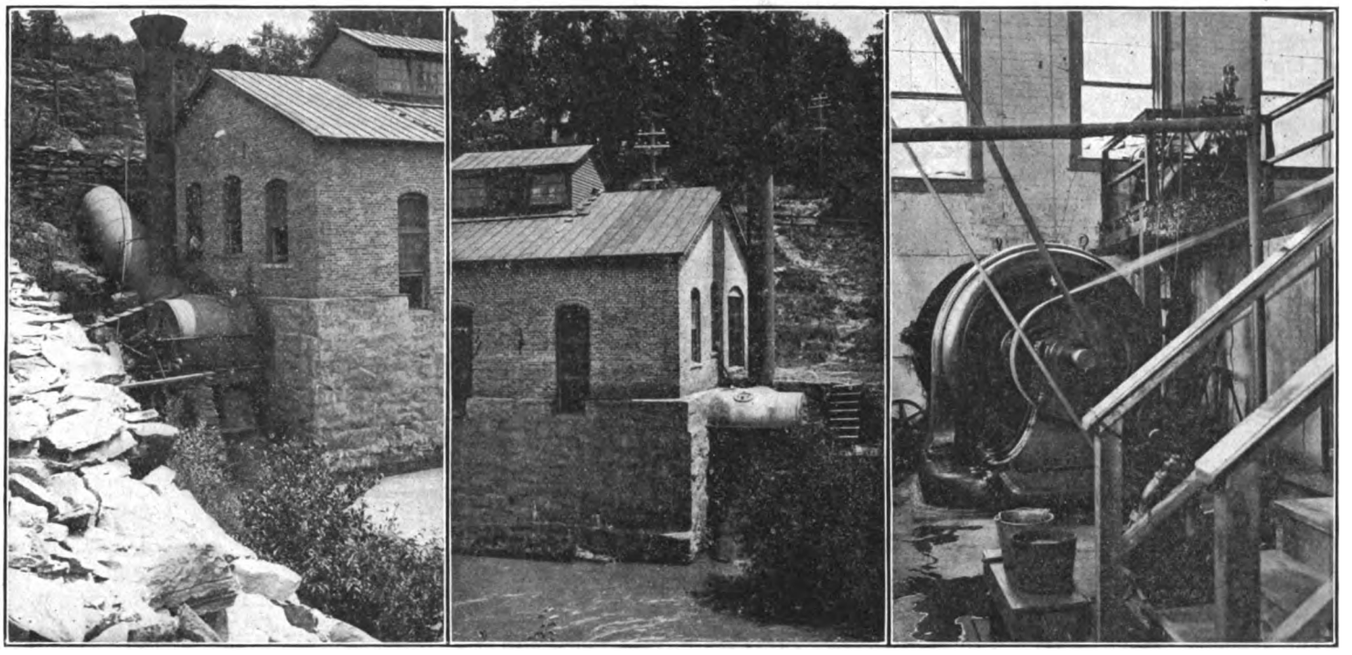


ATHENS (GA.) ELECTRIC RAILWAY COMPANY—DAM AND HEADGATES, AND INTERIOR VIEW, STATION NO. 2.

The generators were installed on brick foundations, the floor level being eight feet above the wheel pit, advantage being taken of the natural trend of the rock to secure a floor level free from dangers from

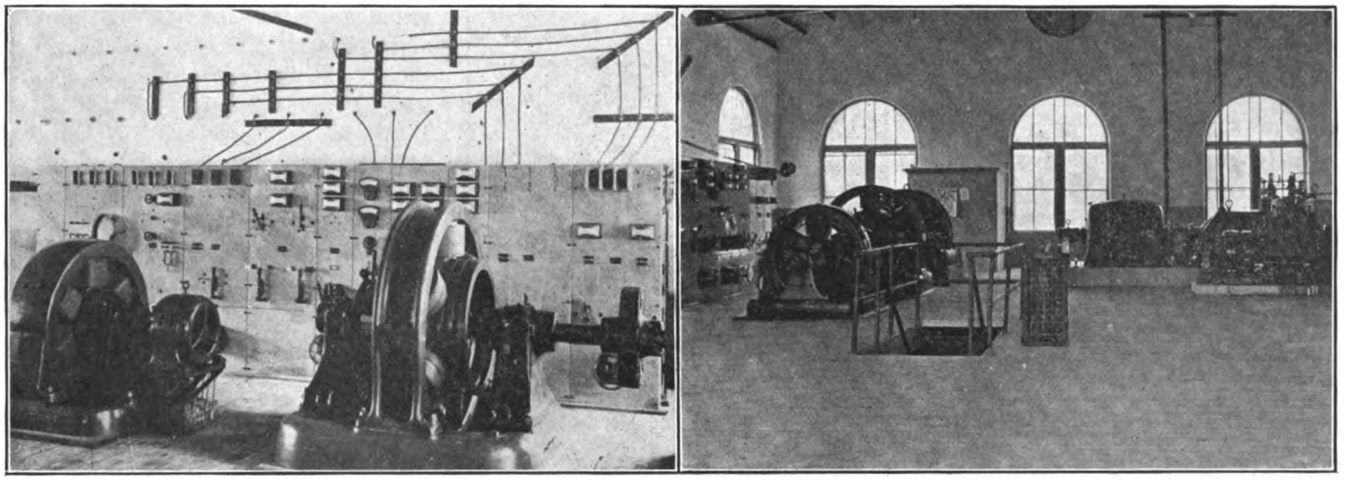
Digitized by Google

high water. The hydraulic equipment included one pair of thirty-nine-inch horizontal Victor turbines, one thirty-three-inch horizontal Victor turbine, and a ten-foot flume for an additional wheel. To the large pair of turbines was belted a



ATHENS (GA.) ELECTRIC RAILWAY COMPANY—TWO EXTERIOR VIEWS AND VIEW IN GENERATOR PIT, STATION NO. 2.

General Electric monocyclic generator of 250 kilowatts capacity, and to the small wheel the eighty-kilowatt Detroit generator from the original steam station, which later gave way to a General Electric multipolar machine of 150 kilowatts capacity. On the larger turbine an extended shaft provided for a connection to two Thomson-Houston fifty-light arc generators which had been owned and operated by the city authorities with such satisfactory results that the company was able to make a favorable contract to operate these machines, displacing municipal ownership. The water-wheels were controlled by two Geisler governors, which gave fairly good results. In 1900 a single thirty-nine-inch horizontal turbine was installed in the extra flume with a No. 10 Brush arc machine of 100 lights capacity as an addition to the electrical equipment. From each generator a single circuit was carried to the city—4/0 wire for the railway, 1/0 outside wires, and No. 1 teaser wire for the monocyclic, and two circuits of No. 6 for the arcs. With this addition to the generating apparatus which appeared at the time ample for years, the business of the company expanded until in 1900 the continuity of the service was menaced by the heavy load carried by the single equipment for each branch and the directors began to cast about for more power. In 1900 they purchased the Tallassee Shoals property seven miles from the city on the same river a few miles higher up, where a fall of forty-five feet was available. Plans were laid for a complete and radical change in the method of generating and utilizing the power, three-phase apparatus of 2,300 volts replacing the direct-current and monocyclic machines at the old station, and three-phase, 12,000-volt generator specified at the new station. Current from each station is transmitted at the voltages at which it is generated to the substation at the city limits, the 12,000-volt current transformed to 2,300 volts and switched to one set of bus-bars, a second set being provided for the 2,300-volt current from station No. 1. From the switchboard the current is transmitted through lighting and power feeders to the



ATHENS (GA.) ELECTRIC RAILWAY COMPANY—TWO VIEWS IN THE STEAM AND SUBSTATION.

Digitized by Google

different sections of the city or converted into direct current, for the railway through the medium of a rotary converter and a motor-generator set, the latter made up of the old monocyclic generator with a new three-phase armature and the multipolar generator, both of which had been moved from the No. 1 water power station. Since the completion of this development, the direct-current arc machines have been discarded and alternating-current series transformers of the General Electric type substituted, furnishing current for 160 lights of 6.6 amperes contracted for by the city.

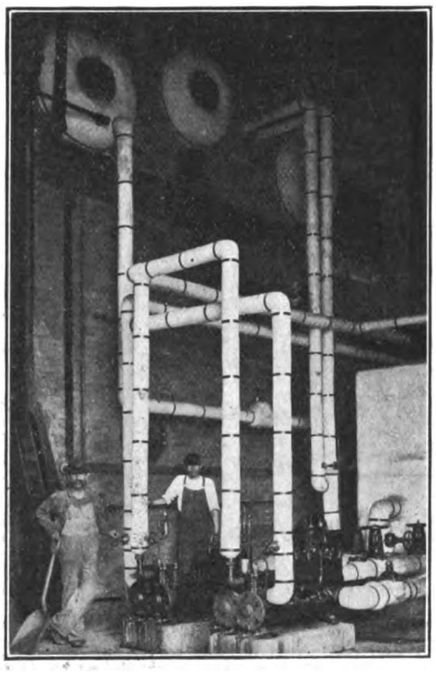
The hydraulic development of the No. 2 station at Tallassee Shoals included the construction of a dam twenty-eight feet high and 360 feet long, the design of which appears novel to some engineers.

Founded upon the rocky bed of the river, the up-river side of the dam is provided with a yellow pine mud sill, twelve inches by fourteen inches, securely pinned to the rock, bedded in concrete, and double-sheet piled on the upper face. Fifty-six feet below this sill on a masonry foundation, twenty feet wide, leveling up the bed of the river, a dry masonry wall was laid and thoroughly pointed on the down-river face which was given a batter of one inch to the foot, while the up-river side of the wall had a batter of one foot in three.

Between this wall and the mud sill loose rock of various sizes and shapes was dumped, with a finished slope from the mud sill to the crest of the dam. Pine rafters were spiked to the mud sill and to a sill anchored in the masonry at the top and upon these a double floor of one-and-one-quarter-inch rough pine was laid. Between the sills to which the planking forming the crest of the dam was spiked concrete was rammed in up to the level of the under side of the flooring. The dam was given a bend up river and the ends anchored with solid masonry abutments, that on the east side being provided with a sand gate and three head gates leading into the canal.

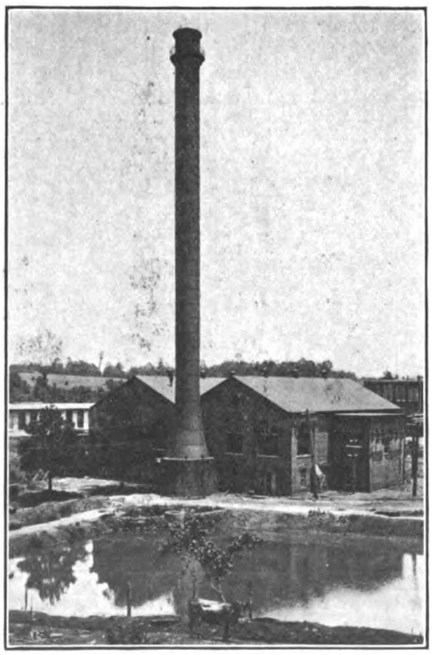
The masonry retaining wall of the first hundred feet of the canal formed a spillway to provide an outlet for any excessive amount of water coming through the gates. From the spillway to the forebay, a distance of 1,200 feet, the retaining wall is of red clay six feet wide at the top with a slope of one and one-half to one on each side.

From the forebay to the turbines the water is conducted through steel flumes six feet in diameter to two pairs of twenty-four-inch Victor horizontal turbines placed fifteen feet above tail-water and set outside the station, the wall of which was built around one head forming a water-tight compartment for the



ATHENS (GA.) ELECTRIC RAILWAY COMPANY—ARRANGEMENT OF STEAM PIPING, STEAM STATION.

generators. The electrical equipment comprised two 450-kilowatt, 12,000-volt, revolving-field generators direct connected



ATHENS (GA.) ELECTRIC RAILWAY COMPANY—STEAM AND SUBSTATION, STACK AND COOLING POND.

to the water-wheel shaft, two twenty-five-kilowatt, General Electric, multipolar exciters belted to the generators; two switchboard panels of blue Vermont marble, equipped with oil switches, watt meters, ammeters, voltmeters, ground detectors, etc., and two Lombard governors, the auxiliary apparatus being placed on a level nine feet above that of the generator pit.

The transmission line, seven miles long, located in as near an air line as possible, consists of six No. 4 B. & S. bare wires in two circuits, transposed three times, on juniper poles set 110 feet apart. Locke insulators (No. 3), carried on paraffined locust pins in heart pine arms, properly braced, formed a triangle of twenty-two inches, one circuit on each side of pole.

Coming into the substation at the city limits, the high-tension wires controlled by oil switches are connected to the primaries of two sets of 150-kilowatt, air-cooled transformers, the secondaries of which are carried to oil switches which throw the current on one or the other of two sets of bus-bars. The feeder panels at all the stations are equipped with Thomson polyphase wattmeters in addition to the standard General Electric equipment of ammeters, voltmeters, power-factor indicators, etc. The lightning protection is of the General Electric type, a varying number of air gaps according t the voltage in series with a graphite resistance with choke-coils between the taps and the switchboards. Provision is also made for the abnormal difference in potential between line and line during seasons of electrical disturbances in the atmosphere.

In addition to its electrical equipment to control and distribute the output of the water power stations as a substation, the steam station, recently completed, is equipped with one Westinghouse 500-kilowatt Parson's turbine connected to a Deane jet condenser and air-pump; one battery of Stirling water-tube boilers of 750 horse-power, equipped with superheat tubes in the middle pass; Cochrane feed-water heater and Deane feed and tank pumps. The brick station building, eighty feet by ninety-six feet, was planned to accommodate four units of the same capacity as now installed. A self-supporting steel stack 150 feet high and 106 inches in diameter provides ample draught for 200 horse-power.

The steam piping, erected under a contract with the General Fire Extinguisher Company, is modern in design, long bends and extra strong pipe being used throughout. All piping is covered with eighty-five per cent magnesia two inches thick, formed in place, wrapped and banded. Water meters, recording steam, vacuum, and temperature gauges and recording voltmeters, are installed in addition to the

Digitized by Google

integrating wattmeters on the switchboards.

To provide cooling water for the condenser a spring lake four hundred feet long by one hundred and fifty feet wide, protected by storm ditches to divert the muddy water coincident with heavy rainfalls, was constructed close to the powerhouse, the condenser taking water from an intake well at the station end and discharging it through sewer pipe near the head of the pond.

The station is thoroughly modern and up to date, and when filled with the apparatus for which space has been left in the building will be capable of delivering 3,000 horse-power normally or 4,000 horse-power under overload conditions.

The company is pumping the city water, an induction motor of 150 horse-power, direct-connected to a Worthington four-stage turbine pump, forcing one thousand gallons per hour under a pressure of 140 pounds through the city mains.

A thirty-horse-power induction motor, belted to a centrifugal pump, lifts the water from the river to a subsidence reservoir, and a five-horse-power motor operates the filters.

The railway is equipped with two double-truck closed cars, two double-truck open cars, both types equipped with air brakes; six single-truck closed cars, and two single-truck open cars.

The lighting circuits carry 11,933 sixteen-candle-power equivalents, a number of motors under five horse-power, fan motors and heating devices.

The power circuits, four in number, furnish current for 1,190 horse-power in induction motors, operating two cotton mills, one fertilizer factory, one leather factory, one oil mill, two grist mills, two wagon shops, three newspapers, one granite yard and a number of small industries.

The city is lighted with 160 series, alternating enclosed arcs of 6.6 amperes.

The engineering and construction work have been under the supervision of the general manager of the company, C. D. Flanigen, M.E., assisted by W. T. Bryan and H. M. Hughes.

The officers of the company are:

J. Y. Carithers, president.

W. S. Holman, vice-president.

W. T. Bryan, secretary and treasurer.

C. D. Flanigen, general manager.

The board of directors includes these officers and A. H. Hodgson, Billups Phinizy, James White and John R. White.

The company is entirely a home affair, officered and directed by Athens people.

AN ENQUIRY INTO THE OPERATION, EFFICIENCY AND CONSTRUCTION OF A TYPICAL MODERN INDUSTRIAL PRODUCER GAS POWER PLANT.[1]

BY J. R. BIBBINS.

With all the present activity in power development for various purposes, industrial or otherwise, the value of the simple producer plant used exclusively for power generation seems to have been somewhat overlooked, or at least questioned. The ability of the modern gas engine to take the place of the steam engine in general power work has likewise been questioned, as well as the capacity of gas engine and producer to work together harmoniously under widely varying load demands.

Fortunately neither of these charges is founded on a basis of actual conclusive experience, and it is the purpose of this paper to present some practical data upon the operation of a thoroughly representative commercial gas power plant; one in which a high measure of success has been obtained through intelligent engineering and supervision. Even though some minor improvements might still be suggested, the fact remains that this gas power plant is operating week in and week out, twenty-four hours per day six and one-half days per week, on a fluctuating manufacturing load, with a fuel consumption fully one-half that of a modern steam plant of like character and suited to the same work. On an average of half load this 450-kilowatt plant ordinarily consumes from two to two and one-quarter pounds of coal per kilowatt-hour, and, on heavier loads, has reached as low a consumption as one and one-half pounds per kilowatt-hour in regular daily running. During heavy loads the plant has repeatedly developed without the battery 530 kilowatts on maximum fluctuations, which represents an overload of eight per cent rating. Furthermore, with the exception of the engineers in charge during the two watches, the plant is operated by attendants originally quite unskilled in gas work; up to the present writing, however, no complete interruption of service, traceable to defective equipment, has been recorded.

The plant in question serves the entire Gould Manufacturing properties at Depew, a suburb of Buffalo, N. Y. Two complete works are located here; one devoted to the manufacture of storage batteries and the other to the manufacture of railroad specialties, principally automatic couplers. The latter contains a large and well-equipped steel foundry. Both are electrically driven and lighted throughout from the central gas power plant.

Contributing to the station load are a large number of labor-saving machines of different types, such as electric traveling cranes, charging tables, transfer locomotives, elevators, conveyers, fans, pumps and machine shop tools. The storage battery works also use considerable current at times for "forming" battery plates.

TABLE 1—EQUIPMENT DATA.

450-KILOWATT PRODUCER GAS ENGINE POWER PLANT.

Service—Power, some lighting.
Capacity of plant—450 kilowatts.
Number of units—Three, 150 kilowatts.
Distribution system—Direct current, two-wire.
Pressure—250 volts, normal 230.
Power building—Forty-five feet by sixty-one feet inside; height of roof trusses, twenty-eight and one-half feet; height of basement, nine feet; total area per kilowatt, 6.1 square feet; net area of unit, fifteen feet by thirty-three and one-half feet (with six-foot passageways); net area unit per kilowatt, 2.87 square feet.
Walls—Red brick, exterior pilasters, limestone trimmings, steel framework.
Roof—Wood, tar and gravel, steel trusses, monitor.
Floors—Steel, wood, three-quarter-inch maple finish; basement floor, concrete.
Foundation—Concrete.
Crane—Hand-power, tons.
Producer building—Steel framework; corrugated iron walls and roof; charging floor, boiler plate.
Cooling pond—1,000,000 gallons; dimensions, 280 feet diameter by ninety-three feet wide; area (power plant), 7,300 square feet; area (producer plant), 7,500 square feet; total, 14,800 square feet; depth, normal, ten feet.
Holder—Thirty-six inches diameter, single lift, 15,000 cubic feet.
Coal used—Bituminous run of mine.
Sources—Buffalo, Rochester & Pittsburg Railroad.
Price—$2.30 per ton.
Heat value—13,500 British thermal units.
Engines—Westinghouse three-cylinder, vertical gas engines; type, single-acting four-cycle; capacity, 235 brake-horse-power, 260 maximum; normal speed, 200 revolutions per minute; size cylinders (three), nineteen-inch by twenty-two-inch stroke.
Ignition—110 volts and eight volts; two sets four-cells storage battery; one motor-generator set, one-half kilowatt.
Cooling water (jackets)—Motor-driven centrifugal pumps; two two-inch Worthington "Volute"; fifteen-horse-power motor 1,450 revolutions per minute.
Cooling water (scrubber)—Two-stage motor-driven; two-inch Worthington "turbine" type; fifteen-horse-power motor.
Compressed air—100 pounds from works, also six-inch by six-inch Rand duplex single-stage compressor; ten-horse-power motor.
Generators — Westinghouse compound-wound; direct current.
Capacity—150 kilowatts, 250 volts.
Switchboard—250-volt direct-current.
Producers—Loomis-Pettibone; type, bituminous, duplex intermittent blast; three-feet to eight-feet diameter.
Boiler—Five-feet diameter vertical tubular, utilizing waste heat.
Wet scrubber—Six-feet diameter, vertical, coke, water-sprays.
Dry scrubbers—Two nine-and-one-half-feet diameter, in parallel; excelsior, two layers.
Valves—Gear lift, water-cooled.
Exhauster—Roots simple engine-drive.

[1] A paper presented at the New York meeting (December, 1906) of the American Society of Mechanical Engineers. Condensed.

Digitized by Google

Gas main—Twelve-inch diameter.
Gas risers to engine—Eight inches.
Fittings—Screwed.
Valves—Chapman gate.
Coal handling—Bucket elevator, motor-driven.

Although the power station load is smoothed out to some extent by the overlapping of demands from these various sources, yet the larger machines pull heavily upon the system, with the result that the load at the station bus-bar is subject to violent fluctuations, easily eighty per cent above or below (on light loads 100 per cent) the general averages. As no system of notification is in force, the power station can not be apprised of anticipated demands from the several production departments of the works. The storage battery forming load is, of course, steady while it exists, but it is liable to be abruptly thrown on or off at any time.

A typical run is shown in the accompanying log, Fig. 1, for September 25, 1905. Although the recorded output is fairly steady through the day, the fluctuations correspond on some days to overloads of fifteen to twenty per cent on the engines.

The original plant was entirely capable of handling these fluctuations, but on account of doubling the steel plant load and adding electrically driven air compressors, an auxiliary storage battery[1] was recently installed for the dual purpose of securing a more constant load on the engines, with higher economy of fuel, and of increasing the average load. Formerly it was necessary to keep the spare unit constantly in service to tide over the peaks.

From the daily records of the plant an excellent idea of its operative efficiency may be obtained. These records, although not elaborate, are carefully kept and show not only the output and duty of the plant but also the maximum loads that occur during the hour. During a typical day's run with continuous operation except at noon and midnight—to be exact, ninety-seven per cent of the elapsed time—the load averaged 263 kilowatts, or fifty-eight per cent of the generating capacity in service with nine full load hourly maxima and five equivalent to eight per cent overload. The average coal consumption for all purposes was 1.98 pounds per kilowatt-hour generated.

During a ten-day run in September, 1905, the results shown in Table 2 were recorded. The engines averaged eighty-seven and one-fourth per cent of the possible running time, and on fifty-four per cent station loading factor[1] the plant consumed 2.04 pounds fuel per kilowatt-hour, or 1.44 pounds per British horse-power hour. With coal of 13,500 British thermal units calorific value, the efficiency of this plant averages about 13.1 per cent, thus rivaling, if not excelling, the largest

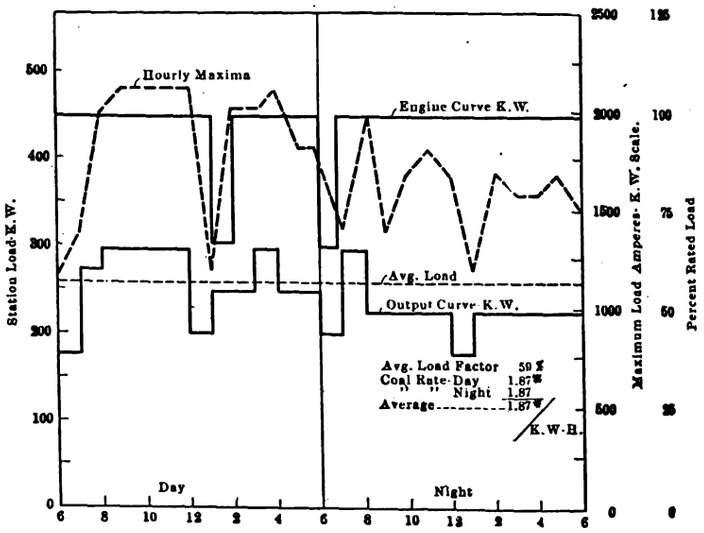


FIG. 1.—LOAD DIAGRAM GAS ENGINE PLANT, SEPTEMBER 25, 1905.

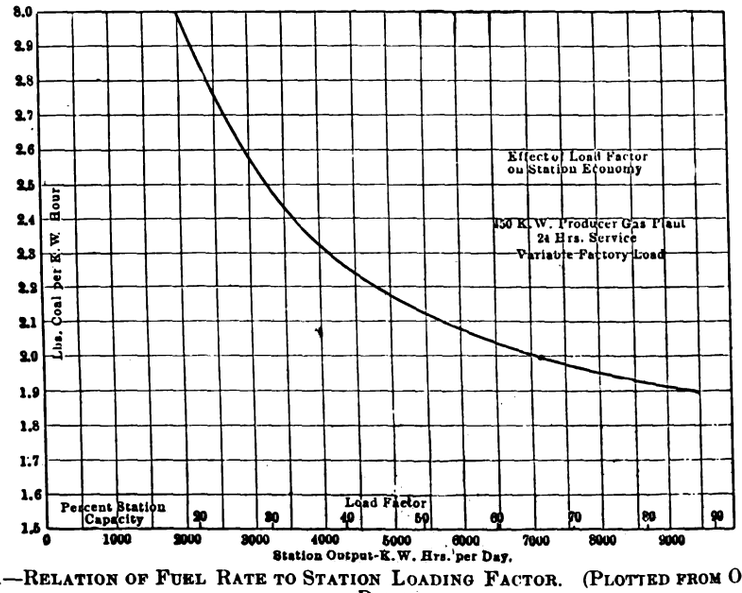

Effect of Load Factor on Station Economy
450 K.W. Producer Gas Plant
24 Hrs. Service
Variable Factory Load
Lbs. Coal per K.W. Hour
Percent Station Capacity
Load Factor
Station Output-K.W. Hrs. per Day.

FIG. 2.—RELATION OF FUEL RATE TO STATION LOADING FACTOR. (PLOTTED FROM OBSERVED DATA.)

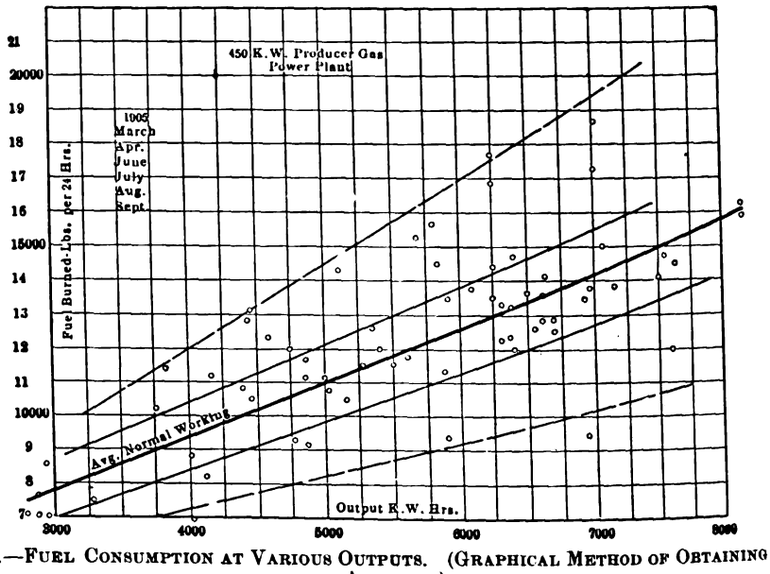


FIG. 3.—FUEL CONSUMPTION AT VARIOUS OUTPUTS. (GRAPHICAL METHOD OF OBTAINING TRUE AVERAGE.)

[1] This battery, however, was not placed immediately in service and does not affect the results presented in this paper except in the matter of capital costs

[1] Loading factor = $\frac{\text{Avg. 24 hour station load}}{\text{Rated capacity}}$

True load factor = $\frac{\text{Avg. 24-hour load}}{\text{Maximum}}$

Digitized by Google

modern steam power stations. On September 27, the fuel rate was 1.88 pounds per kilowatt-hour (or about one and one-quarter pounds per British horse-power hour), with sixty-two per cent loading factor, corresponding to a plant efficiency of over fifteen per cent.

The author has been deeply interested in the effect of the loading factor of a plant upon its efficiency and commercial duty. An unusually good opportunity arose in analyzing the results of this plant and the approximate relation is presented in Fig. 2. In order to obtain a closer average, the "shotgun" method (Fig. 3) was used, plotting total fuel per day to output. Barring some unusual results occurring in the early days of the plant, the average fuel consumption is approximately a straight line within observed limits. From this the average fuel per kilowatt-hour may be obtained, Fig. 4, and the relation approximates a rectangular hyperbola within normal ranges of load. The upper convex curve, Fig. 4, expresses the kinetic or absolute efficiency[1] of the station, and it is interesting to observe that this small plant normally operates with an efficiency[2] between twelve and thirteen per cent average.

higher loading factor—seventy-five per cent, the plant efficiency is thirteen per cent average, engines twenty per cent and producers sixty-five per cent. During an

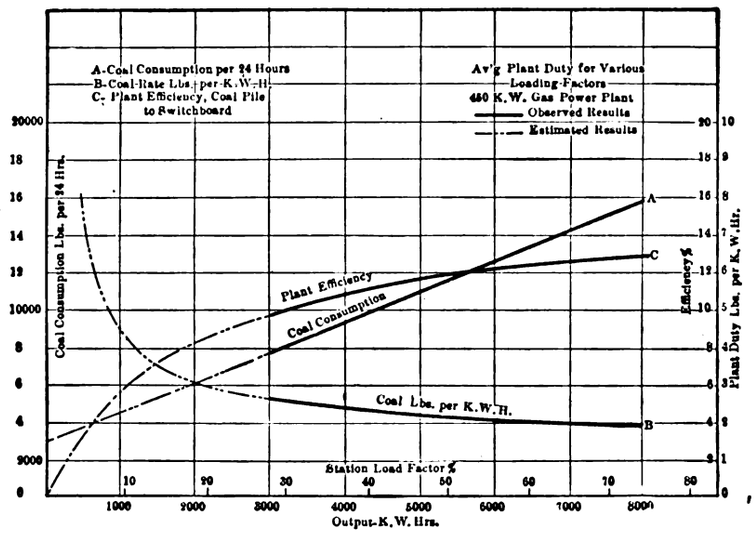


FIG. 4.—AVERAGE PLANT DUTY AT VARIOUS LOADING FACTORS.

especially good day's run, as on September 27, the efficiencies were as follows: plant, fifteen per cent; engines, twenty-one per cent; producers, 71.5 per cent. These results indicate that the producer plant is, from an everyday operative standpoint,

to 10,000 kilowatt-hours representing the probable minimum and maximum for full working days, and adding the fixed or capital charges amounting to about nine per cent on $91,650 (or $81,000 excluding the battery), the distribution of cost items is substantially that given in Table 3.

In order to emphasize the effect of loading factor Fig. 5 has been prepared showing the relation of both capital and operating costs to the station loading factor, the former plotted above and the latter below, the X axis. Total cost of power is given by the total ordinate. Observe the rapid change in costs on light loading, especially of fixed charges. Coal, on the other hand, remains fairly constant; labor a constant charge, increases rapidly on light loads, and supplies and repairs a variable charge, less rapidly. The importance of loading factor is well brought

TABLE 2—OPERATING DATA.

450-KILOWATT PRODUCER-GAS POWER PLANT.

Date. Sept. '05.	Engine Hours Run.	Per Cent Full Day Run.	Output K. W. H.	Load—K. W. Avg.	Load—K. W. Rated.	Station Loading Factor.*	Fuel Used.	Coal per K. W. H.	Coal per B.H.P. HR.
20	71	98⅝	4,850	202	450	45	11,100	2.29	—
21	65½	91	5,275	220	450	49	11,400	2.16	—
22	70	97¼	6,550	273	450	61	12,700	1.93	—
23	45¾	63½	4,025	188	450	41.7	8,800	2.18	—
24	24	33⅓	2,250	187.5	450	41.6	†6,600	†2.93	—
Sun									
25	70½	98	6,400	267	450	59	12,000	1.87	—
26	69¾	97	6,300	263	450	58	12,300	1.95	—
27	70½	98	6,700	279	450	62	12,600	1.88	—
28	72	100	6,700	279	450	62	12,900	1.92	—
29	70½	98	6,600	275	450	61	12,900	1.95	—
Avg.	63	87¼	5,565	243.4	450	54	11,330	2.04	1.44

Westinghouse vertical three-cylinder engines—Loomis-Pettibone producers.
* Loading factor = % continuous generating capacity.
† Includes extra coke used on Sunday for starting new fires.

From the above data and the measured efficiency of the gas engine, the efficiency of the producer plant may be roughly estimated. Assuming fifty per cent loading factor, the average plant efficiency is twelve per cent; as the efficiency of the engines is approximately seventeen per cent at this load (see Fig. 6), the producer plant operates at an efficiency of slightly above seventy per cent. With fully as efficient as a high grade boiler plant and frequently more so. It is certainly not more difficult to handle.

As to the cost of power the following analysis reveals a total cost of well under

TABLE 3—APPROXIMATE POWER COSTS.

	Minimum.	Normal.	Maximum.
Output, kilowatt-hours per day	5,000	8,000	10,000
Fuel, cent per kilowatt-hour	0.25	0.22	0.20
Labor, cent per kilowatt-hour	0.28	0.17	0.14
[1]Supplies and repairs (estimated), cent per kilowatt-hour	0.17	0.13	0.11
Operating costs, cent per kilowatt-hour	0.70	0.52	0.45
Fixed charges	0.45	0.28	0.22
Total costs, cents per kilowatt-hour	1.15	0.80	0.67

[1] These charges are estimated owing to absence of more accurate data and the comparatively short time plant has been in operation. Assume twenty-five per cent of total power costs at fifty per cent load factor, hence, the estimate is conservative.
It should be noted that were the plant to operate regularly at the lower load factors less labor and supplies would be required and the light load costs would be correspondingly reduced. The curves Fig. 5 are based on full plant in service operating continuously.

out by this diagram; e. g., the total cost of power is halved by increasing the loading factor from twenty-four to fifty-five per cent. An industrial or railway power

[1] Kinetic efficiency is defined as = Thermal equivalent of work done / Heat in coal

[2] Since the above observations were made the plant has been giving much better efficiency, the coal consumption averaging 1.8 per kilowatt hour with an eighty-five per cent loading factor. This corresponds to a plant efficiency of over 15.4 per cent at the engine shaft or, fourteen per cent at the switchboard. Several runs averaging 1.55 pounds per kilowatt are recorded, equivalent to a plant efficiency of 17.7 per cent at the shaft, of 16.3 per cent at the switchboard.

[1] Buffalo, Rochester and Pittsburg bituminous run of mine, 13,500 B. T. U. per pound.

Digitized by Google

plant usually operates on about the latter figure, a moderate sized lighting plant on the former; hence, the danger of indiscriminate comparisons of operating costs in power plant work.

Considering that the results above enumerated have been obtained from a comparatively small plant, operating under conditions by no means conducive to the attainment of the highest economies, the Depew plant offers a striking object lesson that should not fail of appreciation among engineers confronted with similar problems; and much credit is due the Gould Company through its consulting engineer, W. E. Winship, and its resident manager, J. O. Gould, for early appreciation of the advantages of gas power and efficient management of the Depew property. The author begs to acknowledge their courtesy and assistance in placing cost and operating data at his disposal.

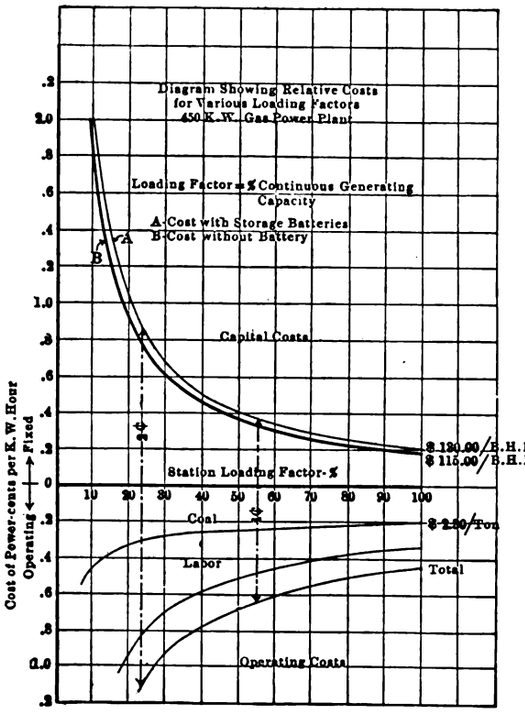


FIG. 5.—RELATIVE POWER COSTS AT VARIOUS LOADING FACTORS.

DESCRIPTIVE SECTION.

An excellent location has been chosen for the power plant adjacent to the Lackawanna Railroad main line. In the intervening space is a large semi-circular reservoir, serving the twofold purpose of a cooling pond and reservoir for general fire protection, and incidentally enhancing the attractiveness of the property to no small degree.

For convenience to coal supply the producer house is located several hundred feet in the rear, adjacent to a large metallurgical producer plant serving the steel furnaces. A single coal-handling system thus serves both producer equipments. This arrangement of buildings emphasizes the possibilities in gas-power work of separating, at any distance, the producer and gas-engine parts of a power plant for operative, or other, convenience.

Brick, steel and concrete are largely used as building material. In the producer house, where the fire hazard is, of course, considerable, no wood at all is employed, wall and roof being constructed of corrugated iron and charging floor of boiler plate. Spacious monitors in both buildings provide the very necessary ventilation and light.

Considerations of operating economy largely influenced the choice of gas engines for this plant where steam coal costs from $2.25 to $2.40 per ton, and gas coal about the same. At this price it was estimated that, although the difference between the steam and gas was small on half day working, for a twenty-four-hour day the latter's advantage was decisive.

The installation of three units of similar size and identical construction wisely avoided the duplication of parts which two or three sizes of engines would have occasioned. By the use of direct-connected units a very compact power-house arrangement has resulted, the total floor area per kilowatt being 6.1 square feet, and the net area of each unit with six-foot passageways 2.9 square feet per kilowatt.

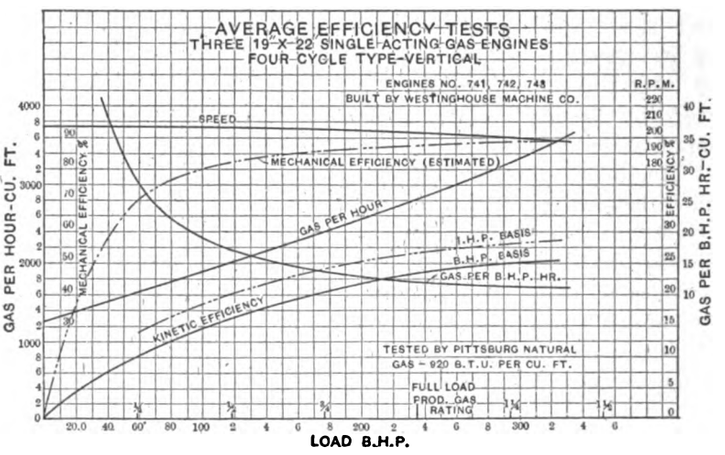


FIG. 6.—AVERAGE EFFICIENCY TESTS.

The efficiency of these engines as heat engines is well indicated by the appended results of tests[1] shown in the accompanying Table 4 and diagram Fig. 6. In the latter the upper concave curve represents the gas consumption per brake-horsepower under different loads and the convex curve, the kinetic or absolute efficiency.

The ability to convert into useful power over twenty-five per cent of the effective heat in the gas gives evidence of high efficiency. These engines operate on the four-stroke cycle involving constant quality of mixture and throttling governing.

A most important factor in the successful operation of the engines is the

TABLE 4—ENGINE EFFICIENCY.

AVERAGE OF TESTS.

Three 19-inch by 22-inch Single-Acting Four-Cycle Gas Engines.
Engines Nos. 741, 742, 743.

Load.	Over.	Full.	Half.	Remarks.
Brake-horse-power.....	325.3	239	121.3	By Prony brake.
Speed, R. P. M.	198	203	206.3	By counter.
Gas per hour	3,547	2,840	1,985	Corrected to 62 degrees Fahrenheit, 30 inches Hg.
Gas per B.-H.-P.-Hr.....	10.9	11.87	16.36	Corrected gas—no load—1,250 ft. per hr.
Heat value gas[1].....	920	920	920	Effective B. T. U. per cu. ft.
B. T. U. per B.-H.-P.-Hr...	10,030	10,910	15,050	
Brake kinetic efficiency..	25.37	23.32	16.9	B.-H.-P. basis.
Mechanical efficiency	89	87.5	82.5	Estimated.
Indicated kinetic efficiency	28.5	26.7	20.5	I.-H.-P. basis.
Speed variation, max....	4.2%			No-load speed, 206.6.
" " No full load..		1.8%		Average speed.
" " No half load.			0.7%	
Per cent full rating.....	138.4%	101.6%	51.6%	On producer gas.

[1] Pittsburg natural gas—Junker calorimeter.
Engines rated 235 B. H. P. on 180 B. T. U. producer gas.

[1] Made at the builder's works on natural gas which was at that time the only fuel available for testing purposes. As engines for producer gas are usually constructed for somewhat higher compression than those operating on illuminating or natural gas, their efficiency would presumably be slightly better on natural than on producer gas fuel; yet for commercial work a difference of 15 pounds in compression would scarcely be appreciable.

Digitized by Google

ignition apparatus. For increased security each igniter plug has two sets of points, each set independently connected. Should one set of points, through any cause, become unfit for use, a small double-throw switch may be reversed, thus turning the ignition current through the other points. In addition, three independent sources of current have been provided, all of the apparatus being contained in a central ignition cabinet. For starting, one of two eight-volt storage batteries is used. For running, a small one-half-kilowatt motor-generator unit is used delivering 110-volt current to the igniters through incandescent lamps, which furnish a valuable "tell-tale" of "open circuits," "grounded igniters," or "hanging fire" of igniters. These two sets of storage batteries are charged alternately through a bank of lamps from the motor-generator or from the main station bus-bar, one or the other set being always available in an emergency. By means of small double-pole switches at the igniter cabinets, throwing over from the low to the high-tension system may be instantly accomplished without in the least disturbing the engines. The ignition problem has thus been handled with great care in the provision of six individual combinations of current supply.

Starting of the engines is accomplished as usual by compressed air drawn from a pipe connection to a compressed air line in the works or from the relay compressor. Although only ninety to 100 pounds pressure is ordinarily carried; yet the engines may readily be brought up, cold, to full running speed, within thirty to forty seconds. With higher air pressure available, starting may be accomplished in even less time, as the mixture ignites more readily when quickly compressed, owing to the smaller opportunity for the dissipation of internal heat.

Another important part of the plant equipment is the circulating water system for cooling jackets, combustion chambers and exhaust valves. Motor-driven rotary pumps are ideally suited to this work on account of the moderate pressure required —about twenty-five pounds per square inch. Two of these pumps (one for relay) serve the engine plant, while a third, of the two-stage turbine type, serves the gas-producer scrubber in which a higher pressure is desirable. Although each pump is driven by a fifteen-horse-power motor, the power ordinarily required is considerably less than this, especially in moderate and cold weather when the quantity of water supplied to the engines may be largely reduced by throttling the pump outlets.

Previous mention has been made of a cooling pond. This has a normal depth of ten feet with a total capacity of about 1,000,000 gallons. It is approximately semi-circular in plan and is divided radially into two compartments to separate the comparatively dirty scrubber water from the pure jacket water. All make-up water used at the plant is delivered to the pure water pond through the engine jackets. Cooling water for the engine is drawn from near the bottom through a screen house, while the hot jacket water is returned to the surface of the pond, about 150 feet distant. During the progress of the water from inlet to outlet enough heat is dissipated to the earth and atmosphere to reduce the outlet water to the proper temperature.

Some trouble has been experienced with the gas gates, due apparently to cumulative deposits of carbon, and frequently it becomes impossible to seat the valves tight. In work of this class it would seem that a parallel seated quick-closing gate would be best suited, being self-cleaning, and the gas could be cut off almost instantly in case of emergency.

The engine exhausts all discharge into a cast-iron header running beneath the floor to a concrete exhaust well outside, serving as a muffler. Unfortunately, it is impossible to cool these exhausts by water sprays on account of the large amount of SO_2 in the gas. If water were used, as is the practice with natural gas, the piping would soon be destroyed by corrosion. As some thirty per cent of the total heat value of the gas is lost in the exhaust, radiation is a somewhat disagreeable feature, especially in warm weather.

Water cooling piping is simple, a manifold supplying all three cylinder jackets in parallel. Water enters at the bottom of the jacket, emerging from the top. A small pipe loop at the discharge end of the upper manifold with vent cocks at the top to break the vacuum serves to prevent the syphoning effect which under certain conditions might pull all the water out of the jackets, leaving nothing but steam. This vent is useful as a tell-tale showing stoppage of jacket water supply.

While the producer is undergoing renovation on Sundays the engines are also inspected in rotation, mixing valves flushed down with gasolene to remove lampblack deposits (likewise cylinders, now and then, to keep the packing rings free), valves are ground in and igniters replaced when necessary, jacket deposits cleaned out when obstructed to any extent, and the engines generally adjusted. Reducing valves are also cleaned, at intervals, from carbon deposits. Practically the only trouble experienced thus far has been the occasional cutting of an exhaust valve, presumably due to cumulative carbon deposits on the valve seats. The lampblack has also occasioned some difficulty in lubricating valve stems. Igniters, of course, wear down gradually, but extras are always kept on hand and repointed as fast as necessary. Usually one igniter will last from six to nine months without repointing. Since commencing normal operation engine repairs have been confined to these two items and are comparatively light considering the conditions of operation. Very little trouble has been experienced with lubrication, as the main working parts are automatically supplied by the splashing of oil.

A notable feature of the producer plant is that it is capable of gasifying bituminous coals without making quantities of tar. The process is intermittent, embodying the now more or less well-known system of passing the green hydrocarbon distillates through a secondary fire bed which has previously been brought up to the proper temperature by blasting with air. Since the plant was started, a fair grade of soft coal (B., R. & P. run of mine) has been used, averaging about 13,500 British thermal units per pound. Although this coal presumably contains thirty-five per cent of volatile, tar destruction in the producers is complete, but at the same time a considerable quantity of lampblack has resulted which has made it necessary to devise special means to handle this by-product.

Straight producer gas is not made directly, but water gas and air gas are made at alternate intervals of varying duration according to richness of the gas desired. The two gases are mixed in a single holder in the proportion generated. In this system two producers constitute a unit.

A feature of the system is that all steam required is generated entirely from the sensible heat of the gases coming from the producers which would otherwise be wasted in cooling water.[1] With the high "heats" necessary in the intermittent process this represents an important saving. The boiler, however, requires weekly cleaning.

The proper cleaning of the gas is a difficult problem, owing to the fact that lampblack does not easily adhere to a wetted surface as does ordinary cinder

[1] This condition, however, obtains only when the plant is heavily loaded. Running light it would be difficult to make sufficient steam to operate the producer auxiliaries. An air auxiliary boiler would have to be drawn upon.

Digitized by Google

dust. In this plant the gas first passes upward through a wet scrubber containing several tiers of small coke constantly wetted down by water sprays. A thin layer of dry excelsior is also used in the top tiers. Emerging from the wet scrubber the gas enters two large dry scrubbers filled with several tiers of excelsior and piped up in parallel so that the velocity of the gas is not only reduced, but also the amount of gas handled by each drier. Finally, an engine-driven Root's exhauster delivers the gas to the holder.

The present method of operating the producer plant requires an air gas run of ten to fifteen minutes, according to the demand for gas at the power plant, and a water gas run from one-half to three-quarters of a minute, the resulting mixture being well suited to power work. Calorimeter tests show the gas as made at the present time to average slightly above 100 British thermal units per cubic foot.

The entire producer plant is operated throughout the week by four men, two to a shift, with some additional labor on Sundays for cleaning. All the attendants were unskilled foreigners before taking up the producer work. During a half day shutdown of the plant on Sundays all renovating of the producer equipment is done; boiler tubes are cleaned, wet scrubber washed down, the excelsior in the dry scrubbers taken out and shaken free from lampblack, gas mains flushed out and a new fire started in the idle producer. At the same time another producer is taken out of service, fires are drawn, and during the week, after it has had an opportunity to cool off, the hard clinker, which adheres to the lining, is broken off. For the starting layer of a new fire bed, coke is used to the extent of some 3,000 pounds per producer, a sufficient quantity to affect the coal consumption of the succeeding day. If allowed to form to any extent clinker constitutes a frequent source of trouble in operating the plant, and it is important that the selection of coal be made with this in view.

A Memorial to Faraday.

On November 24 a tablet was unveiled at the Barnsbury, England, exchange of the National Telephone Company, to commemorate the fact that the building in which the exchange had been placed was formerly the meeting house of the Sandemanians, and that Michael Faraday had worshiped there from 1862 until his death in 1867. Faraday was an elder of this religious body, and the tablet, which was unveiled by Lord Kelvin, marks the position which he usually occupied on the platform. The unveiling took place with suitable ceremonies.

ELECTRICAL MINING NOTES.

BY SIDNEY F. WALKER.

ACCIDENTS IN MINES.

The issue of the report by the Home Office of the accidents that took place in mines during the year 1905 brings forward the question of how far electricity will tend to reduce those accidents, and how far new forms of accidents are being introduced by it. In particular, the question of explosions from defective safety lamps is a most important one. During the period covered by the report there were 108 accidents in coal mines due to naked lights, one due to a miner opening his lamp, and one due to a lamp being in a defective condition, these two accidents leading to the injury of ten persons, while the accidents due to the use of naked lights led to the injury of 148 persons. In addition to this, there were thirty-three deaths due to one accident, ascribed to the lighting of the mine, for which the precise cause is stated to be unknown. The question naturally arises, could some of these accidents have been avoided if portable electric lamps had been employed. There has always been a great objection among miners to the introduction of safety lamps, mainly because the light given is so much less than with a naked candle or lamp, and also because it so easily goes out.

When the incandescent lamp was first introduced there was a strong feeling among mining men, and electrical men, that the problem of lighting mines with safety had been solved, and very soon after, attempts were made to produce portable lamps. Mr. (now Sir) Joseph Swan was very early in the field, but though a number of inventors have attacked the problem, only one lamp has so far been introduced into practical mining work, the Sussmann, and this not to a very large extent. When the problem was seriously attacked it was found to be a very much more difficult one than was supposed. The weight offered a very serious difficulty. The early lamps, in which accumulators were employed, weighed as much as seven pounds and over. The Sussmann lamp weighs about four pounds. The ordinary Davy lamp weighs about three and one-half pounds, and there are some modern lamps weighing as little as two pounds. Several attempts were made to adapt primary batteries for the purpose. Schanschieff introduced a lamp worked by a primary battery, in which a mercurial salt was employed, the important feature of which was the resultant products were supposed to be more valuable than the initial substances with which the batteries were charged. This was correct in a sense, but it omitted the very important question of the cost of the collection of the resultant products. In practice also the Schanschieff lamp was found to be too delicate for mining work. The secondary battery, used in the Sussmann lamps, appears to have solved the problem fairly well, but it is only on condition that the course which has been adopted in the one or two collieries where it is in use is followed. The difficulty of the slopping of the electrolyte, which is a serious one in all forms of portable batteries, is solved in the Sussmann battery, by the use of an absorbent, finely divided cork or other substance. But the cells themselves are necessarily brittle, being made of vulcanite, and the tin vessel in which they are held, being made light, is also very quickly attacked by any of the acid which is spilt over them, and which it is very difficult to avoid. At the South Hetton and Murton collieries, in the County of Durham, where a large number of the lamps are in use, the problem has been solved by the construction being practically undertaken at the colleries themselves. The plates are made and formed, the cells made up and charged, and the whole thing put together. The arrangement is as follows: Each lamp when it comes out of the pit is dismantled, the cells carefully examined, the tinned iron containing case also, and the cells, if they are in good order, immediately put on the charging bench. When the miners are coming for their lamps cells that are known to be good are put together, placed in sound outer containing vessels with sound lamps, and so on. And the result has been apparently that the system has worked well and is very much liked, the light given being so much better than that of the ordinary Davy lamp.

But the above does not give the whole of the difficulties involved. The charge in the cells is sufficient to run the lamp, with a serviceable light, for about fifteen hours. In the County of Durham men are often ten and eleven hours between the time they leave the surface and the time they return to it again, the workings often being at a considerable distance from the shaft where the men work, and considerable time being taken up in going and returning. Further, there is always the chance of a man being left in the pit, and therefore it is important that the whole of the reserve in the cells should be kept intact as far as possible. Hence the switch, which is attached to the

Digitized by Google

Sussmann lamp, is by no means the least important part of the apparatus. But the space available makes the switch a very delicate affair indeed, and it is only by the skill which has been gradually acquired by the men at South Hetton and Murton, and elsewhere where the lamp is in use, that this difficulty has been overcome, assisted by the care in handling the switch, which the miners have learned by practical experience. The miners like the lamp, not only because it gives a better, a whiter light than the ordinary Davy lamp, but also because they can hold it in any position. The ordinary Davy lamp is an exceedingly sensitive apparatus. If it is held slightly out of the vertical it commences to smoke, and if it receives a sudden jar, is very apt to go out.

But there is yet another most important feature of the problem. The ordinary Davy lamp performs two offices, it gives light and it denotes the presence of gas. When fire damp is present in the atmosphere of the mine it is shown on the ordinary miners' lamp by elongating the flame. In testing for gas the deputy, as the official is usually called, or the fireman, reduces the flame of his lamp to a very small size, and he can then judge the elongation, and with skill he can tell approximately the percentage of gas present. The best lamps will denote the presence of gas from one-half per cent up to as much as six per cent, the explosive mixtures being from five per cent to fifteen per cent. That is to say, with less than five per cent of gas present in the atmosphere of the mine, it will not explode, and with more than fifteen per cent again it will not explode. The incandescent lamp used with the Sussmann, and any other form of portable electric miner's lamp, is necessarily unable to show the presence of gas. At South Hetton, Murton and other places, I understand the difficulty is overcome by providing the deputies with ordinary Davy lamps for the purpose of testing. But several attempts have been made to add a gas-testing apparatus to the portable lamp. One was added to the Sussmann lamp some five or six years ago, and it was exhibited at the office of the Sussmann Company in London, where they had a gas receiver into which they could place the lamp, the receiver being formed of a pedestal with a glass globe over it, fitted airtight on the pedestal, a gas pipe leading from the pedestal to the enclosure. The gas indicator consisted of spongy platinum, enclosed inside a cylinder, and there was a small incandescent lamp attached to the apparatus which gave a red light when gas was present. As exhibited under the conditions named above the apparatus worked very well. It was very interesting indeed to note the lamp when placed under the receiver, the red light appearing when the gas was turned on, as soon as a certain proportion was present. But unfortunately there was a serious flaw in the arrangement. Ordinary illuminating gas, with which the apparatus was tested, is not the same as the gas which is found in a coal mine. I do not refer to the difference in the actual composition of what is supposed to be illuminating gas, C_2H_4, and the composition of the gas known as fire damp, CH_4. For testing purposes these may be taken as practically the same. But the serious difference between illuminating gas, and mine gas is, illuminating gas is now very largely composed of hydrogen, and it is to the hydrogen that the Sussmann indicator responded. H. J. Prested worked at the problem afterwards, and produced a very sound apparatus, which I tested some years ago in a coal mine in South Wales. The testing apparatus was supplementary to the lamp. It consisted of a porous cell, similar to those used in batteries, the open end of which was closed by a diaphragm actuating an electric contact, which closed the circuit of a battery and the usual little red lamp. The force actuating the apparatus worked was the pressure produced by the difference in the rate of diffusion of different gases. When the porous cell was placed in a gaseous atmosphere the gas passed into the porous compartment quicker than the air could pass out, with the result that a pressure was exerted upon the diaphragm, the contact was closed and the red lamp lighted up. I understand that not much has been done with this apparatus, but it is evidently on these lines that the portable electric gas indicating apparatus will probably be arranged. The importance of testing for gas will be understood from the fact that it is a rule in several mining districts when a cap appears upon an ordinary Davy lamp, that is to say, when there is any elongation of the flame, as explained above, the whole of the men are to be withdrawn from the district, the working places, etc., where the gas is indicated, until the ventilating air current has diluted it down to safe proportions.

In South Wales, when I was carrying out the investigation mentioned above, a particular case was mentioned to me where the gas came away very suddenly and in large volumes from the working face at certain irregular intervals. No one knew when the gas would come away, but when it came the whole of the men were withdrawn from that face, and could not return until the gas had been removed. It should be mentioned that the very great improvement that has taken place in the ventilating of coal mines during the last twenty years has reduced the dangers from gas very largely. The enormous ventilating current hardly allows time for gas to accumulate in sufficient quantity to become a danger. The ordinary miner's lamps also have been largely improved. I have called the ordinary miner's lamp the Davy lamp in the remarks made above, but this is not strictly accurate. The old "Davy" and the old "Clanny" lamps are not often used now. In the modern lamp the flame is protected by gauzes and by metal bonnets, so that it will not be so readily extinguished when the miner is walking against the powerful air current that is so common in modern coal mines. The old "Davy" or "Clanny" lamp would go out. In addition, also, mineral oils are now used in a number of lamps, and they give a light at least twice as powerful as that given by the old-time lamp, and the flame is also very much more sensitive to the presence of gas.

Chicago Electrical Trades Exposition.

The following special days have been announced for the electrical show of the Chicago Electrical Trades Exposition Company, which will be held at the Coliseum, Chicago, Ill., next January: Monday evening, January 14, formal opening; Wednesday, Thursday and Friday, January 16, 17 and 18, annual convention of the Northwestern Electrical Association; Thursday, January 17, Ben Franklin day; Friday, January 18, Illuminating Engineering Society; Monday, January 21, telephone day; Tuesday, January 22, Sons of Jove; Wednesday, January 23, Thomas A. Edison day; Thursday, January 24, Electrical Salesmen's Association.

It is announced that a new storage battery which has just been completed by Mr. Edison will be exhibited and demonstrated for the first time.

The main floor of the Coliseum annex will be divided into four small theatres, which will form an "electrical midway." One of these will be devoted to new demonstrations with static apparatus and high and low-frequency currents. Another theatre will have a new electrical and mechanical creation called the Aurora Borealis. This will show some lighting effects invented and arranged by Edgar Healy, of Chicago. In the third theatre there will be arranged an electrical musical concert.

Thirty thousand square feet of space has been sold for general exhibits on the main floor of the Coliseum, but four spaces remaining unsold.

Digitized by Google

ENGINEERS AND THEIR WORK.[1]

BY SIR ALEXANDER B. W. KENNEDY.

In relation to science, I have always claimed for engineers a very high place, a place much higher than some of my purely scientific friends are disposed to allow them. M. Jourdain talked prose all his life without knowing it. So I really believe not a few engineers have spent their whole lives in scientific work while they were nominally only earning their daily bread in ordinary mechanical pursuits. It is not, however, so much that engineering is science as that the scientific spirit is often the basis of engineering, and that when this is the case, engineering becomes as truly scientific as any other branch of exact research, and none the less scientific because it is also the means of making an honest living. Engineering problems differ from ordinary academically "scientific" problems, partly in that they are much more complex, and consequently more difficult of anything like exact solution, and still more because—exact or inexact—some solution to them has always got to be found. Not only must the solution be found, but it has to be translated into steel and gun metal, as well as into £ *s. d.*, and any mistake will entail very much more serious consequences than a controversial paper in the *Philosophical Magazine*, or a letter in *Nature*, pointing out a wrong estimate of terrestrial radioactivity in prehistoric epochs.

It has been, no doubt, a source of regret to many who have passed this chair, as it is to myself, that as years go on and experience accumulates, one's work comes always more and more to deal with men and matters, with general schemes and methods, even with financial means and possibilities, and less with the directly mechanical problems which fascinated us when we were younger, and for the sake of which—probably—we took to engineering at all in the first instance. This is one of the penalties of old age—of engineering old age, at all events—and it is no use lamenting it. But speaking of the constructive part of an engineers' work and life, the part on which some of us look back as the very essence and joy of our careers, we can see that it consisted essentially of a long series of scientific problems to be dealt with, scientific questions to be answered. If the engineer has dealt with these by scientific methods and in a scientific spirit, if he has carefully marshaled his data, deliberately reasoned from them, recognized where they were incomplete, estimated the probable effect of their incompleteness upon his judgment and upon the result, and finally made his decision and taken his action on the whole matter as a logical conclusion from his previous reasoning, then, I say, the engineer is acting as truly as a man of science as if he were conducting a laboratory research with appliances and methods of exactness and precision unknown in actual professional problems.

But a word of caution—unnecessary to the experienced, but sometimes necessary nearer the start. The mere use of formulæ or of exact calculations of any sort is not in itself scientific. That man shows far more of the scientific spirit who recognizes when his data do not allow of the use of any exact formulæ, and who therefore reasons with what may be called mathematical common-sense, than the man who tries to force the facts to fit a class-room formula, and arrives at a result which satisfies the formula without recognizing that it bears no relation to the facts. The scientific engineer may use elaborate calculations, or he may not; a most important part of his science lies in judging whether to use them or not. Conversely, the man who calculates elaborately may be working scientifically, or he may not. The mere calculation is not scientific, and in certain cases may only be a cloak to essential defects both in scientific method and in technical perception.

To what extent do engineer and artist come in contact? It can hardly be denied that there are points which at least ought to be points of contact in their work, although their paths seem frequently to intersect rather than to be tangential, and the intersection is too often at ninety degrees! When engineering structures were confined to masonry bridges and pumping stations the matter was comparatively simple. It was difficult to make a stone bridge which was structurally efficient and actually hideous at the same time, and many of the older structures of this type left nothing to be desired by way of beauty of line. Whether a castellated or a quasi-Gothic building was the most suitable form for a Cornish engine-house may be questioned, but at any rate many of the pumping houses which once covered the country were not eyesores, and along with a not unpleasing exterior they combined complete internal suitability. It seems a little odd to us now—but it was certainly prompted by worthy motives—that even the machinery inside the houses was designed on architectural lines which were at least supposed to be lines of beauty. Even in the time of my own apprenticeship, it was universal for bedplates, entablatures and other large castings to be finished at their corners and angles with moldings more or less carefully designed according to classical models. Even moving parts such as the bosses of cranks, were ogeed round their edges, and no connecting rod of a stationary engine was considered finished without a double ogee ring round the middle of its length. Some of these details were survivals from cast-iron construction applied to a forgeable material, but they all died hard, like many less harmless customs. Penn's oscillating engines in the Thames steamers, which were at work until only a few years ago, had their cylinder-cover nuts of gun metal, each made with a turned ogee molding at their base like a fixed washer. And the entablatures of the same engines were wonderful in their wealth of detail.

We expect architects to consult and employ engineers to help them over structural difficulties and we may even scoff when they come to grief for not doing so. They are, on the other hand, quite entitled to turn the tables on us when they see that an engineer has put up a hideous barn which they could have transformed into a pleasing structure by their own special knowledge, and by that sense of form which it has been their chief business to cultivate, while we have been working at bending moments and breaking loads.

I have spoken of engineering in relation to art; it would perhaps be put down to cowardice if I did not say something of the relation of engineers and engineering to nature, especially as my mountaineering colleagues at the Alpine Club occasionally try to convince me that if I had any conscience I should renounce engineering altogether. We are sometimes guilty of disfiguring nature, I believe and regret. What is the extent of our guilt? Our interference with nature—that is, especially with natural scenery—comes practically under two heads—the erection of works for the utilization of water, either for use in cities or for power, and the construction of railways in mountainous or other beautiful districts.

The first is the easier to deal with. The conversion of upland valley bottoms into lakes by the construction of dams seems to me to be out of court at once. I am not inclined to admit that to cover boggy peat land with blue water is doing

[1] Excerpt from the presidential address before the Institution of Civil Engineers of Great Britain, November 6.

Digitized by Google

any harm to nature, or that a fine masonry dam is an eyesore. Moreover, if it is required for the supply of water to cities which could not obtain the water otherwise, it is a "work of necessity and mercy," and there is no more to be said about it, unless the engineer does his work with wanton disregard to all appearances, which, I believe, is never alleged. Water storage for power purposes can hardly be put upon quite so high a level, no doubt, and unfortunately such works are generally accompanied by pipe lines, which, it must be owned, are not things of beauty. But if the net result of the whole is to give employment to hundreds of men in places where hitherto no one could maintain himself, and to utilize natural sources of power hitherto neglected, for doing useful work on the spot where they exist, then I think an impartial arbitrator would say that the schemes were justified, even at the expense of ruling a straight line on the landscape. I admit that *tu quoque* is not argument, but some of us who love the hills best find, I think, that the scar along the hillside made for a deer road is every bit as disfiguring in itself as a pipe line, while it is infinitely less agreeable in all its suggestions. It may cheer the guilty engineer a little to think that if there is anything iniquitous in the utilization of water power, then, *à fortiori,* our whole nation is involved in the guilt accompanying the utilization of its coalfields, compared to which the construction of a few dozen pipe lines is a quite microscopical offence.

I am not saying anything to justify the putting down of a village where hitherto there has been no more than a ruined hut, because this seems to me to require no justification whatever. If we engineers can help to create places where a few of the overflowing thousands of our population can find healthy and remunerative occupation, we have nothing to repent of, even if, as I quite admit, the bare landscape would please some of us (myself certainly included) much better than the sight of the works and cottages.

There remains to be considered mountain railways, or railways in mountain districts. These really may be put into three categories. There come first the great lines, like the Simplon, which run through mountainous districts, and which are important means of continental communication. I have already suggested that it might, possibly, have been better for the world if it had stuck to stage coaches and had never gone traveling; but the world itself elected otherwise, and such works, therefore, require no justification. Also, I must add, that some of these—the St. Gothard and the Albula lines are examples—rather add interest to the landscape than disfigure it. I admit that in Switzerland I have often wished that the railways would burn smokeless coal, for in that case the trail of white steam would be a beauty in itself, and certainly more in keeping with the landscape than the trail of dust and filth which marked the course of the diligence along the high road.

I dare say that the feeling of contempt and dislike which we have for these things leads us sometimes, however, to exaggerate the actual damage which they do to nature. Happily nature is very forgiving, and has a way of covering up engineering iniquities so completely in a few years that they practically disappear and cease to trouble the eye. It is not so, unfortunately, with the works of a kindred profession. The railway to St. Moritz, for example, is almost out of sight, the railway station is perfectly harmless, but St. Moritz itself, spread in all its hideousness about a lovely lake side, is nothing less than a scar on the face of the earth—an absolute shock when you catch sight of it suddenly. For this, happily, we engineers can not be held responsible; I would gladly believe that Swiss builders employ no architects, if any one would only say so authoritatively!

With another profession, that of the law, we are brought by our daily work into very close connection, so close that in many matters it is necessary for the engineer to carry out his work in the most strictly legal spirit, however undesirable it would be for him to be his own lawyer. All engineering work of importance is carried out according to both a specification and a contract. An engineer prepares the specification and is practically responsible for the contract, while very often other engineers—from the manufacturing side—accept both documents and undertake to work to them. There is little doubt that the more strictly legal, which means in this case equitable, the conduct of both parties is in reference to these documents, the less is the probability that the aid of the purely professional lawyer will have to be called in later on.

On the manufacturer's side there is one chief and simple, but absolutely necessary, duty to perform in reference to these documents—namely, to read them. The duty is as simple and as obvious as "keeping your eye on the ball" in another phase of existence, and is just as often neglected. Hence many tears! If the contractor or manufacturer is dealing with a responsible and experienced engineer he may be sure that the documents are intended to mean what they say, and that, barring mistakes, they do mean it. If, therefore, he finds that he can not do what he is asked to do there is nothing to be gained by slurring it over. The only means of avoiding trouble is the raising of all doubtful points before the work begins so as to get them settled. If, on the other hand, the contractor is dealing with an irresponsible or inexperienced engineer, and no doubt there are such, it is all the more necessary that he should know exactly what he is asked to do. For in that case there may be meanings in the documents which only careful reading will discover, but which will certainly be taken advantage of, later on, against the contractor himself.

On the side of the engineer who draws up the specification, it is surely his duty, after drawing it up, after stating as clearly as possible his requirements, to endeavor to go through it from the point of view of the contractor, and make sure that there can be no reasonable doubt of the meaning of the words or phrases he has employed. This is every bit as true of the specification as of the contract, but whereas with the latter there is always legal help available, with the former the engineer has to trust to his own power of exact expression in saying just what he wants, and no more and no less than he intends to have.

Electrical Trades Society of New York.

At the eleventh annual meeting and dinner of the Electrical Trades Society of New York, held December 11, the personnel of the board of directors was changed slightly—two retiring members, P. M. Haight (Sprague Electric Company) and A. S. DeVeau (DeVeau Telephone Manufacturing Company) being succeeded by W. M. Franksen (Sawyer-Man Electric Company) and F. Stout (I. P. Frink), who were elected for a term of three years.

The following officers were elected for the ensuing year:

President, R. B. Corey.

Vice-president, W. E. Carmichael (Diehl Manufacturing Company).

Treasurer, B. H. Ellis (Manhattan Electrical Supply Company).

The other directors hold over for varying terms, and they are as follows: John H. Dale (The Dale Company); John Bray (Western Electric Company), besides Mr. Corey and Mr. Ellis.

Digitized by Google

Illuminating Engineering Society.

A meeting of the New York section of the Illuminating Engineering Society was held at the Edison Auditorium, New York city, Friday evening, December 14, to hear a discussion of "Light and Illumination," by Dr. Charles P. Steinmetz. Dr. Steinmetz spoke for an hour and a half extemporaneously, and during that time presented clearly the various problems met in measuring and producing light and in using it most effectively.

The speaker first explained that there is no physical difference between the types of radiation which are known as heat, light and chemical rays, other than that of frequency; that this classification is due simply to our physiological limitations; that what we recognize as heat and as light are the same thing, except that in the latter case the eye responds to the stimulus, and in the former it does not; that both these radiations, as are also the chemical rays, are transformed usually into heat when they fall upon an absorbing body, and that our recognition of a class as heat rays is due simply to the fact that it generally happens that the radiation of longer wave-lengths represent more energy and therefore appear to produce more heat when interrupted—for example, by the hand—than do the others; but the other radiations produce heat in the same way, though the amount thus produced is frequently too small to be detected by the hand.

The study of light and illumination is greatly complicated by the fact that it is a physiological effect and has no physical basis. There is, therefore, no true physical means of measuring or comparing light. While we may compare the quantities of energy represented by different radiations, these do not bear any relation to the amount of light produced. The eye itself reacts in a very complex manner, because it is sensitive to a limited range of rays—something less than one octave in frequency—and because its sensibility is different for different parts of this range. The same amount of energy in radiation lying in different parts of the spectrum produces very different effects upon the eye, as the latter is more sensitive to the green and yellow rays than it is to the red and the violet. Moreover, the sensibility of the eye depends not only upon the character of the rays, but upon their absolute intensity. There is, therefore, no method of comparing in a photometer lights of different color; in fact, the two things are different and, therefore, can not be compared directly. An indirect method might be used which consists in determining which color enables the eye to distinguish bodies more clearly. For eample, the lights may be used to illuminate a printed page, and the distances found at which they enable this to be read. The intensities of the illuminants might then be considered as proportional to the square of these distances, but this test fails because the sensibility of the eye, as mentioned above, depends also upon the absolute intensity. If a page with smaller print be substituted for the other it will be necessary to bring it closer to the eye to distinguish the printing, and the new comparison thus obtained will not agree with the previous one; and by using larger print, thus moving the page further off, a still different value will be found. In such comparisons it is necessary, therefore, to state not only the ratio of the two intensities of illumination, but the distance of the illuminated surface from the eye. If the illumination be intense, the red rays produce a greater effect; while if it be faint, the green cause the greater response.

Methods of producing light by means of incandescent solids and gases were then discussed, and it was shown that the efficiency may be increased by raising the temperature, since in this way the greater proportion of the radiant energy is given off in the visible spectrum, or by so-called selective radiation. It is necessary to define clearly what is meant by selective radiation. If it be meant by this simply that the relative quantities of energy represented by the different rays are not that given by the so-called black body, then certain solids do give such selectivity; but if it be meant by selective radiation that certain wave-lengths only are radiated, representing spectrum bands, there is no such thing as selective radiation from solids. The molecules of solids seem to be so closely compacted that there is not room for free vibration. Interference must take place, and therefore wave radiations of all wave-lengths are given out. In gases, however, the molecules are more widely separated and there is room for individual action. Gases do give selective radiation according to the second definition. To increase the efficiency of a light-giving source, if a solid be used, it is necessary then either to use a material such as tantalum, which may be heated to a very high temperature; or to use a substance in which the distribution of energy does not follow the black body law. Calcium is such a material. To increase the efficiency of the gaseous illuminant it is necessary to use a gas the molecules of which have a natural period of oscillation, which gives off a good proportion of the radiant energy within the visible spectrum. Here again it is necessary to consider the end sought, for if these visible rays lie at the extreme ends of the spectrum, the quantity of the light may be low, although the energy in the visible rays be large. If the visible rays lie in the yellow or green, the efficiency will be greater. But in seeking a high efficiency, the color of the light must also be borne in mind, for a green, although more powerful, may produce a poorer effect. Since the eye has been developed under the influence of sunlight, which we call white, this light must be taken as the standard, and for general purposes an illuminant should give off rays from all parts of the spectrum. This is possible, an example being the magnetite lamp the light of which is due to incandescent titanium vapor.

During this discussion Dr. Steinmetz threw out some interesting suggestions respecting the reason for our classification of radiations. The chemical rays are called so because of their marked action on certain unstable chemical compounds, and it seemed likely that this is a case of resonance, the natural period of the atoms of these compounds being approximately that of violet and ultra-violet light. On the other hand, the heat rays, being longer, may correspond more nearly to the natural period of molecules, which are necessarily larger and will vibrate more slowly than atoms. For the same reason heat rays probably play an important part in organic growth. Hence the preponderance of the colors red, yellow and green.

Turning then to the question of illumination, Dr. Steinmetz said that, after all, what we are seeking is not light, but the effects of light—illumination. This is a feature that has been overlooked by those developing sources of light. Their attention has been fixed upon increasing the efficiency and intensity of light sources. But an intense source of light may defeat the very purpose for which it was created, because the eye protects itself in such cases by closing the pupil. An intense source of light may then, particularly if it be in the line of vision, produce a less stimulus than one less intense. As a consequence, the lighting will be poor. This condition suggests that the end sought in lighting problems should be uniform illumination. But here again we may find ourselves at cross-purposes, because what we are really seeking is not illumination, but the effects of illumination, and a per-

Digitized by Google

fect uniformity of illumination would make it impossible for the eye to distinguish objects. In other words, the eye sees not by measuring the intensity of illumination received, but by comparison of different intensities; and if the illumination be perfectly uniform within a room, comparison is impossible. This difficulty has sometimes been met when indirect illumination is used—that is to say, when the light within a room is given by hidden sources which throw out a diffused light. Such methods are marked by an absence of shadows, and in such interiors, where the eye must depend upon shades and shadows for perception, uniform illumination, produced by diffusion, is sometimes unsatisfactory. The eye feels the need of shadows, and it strains itself, looking for them, and thus is tired and there is a feeling of dissatisfaction. Another uniform illumination may also be secured by directing the light given out by the lamps by the use of globes and reflectors, so designed as to distribute the light uniformly throughout the space. A marked characteristic of this method of illumination is the sharp, dark shadows cast by bodies in the room if there be not a number of sources of light. Here again the result may be unsatisfactory because the eye can not distinguish objects lying in the shadows and involuntarily strains itself to do so. The two methods of indirect and directed illumination may be combined to produce the best results.

But in studying illumination problems the end which is in view must be borne in mind. A solution satisfactory in one case is entirely unsatisfactory in another. Further, it must be borne in mind that the eye distinguishes not only by lights and shadows, but by color; and if the color effects are marked, uniform diffused illumination may be the best. The use which is made of the room must be borne in mind. For the home in general, there must be a combination of directed and diffused illumination for comfort, because here the eye sees by lights and shadows. In the ballroom, on the other hand, there is not so much need for directed illumination, because of the color variety. Again, in the shop or store the work which is to be done must be considered. In comparing colored goods a white light is essential, because daylight is our standard. If, however, it be sought to select goods and detect blemishes, a green or bluish-green light is the best, because dead organic matter has, in general, a brownish color which will appear black in a green light, but will be not so noticeable in an orange or red light. If, on the other hand, it be sought to mask defects, as may be the case in a ballroom, a reddish tinge will give the best effect.

It is of the greatest importance in illuminating problems to consider the reflection which takes place from the bodies on which the light falls directly. Frequently the reflection from the walls and ceiling of a room will increase the illumination three or four times over that which would be given by the direct rays only. The amount of reflection depends upon the color of the surfaces. A white surface reflects all the rays and hence will produce the greatest illumination; but white walls are not always satisfactory. In the home the standard of illumination must be daylight, but in this light the direct illumination comes from the windows, which have a low intrinsic brilliancy; and the diffused light coming from the walls is apt to be proportionally too great, so that a light tint on the wall will be more comfortable. In the machine shop or foundry the walls will, in general, take on a brown tint due to the preponderance of the elements iron and carbon; therefore, in such situations, a green light, which will not be reflected, is less satisfactory than an orange light. This has been found to be true when using mercury vapor lamp in foundries and shops. The same is true of city street lighting, where red and brown shades predominate. In parks and suburbs, however, where there is much foliage, a reddish light is less reflected than a green, and here a better illumination is secured with a light of the latter color. The illuminating engineer must, therefore, consider a number of features in selecting the proper method for any particular situation. He must distinguish between diffused and directed illumination, so as to get the lights and shadows sought; and he must bear in mind the color of the light which he selects so as to produce the proper effect. Heretofore little attention has been paid to these factors, but they are now receiving very careful study.

Dr. A. E. Forstall took issue with Dr. Steinmetz upon one point of the address. The former had said that the Bunsen flame is not luminous, because the mixing of the gas with air before burning enables the carbon to be burned up so quickly that it does not give any appreciable light. Dr. Forstall said that in the luminous flat flame the hydrocarbon is broken up and carbon is burned as such, but in the Bunsen flame the combustion is one of hydrocarbons, and since carbon is not burned as such, it does not give off the characteristic light. He emphasized the necessity for keeping the intrinsic brilliancy of light sources low, as the object is rather to get light to the eye than to secure bright illumination.

P. S. Millar gave the results of certain experiments which have been conducted at the Electrical Testing Laboratories in the comparison of lights of different color. When a comparison was made of a lamp giving a reddish light with one giving a green, such as the mercury vapor, by means of the Lummer-Brodhun photometer, with the sources of light at distances varying from ten to fifty feet, and with an illumination of from one to twenty luces, the Purkinje effect—that depending upon the different sensibilities of the eye to different intensities of different colors—caused a difference in the ratios of the two lights as great as thirty per cent. Substituting the Bunsen photometer, this difference was reduced to fifteen per cent, and when the flicker photometer was employed the difference disappeared. This seemed to indicate the possibility of devising means for comparing lights of different color. Mr. Millar called attention to the poor examples of illumination met not only in public places, but in the offices of companies interested directly in supplying light and lamps. He thought it was time for the society to stop scolding the public and turn its attention to its own members.

W. H. Gardner said that Mr. Millar was correct in saying that the lighting companies gave instances of poor illumination, but he pointed out the fact that they are selling light and illumination, and their object is to attract attention, which they do by exhibiting brilliant sources of light.

G. V. Williams said that the efficiency of an illuminant is not as important as the effect which is sought, and that psychological effects are involved, as well as physiological. The effect must be one agreeing with the mood. Too brilliant illumination is harsh and spoils artistic effects. Softer illuminations are more pleasing, and these should always be used in the home.

V. R. Lansingh pointed out that the effect depends as well on the quantity of light as on the intensity of illumination, and too much light coming from large sources may be objectionable.

In closing the discussion, Dr. Steinmetz accepted Mr. Forstall's explanation of the combustion of the Bunsen flame, saying that, while expressed a little differently, he had the same idea in mind. He questioned whether the flicker photometer would really offer a solution of the problem of comparing lights of different color. In his opinion this photometer produced an effect depending rather upon the average energy reflected to the eye than upon the character of the different illuminants. He thought that the photometer measured a physical rather than a physiological effect. Red and yellow lights easily produce after effects which persist, but this effect is very hard to secure with green and blue lights.

The meeting was then adjourned.

Digitized by Google

Comparative Cost of Cooking with Various Fuels.

BY CHARLOTTE D. SEAVER.

The results set forth in the following table show the relative average expenses of cooking by electricity compared with the different fuels in use, for the same kind and character of cooking operations, the time in each case being based on one hour.

The advantages of electric cooking from the standpoint of sanitation and saving of labor consist in the fact that there is no smoke, flame nor soot, and, of course, no ashes nor dust arising therefrom. When in use there is nothing to indicate the presence of heat, for the apparatus has the same appearance as when cold. While the cooking goes on there is little or no appreciable rise of temperature of the air surrounding the utensils. There is no vitiation of the atmosphere and practically no radiation of heat into the room, which would be of great advantage in the summer. The apparatus may be readily accommodated on a table, thus doing away with the bulky range and its fuel. There is no labor in maintaining uniform heat; no danger of fire or explosion, no danger of personal injury or electric shock, as the voltage of 110, which is usually employed, would not produce more than a slight burn on the fingers. Electricity is quite readily obtained for heating and cooking and may be used, as has been shown, at a reasonably high efficiency. The articles are of superior quality. The work of the oven, for example, is as nearly perfect as possible. The time required, from the turning on of the current to complete the baking of a given article, for instance, may be determined to a certainty. Results which have been found the best by experience may be reproduced easily with the electric oven. It will not burn the top nor the bottom of the food but heats quickly and uniformly. No particular attention is required to be given to what the oven contains, for there is no need of changing a pan containing bread or cake to get a more favorable position. Every loaf of bread or cake may be obtained uniform in height, while all are of that delicious brown so highly desired.

The time required for cooking various articles of food is practically the same as by other methods of heating. It takes the same length of time to boil a potato of given size in one way as in another, to soften the fibre of meat, or to convert dough into perfectly baked bread. The gain in time in electric cooking comes from the heat being so quickly available. For light housekeeping such as is the custom in small city apartments, and in larger houses during the summer months, no other method presents so many desirable features. Gas, gasolene and kerosene are of course extensively used, but with the disadvantages of greater heat in the room, unpleasant odors, vitiation of air, comparative uncleanliness, and always with some danger.

Notwithstanding all its advantages, both sanitary and labor-saving, the expensive utensils and the high price charged per kilowatt-hour for the service will nevertheless tend to make the general use of electric cooking of slow growth. We firmly believe, however, that it will win its way into public favor. Electricity in the near future will no doubt be so generated as to be brought within the means of almost all of the smaller home circles. The greater comfort and convenience, on the other hand, appeal strongly to the woman doing her own work, either from choice or necessity. Indeed, it is not too much to expect that electric heating and cooking may offer at least a partial and perhaps a complete solution of the domestic-service problem, and thus meet one of the highest functions of modern science in preserving the home from the disintegrating influence so imminent whenever some help can not be obtained for the most ordinary operations of housekeeping and homemaking.

COMPARATIVE COST OF COOKING WITH VARIOUS FUELS.

Source of Heat for Cooking.	Electricity.	Coal.	Gas.	Gasolene.	Kerosene.
Amount of energy or fuel required for given cooking operation	1.032 K. W.-H.	10.5 lb.	20 cu. ft.	0.0832 gal.	0.078 gal.
Cost consumed	$0.04 per K. W.-H.	$7.00 per ton.	$1.00 per 1,000 cu. ft.	$0.15 per gal.	$0.14 per gal.
Cost of cooking by given source.	$0.0413	$0.0367	$0.02	$0.0124	$0.0109

From the foregoing results the advantages and disadvantages of cooking by electricity may be summarized as follows: at the rate of four cents per kilowatt-hour it would cost double that of gas fuel; and, at the prices ordinarily paid for electricity, it would cost at least six times that of gas or coal, which are the fuels most commonly used. This fact, together with the initial cost of the apparatus required, would appear to forestall its general adoption at present. While the first cost of cooking utensils seems high, yet an outfit may be obtained for $50, consisting of an oven, a broiler, a griddle, a six-inch stove and a flat-iron; or the following combination: a griddle, two six-inch stoves, an oven and a flat-iron. Either of these outfits would serve for the necessary cooking for an ordinary family of from three to six people. A very complete outfit, comprising a slate-top table with several outlets for electrical connections, with cords and conductors and the following utensils: an oven, a broiler, two stoves, a coffee percolator, a quart pot and a large kettle, may be purchased for $110. This is not so much in advance, therefore, of the ordinary kitchen outfit as it might appear. Moreover, these cooking vessels are of nickeled copper, which is of longer life and is more easily kept in good order than are ordinary utensils. Those utensils that lock on to the stove give the quickest service on account of the close contact. For highest efficiency those water heaters are the best in which the heating coils are embedded in the bottom. The efficiency of a heater of one quart capacity is about eighty-seven per cent.

[1] From an article on "The Economics of Electric Cooking" in the *Clarkson Bulletin*, published by the Clarkson Memorial School of Technology, Potsdam, N. Y., October.

Boston Grants Independent Telephone Franchise.

The board of aldermen of Boston, Mass., on December 13 granted a franchise to the Metropolitan Home Telephone Company. The question of granting a franchise has been before the aldermen since last May, and several hearings have been held on the subject. A few weeks ago the board voted to give the petitioners leave to withdraw, but later reconsidered its action. This action by the board has been the subject of considerable comment. The company received its charter from the secretary of state on May 21, 1906. The capital stock is fixed at $5,000,000, and a number of prominent business men are said to be stockholders. It is announced that the company's plans involve the expenditure of $10,000,000. The ambition of the company is to open the way for independent connections throughout the New England and Middle Atlantic states.

Digitized by Google

Meeting of the Provisional Organization Committee of the Cooperative Electrical Development Association.

Last March, it may be remembered, a joint meeting of a number of leading men from all branches of the electrical trade was held in New York. At this meeting a very representative committee was appointed to cooperate in developing the plans and in perfecting the organization.

W. M. McFarland, acting vice-president of the Westinghouse Electric and Manufacturing Company, chairman of this committee, called a meeting for December 13, 1906, at the Imperial Hotel, New York city, to further consider the objects, plans, results and organization of the association.

At the morning session J. Robert Crouse presented a paper dealing with the work and results, which was fully discussed.

This was followed by a further paper on the commercial plans formulated for the future, which was likewise discussed from various points of view.

At 1:30 P. M. the gentlemen present lunched together, and at 3 P. M. assembled for the afternoon session.

The first part of this session was devoted to a reading of the proposed constitution and by-laws, after which a general and lively discussion of the entire proposition was indulged in.

The sense of the meeting was crystallized in the following resolution introduced by Walter Cary, of the Sawyer-Man Electric Company, which was unanimously passed:

"*Resolved,* That it is the sense of this meeting that the commercial programme outlined for the Cooperative Electrical Development Association for 1907 and the future is along sound lines, and gives good promise of highly profitable returns to all concerned.

"It is the further sense of this meeting that immediate steps be taken to perfect the organization of the Association and to prosecute its commercial plans vigorously, pursuant to which the chair is requested to appoint three committees, of five members each, as follows: Committee on constitution and by-laws; committee on membership assessments; committee on commercial programme."

The chair appointed the following committees:

Committee on constitution and by-laws—E. E. Jackson, chairman; A. D. Page, General Electric Company; Walter Cary, Sawyer-Man Electric Company; F. J. Newbury, John A. Roebling's Sons Company; W. W. Freeman, Edison Electric Illuminating Company, of Boston.

Committee on commercial programme—F. S. Terry, chairman; W. C. Bryant, Bryant Electric Company; R. S. Hale, Boston Edison Illuminating Company; A. L. Doremus, Crocker-Wheeler Company; E. W. Gillmer, Peerless Electric Company; F. Bissell, the F. Bissell Company.

Committee on membership and assessments—J. S. Anthony, chairman; Walter Cary, Westinghouse Electric and Manufacturing Company; W. W. Freeman, Edison Electric Illuminating Company, of Brooklyn; Charles B. Price, Pettingell-Andrews Company; James R. Strong, president National Electrical Contractors' Association.

These committees will in the immediate future, formulate and submit their detailed report to the chairman of the joint committee, so that at its next meeting the Cooperative Electrical Development Association may be formally and finally launched.

In the evening at 8, the *confreres* sat down to a banquet, over which J. S. Anthony, of the General Electric Company, presided gracefully.

The more serious business of the day having been dispatched, the evening was given over to the cultivation of closer acquaintance and general good fellowship.

The following is a list of those in attendance:

W. M. McFarland, Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; Walter Cary, Sawyer-Man Electric Company, New York, N. Y.; W. C. Bryant, Bryant Electric Company, Bridgeport, Ct.; J. S. Anthony, General Electric Company, New York, N. Y.; A. D. Page, General Electric Company, Harrison, N. J.; E. S. Keefer, Western Electric Company, New York, N. Y.; A. L. Doremus, Rodman Gilder, Crocker-Wheeler Company, Ampere, N. J.; E. W. Goldschmidt, Wagner Electric Manufacturing Company, St. Louis, Mo.; F. S. Terry, National Electric Lamp Company, Cleveland, Ohio; F. J. Newbury, John A. Roebling's Sons Company, Trenton, N. J.; E. E. Jackson, New York, N. Y.; W. H. Blood, Stone & Webster, Boston, Mass.; W. W. Freeman, Edison Electric Illuminating Company, of Brooklyn, N. Y.; John F. Gilchrist, Chicago Edison Company, Chicago, Ill.; R. S. Hale, Edison Electric Illuminating Company, Boston, Mass.; J. E. Montague, Buffalo & Niagara Falls Electric Light and Power Company, Niagara Falls, N. Y.; F. M. Tait, Dayton Lighting Company, Dayton, Ohio; F. Bissell, the F. Bissell Company, Toledo, Ohio; Charles B. Price, Pettingell-Andrews Company, Boston, Mass.; James R. Strong, president National Electrical Contractors' Association, New York, N. Y.

The following gentlemen who were expected to be in attendance were unable to be present; Arthur Williams, president National Electric Light Association, New York, N. Y.; Henry L. Doherty, New York, N. Y.; Gerard Swope, Western Electric Company, Chicago, Ill.; O. A. Stranahan, Allis-Chalmers Company, Milwaukee, Wis.; A. T. Clarke, American Circular Loom Company, Chelsea, Mass.; E. W. Rockefellow, Western Electric Company, New York, N. Y.

American Institute of Electrical Engineers.

The 212th meeting of the American Institute of Electrical Engineers will be held in the assembly room of the New York Edison Company, No. 44 West Twenty-seventh street, New York city, on Friday, December 28, 1906, at 8:15 P. M. Ray P. Jackson, electrical engineer of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., will present a paper entitled, "Recent Investigation of Lightning Protective Apparatus." The paper will be discussed by the following members of the Institute: Charles P. Steinmetz, Frank G. Baum, Harold W. Buck, Ralph D. Mershon, Percy H. Thomas, David B. Rushmore and H. B. Alverson.

The Chicago Traction Situation.

It is announced that the long controversy between the city and the street-car companies is practically at an end. The basis of a settlement of the transportation question has been agreed upon along the lines demanded by a majority of the city council and the voters. It is understood that $50,000,000 will be divided between the two big companies, on the basis of approximately $29,000,000 to the Union Traction, and $21,000,000 to the Chicago City Railway.

The Independent Telephone Company of Chicago.

Interests which have secured control of the Chicago subway telephone system, it is announced, will incorporate under the title of the Independent Telephone Company of Chicago. Equipment to the value of $4,000,000, for a telephone service of 100,000 subscribers, will be ordered at once.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Presence of Neon in Radioactive Minerals.

A search has been carried on for some time by R. J. Strutt for the rare gases along with helium in the radioactive minerals. The early results were negative, but a recent test showed a trace of neon in two minerals—zircon and cyrtolite. The amount of the gas could not be determined accurately, but it was judged to be about one-three-hundredth part of the helium. The separations were made by Dewar's charcoal method, and it is possible that with the greater skill attained by the author that a repetition of previous experiments will indicate the presence of neon in other helium-bearing minerals which have previously been tested. On the other hand it is possible that the presence of neon is connected with zirconia, as both of the above minerals contain it. —*Abstracted from Nature (London), November* 29.

A New Type of Continuous-Current Dynamoelectric Machine with Commutating Poles.

While the use of a commutating pole assists in securing favorable conditions for commutation, it is contended by V. A. Finn that the changes thus secured are not as great as are usually assumed, for although a suitable winding placed upon these poles may provide a commutating magnetic field of sufficient intensity, the use of these poles does not affect appreciably the leakage lines passing from the armature laterally through the pole pieces, because the introduction of these poles does not in any way affect the magnetic reluctance of these paths. The auxiliary pole will therefore not be able to compensate for the armature reaction and thus prevent all magnetic field distortion. To secure this result a modification of the magnetic field, indicated in Fig. 1, has been made. This is a two-pole field with auxiliary poles intermediate between the main poles, but the two main poles are completely divided centrally so as to provide two entirely independent magnetic paths. The effect of this is to introduce another air-gap in the leakage path, thereby greatly increasing the reluctance of this path and reducing the field distortion; and there is a further advantage, since the commutating flux may be caused to add itself to the flux through one of the main poles, and thus assist in compounding the generator. To secure this end it is only necessary to arrange the commutating pole unsymmetrically with regard to the main poles. This is indicated in Fig. 2. With such an arrangement there is no necessity for placing windings on the commutating poles. Fig. 2 also shows the method of increasing still further the reluctance of the leakage paths by splitting the main poles. With a design of this kind the two independent magnetic field sections may be supported by end shields, from which they are insulated magnetically. This is a design which allows the use throughout of maximum densities and of an air-gap limited only by mechanical considerations and a comparatively small number of ampere-turns on the commutating poles. It also simplifies somewhat the problem of ventilation.—*Abstracted from the Electrician (London), November* 30.

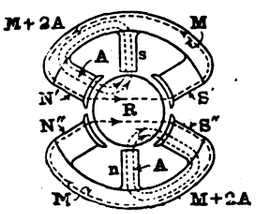


FIG. 1.—ARRANGEMENT OF COMMUTATING POLES.

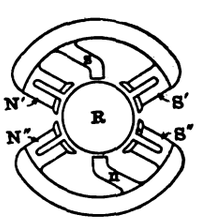


FIG. 2.—ARRANGEMENT OF COMMUTATING POLES.

An Automatic Circuit-Breaker.

If a round carbon rod be placed upon two similar rods held parallel and separated from one another by about one centimetre, and each of the latter be connected to one pole of a battery giving about eight volts, a bright glow appears at the points of contact of the rods and a loud note is heard. This phenomenon has been investigated by Chr. Rice, who finds that the rods form an automatic circuit-breaker giving a very high period of interruption. By connecting into this circuit the primary winding of an induction coil a powerful discharge takes place between the electrodes of the secondary. By shifting the superimposed rod on the other two, so that it is nearly balanced upon one of them, resting but slightly upon the other, the sparks increase and the tone rises in pitch, showing that the frequency of interruption has been increased. During this discharge the upper rod is seen to vibrate rapidly from side to side. The action is supposed to be due to the alternate heating and cooling of the point of contact.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), December* 1.

Measurement of Temperature Rise in the Windings of Electrical Machinery.

A comparison is made here by F. Loppé of the rules for determining temperature rise in the windings of electrical machinery in force in the United States, in Germany and in France. In the United States the temperature coefficient of resistance is taken as 0.42 for each 100 degrees centigrade, and the normal temperature of the room is taken at twenty-five degrees centigrade. If the actual temperature differs from this the temperature elevation should be corrected by one-half per cent for each degree, so that a temperature in the test room of thirty-five degrees should make a decrease of five per cent in the observed value. The rules call for a temperature determination by resistance measurements, except for squirrel-cage windings. The German rules say that, except for field windings excited by continuous currents and windings of stationary elements, the increase in temperature must be determined by means of a thermometer. The increase in temperature of the field windings should be determined by resistance measurements, and the temperature coefficient of resistance is taken as 0.004. The Association Français prescribes the determination of temperature rise of windings, whenever possible, by simultaneous resistance measurements and thermometer readings, and the higher value shall be taken. The temperature coefficient of resistance is taken as 0.004. If the winding to be measured is thick the

Digitized by Google

rise in temperature will be considerably greater than that indicated by the thermometer, and the value determined by resistance measurements may be ten or twenty per cent greater. For thin coils wound on iron in which hysteresis losses are taking place, the thermometer will generally indicate a temperature slightly higher than that given by the resistance measurement. The author shows the application of the various rules to an assumed case, and finds that the values thus determined differ but slightly from one another.—*Abstracted from L'Industrie Électrique (Paris), November 25.*

The Irreversibility of the Heusler Alloys.

An investigation has been made by Bruce V. Hill to determine to what extent the Heusler magnetic alloys are reversible as regards temperature effect. Iron and nickel alloys, which become non-magnetic at about 700 degrees centigrade, regain their susceptibility upon being cooled to low temperatures. Upon reheating the same cyclic change takes place. The magnetic bronzes, on the other hand, are but little affected by cooling to low temperatures, as the susceptibility depends rather upon the temperature from which the specimen has been cooled before the test is made. If heated to a temperature slightly above that of transformation the susceptibility at room temperature is found to be smaller than when the latter was first cast. On cooling successively from still higher temperatures the susceptibility at ordinary temperatures increases as the temperature from which the metal has been cooled rises. These results were obtained with four different alloys made by melting together copper-manganese alloy and aluminum. Chemical analysis of the samples showed that a good deal of manganese had been burned away. The percentage of copper varied with the sample from sixty-three to seventy-four; that of aluminum from twenty-two to thirty-four; and that of manganese from one to four. These samples were placed successively in a magnetizing field maintained constant at thirty-eight C. G. S. units. Upon increasing the temperature the intensity of magnetization decreased at an increasing rate, falling to zero at about 320 degrees. Upon allowing the latter to cool, the intensity of magnetization rose, but only to about thirty per cent of its original value. Upon reheating to a still higher temperature the intensity of magnetization again fell to zero at about the same temperature, and remained at this point; and, upon cooling again, retraced practically the path for rising temperature, though rising to a higher value of susceptibility at the temperature of the room. Three of the four samples behaved in substantially the same manner, the original intensity of magnetization being for one, 175, and for a second, 123. After heating the intensity lay between forty-five and fifty-five. One sample was non-magnetic and only showed magnetic properties after being crushed in a mortar. The results indicate that the susceptibility of the alloy at room temperatures decreases as the temperature to which it has been heated rises, up to a certain point. If heated beyond this there seems to be a slight increase in the intensity upon recooling. The alloys do not regain their magnetic properties at the higher temperatures. If it be assumed that the molecular state of the metal is in great measure that naturally stable at the higher temperature, due to the retardation or non-occurrence of certain allotropic changes, then it must be supposed that there are different molecular arrangements of the metals constituting the alloy at different temperatures; and the relations existing at high temperatures allow the transformation of the manganese from the beta to the alpha state to take place more completely than in the molecular groupings at lower temperatures. The experiments seem to indicate that the phenomenon of magnetization is rather a molecular than an atomic property.—*Abstracted from the Physical Review (Lancaster), December.*

Electrical Equipment of a Newcastle (England) Railway Warehouse.

The Northeastern Railway Company, of Great Britain, put into use in October last a new freight warehouse at Newcastle-on-the-Tyne, in which a complete system for handling materials has been installed. All the machinery in the warehouse is driven by electric motors and has been designed for the rapid handling of freight with a minimum expenditure of manual labor and time. Energy for operating the system is obtained from the Newcastle Electric Supply Company at 400 volts, continuous current. This is controlled from a central switchboard in the warehouse, from which the energy is distributed to the various machines and lighting circuits. The electrically driven machinery comprises ten cranes, two transporters, six jiggers, two wagon hoists, one wagon traverser, forty-two capstans, making sixty-three machines in all. These are driven by ninety-five motors of the series-wound, enclosed, multipolar type, with the exception of those in the capstans, which are compound wound, so as to enable them to deal with the variable load with slight variation in speed. The method of handling freight is as follows: In the basement, which is a low-level freight station, cars are drawn by means of capstans into either of the two hoists at the ground level, and lowered sixteen feet to the rail level of the basement, where they are drawn off the hoist table to a traverser, which crosses the basement of the warehouse, and sets the wagon opposite any of the four roads as required. The wagon can then be moved by means of the sixteen capstans and four turntables with which the basement is equipped, to any desired position, while two pillar cranes with a radius of nineteen feet lift materials into and out of the wagons placed within their radius; and two traveling cranes fitted with revolving jibs of twelve feet radius deal with the lorries placed near them as well as the platform over which they travel. These cranes, although they only span a platform twenty feet wide, command an area nearly forty feet in width. The ground floor, which is a high-level station, has six rail tracks running into it, fed by sixteen capstans, with eight turntables inside the building and ten capstans and four turntables outside. The four traveling cranes on this floor are provided with revolving jibs covering a span of forty-eight feet six inches. The jib radius is eleven feet, and the length of track 300 feet. There are also two cranes here with a seventeen-foot radius of jib. Two conveyers on the second floor work across the building and can pick up a load from any of the six ground-floor roads or from the two outside roads and place it on either of the floors above by working through suitable hatchways. The jiggers can pick up from or lower onto the roads outside and serve the first and second floors, while two of them serve short lengths of the third floor. They have a travel of twenty feet inside the warehouse. The jib cranes are equipped with motors ranging from one to six horse-power, the hoists with fifty-horse-power motors, the traverser with a twenty-six-horse-power motor, the capstans with motors of the same size, the traveling cranes with one-and-one-half and fifteen-horse-power motors, the jiggers with one-and-one-half and ten-horse-power motors.—*Abstracted from the Electrical Review (London), November 30.*

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

ADVERTISING ELECTRICITY—III.

BY FRANK B. RAE, JR.

ADVERTISING CAMPAIGN.

It is almost impossible to stipulate what shall or shall not be done in seeking business by means of advertising. Local conditions and business ethics alone make the boundaries of our endeavors. The idea that any given amount of clever printed matter constitutes an advertising "campaign" is wholly erroneous. Advertising is not printing; it is an educational process. The stock "campaign" is successful only in the most limited degree. It may be compared with ready-made clothes in that it serves well and is cheap if one can only be sure of a "fit." This statement goes counter to the rules of the game as laid down by men of standing in the advertising field, but nevertheless it is subject to confirmation by any one capable of analyzing his own, or better still, another company's local conditions. Such an analysis will bring home sharply this truth—there is no cut-and-dried rule for undertaking an advertising campaign, any more than there is a hard and fast rule for treating physical illness.

The material at hand for carrying on an advertising campaign consists in letters, personal or circular; booklets and folders of more or less decorative make-up, novelties of infinite variety, general publicity by means of bill-boards, painted signs and street-car cards, newspaper advertising and legitimate news items. These, roughly, are the ingredients of the campaign and it rests wholly upon the local conditions to decide in what proportion and amount one or several or all of them shall be used. In making such a decision, personal preference and prejudice must be cast to the winds. It makes not one iota of difference what you, gentle reader, like or dislike. What the firm wants are results — contracts — profits. Whatever will get those results without violating the ethics of the business, is good advertising, whether you like it or not. Whatever will not give results is bad advertising, no matter how many of your friends congratulate you on the cleverness of your work.

THE USE OF CIRCULAR LETTERS.

The most common and at the same time the most altogether difficult medium of advertising to handle is the circular letter. The value of the circular letter as a means of advertising is in direct ratio with the ability of the writer and printer to produce a letter which shall appear to the reader to be a *bona fide* personal communication. There is no doubt that the circular letter under letter postage, reaches its destination. A man's mail will find him where the most resourceful solicitor can not penetrate. It will receive attention where the most tactful solicitor would fail. It is the most effective device in the advertising man's bag of tricks.

At the same time, no medium of advertising requires more complete and all-embracing cleverness to handle; for its whole effect lies in the advertiser's ability to deceive the reader into believing that a letter, printed by thousands and addressed to all classes of prospects, is a personal communication intended solely and specifically for one individual. It will be seen that this is no slight achievement. The mail of every business man is lumbered with this very class of material, and so suspicious has the public become that dictated personal letters are frequenty mistaken for circulars and consigned to the waste-basket.

The responsibility of the circular letter rests about equally between the writer and the printer. The writer must find a reasonable cause for addressing the prospect and must impress him with the naturalness of his communication. The printer, for his part, must produce an imitation so perfect that nothing but microscopic inspection will develop its real character. If an imitation is not perfect, it is not worth the stamp required to post it. A plain type circular, well displayed, will bring more business and leave a better taste in the mouth of the man who receives it, than an imitation which carries the brand of fake on its face. The reader has but to ask himself how much importance he attaches to circular letters which come to his desk, to realize the necessity of using in his own advertising, letters which will pass the careful scrutiny of business men to whom a poor imitation would be an insult.

BOOKLETS AND FOLDERS.

It would seem that with all the millions of booklets which have been produced within the last century or two there should have been developed a few fundamental rules, or schedule of correct procedure, upon which such advertising material might be based. Apparently, however, the only limitation is set by the booklet maker's own peculiar ideas and these, frequently enough, are a matter more of personal preference than of cogent reasoning.

In taking into account the use of booklets in an advertising campaign, the most primary consideration is that of distribution—how are we to place this material in the readers' hands? The second consideration should be to decide exactly the scope and purpose of the booklet, in order that it may not transgress beyond a fixed limitation. The third factor is quality, which, generally speaking, should be as high as is reasonable in view of the class of business it is designed to stimulate or create.

A few arbitrary laws would seem to govern in the matter of distributing booklets. It is well to remember, first, that only short and very catchy material should be used as enclosures with bills or letters. It is almost instinctive with the receiver of such matter to throw away the advertisement. Only the most casual glance is given to make sure that it is not of personal interest. The booklet must win attention in that instant of pause.

Where the books are to be distributed by solicitors or third-class mail, it is well to have them quite elaborate in order that they may receive consideration from their intrinsic beauty, cleverness or value. When a solicitor personally delivers a piece of advertising it is expected that it will complement the selling argument which he has made, giving, perhaps, fuller and more interesting data.

The scope of the booklet is the most difficult to handle discreetly. As a rule, the amateur in advertising endeavors to tell too much. As the preparation of such a book progresses, additional points come up, which seem absolutely necessary to include. Thus, from an eight-page booklet, designed to stimulate, let us say power business, there gradually develops a very cyclopedia of technical data on power and motor applications, so obviously overdoing the matter that the book fails from excess. The rule here is summed up in

Digitized by Google

two words—brevity and suggestion. Since the whole subject can not be covered, let a few vital, salient points be made in such manner as to prove the value of your service while suggesting its illimitable applications.

The mechanical preparation of advertising booklets is a matter which runs the whole gamut of types, plate-making, printing, paper and binding. On any one of these subjects, there exist whole libraries of information, so that it is obviously without our province to touch upon any one of them. It may be said, however, that the printed matter put out by an electric light company should be as good as the class of business solicited will warrant. No slightest detail should be overlooked. If the funds available will not admit of making the proposed work wholly excellent, then a smaller piece of advertising matter should be employed. A four-page folder well done will bring better results than a twenty-page book which looks cheap, or in which any detail is less than perfect.

NEWSPAPER ADVERTISING.

In the 1906 Question Box of the National Electrical Light Association the advisability of newspaper advertising was questioned and the answers proved that sometimes newspaper advertising pays and sometimes it does not. About the only law one may safely follow in reaching a decision is the law of common sense. For example, in a town where there are probably not over half a dozen private plants, it is palpably unprofitable to offer arguments designed to put the isolated plant out of business. In a town where metropolitan newspapers divide patronage with the local press, it is obvious that newspapers will have comparatively little value. Under the most favorable circumstances and in anything less than a metropolis it must appear self-evident that advertising for power business in the newspapers is a waste of money and effort. There are, however, no substantial reasons why any of these things are so—and sometimes they are not so. Exceptions abound.

In many cases newspaper advertising is of the greatest advantage; among these may be cited the moderate sized city, fairly remote from large centres and where rivalry among merchants is keen. In such communities the local newspaper is carefully read by all classes and is a first-rate medium for reaching a desirable market. Likewise in cities having any considerable foreign population, the national paper of that particular people will frequently give astonishing results. The reason would seem that such papers generally have the most absolute confidence of the people to whom they appeal and this confidence extends to the advertiser who uses its columns.

NEWS MATTER.

The old policy of secrecy upon the part of public service corporations is one wholly foreign to modern American ideas. The policy of to-day may profitably lean towards openness and frankness in matters of company news, and this will lead to much gratuitious advertising of a most beneficial sort. The public is interested in its public utilities; moreover, the public feels as if it had a right to know something about them. Finally, if the public knew the scope of the activities of the average utility, it would realize the difficulties under which public service corporations labor and would at once be more just and charitable in its attitude. Every day there develop items of real news value which may be turned over to the local press. These items may be of a personal nature touching officers of the company; they may be facts concerning extensions and betterments, or they may take the form of demonstrations of new appliances for the benefit of editors or reporters. All such items are welcome in the paper of the average sized city.

BILL BOARDS AND CAR CARDS.

The use of bill boards and car cards is in the nature of general publicity. Nothing very definite can be expected of it by an electric light company, except in cases where it is necessary to publish broadly and quickly some specific announcement.

Should rates be materially reduced notice of the fact could be given wide and effective publicity on bill boards. Notice of temporary displays or demonstrations may also be given by bill boards to advantage. It is wise for the electric company in a fair-sized city to use illuminated sign boards at strategic points, in order to stimulate similar advertising by others. The public feels confidence in the firm that will "take its own medicine," and the adoption of such methods will react favorably.

The street-car card is in the same class with bill boards. Obviously there is no opportunity in either case for extensive argument; rather, it is auxiliary advertising—useful in conjunction with a more direct campaign, but almost barren of traceable returns.

PROGRAMS AND SCHEMES.

The lighting company which enters upon a serious advertising campaign should set its face resolutely against all publicity by means of programs or similar schemes. Where the program is for a church affair, society outing or labor entertainment, the advertisement is solicited, not upon the value of the medium, but as a contribution to the "cause." It is a species of charity solicitation wherein as a rule, both the organization and the advertiser lose. For if such matters be investigated it is too frequently found that the solicitor usually pockets the proceeds—or the major portion of it—giving only a shoddy program free to the organization. When it is not plain graft such a contribution is charity and should be charged as such on the books. Advertising is for profit. No profit—to the advertiser—was ever known to result from schemes.

THE USE OF NOVELTIES.

Generally speaking, the advertising novelty is of doubtful value. Its chief purpose is not to stimulate inquiries, nor create desire for the product so advertised, but rather to compliment or placate customers, present or prospective. An advertising novelty is not an argument, but a bribe designed to put the receiver under a certain slight obligation. The amateur is frequently misled by the appreciative comment with which such novelties are received and by the fact that they are preserved for a considerable time. But advertisers who have sunk much good money into such novelties soon learn that whatever good-will the novelty may generate generally finds lodgment where it brings no direct returns, other than increased demand for free favors.

The most effective novelty, perhaps, is the calendar, but these should not consist of a pretty picture wholly irrelevant to the subject advertised. They should, if possible, suggest the business they are intended to promote, should carry arguments, not merely the sender's business card. Of other novelties there would appear to be no end, but their advertising value is wholly a matter of time and chance, and we think can seldom be recommended as having any real part in a serious campaign.

Illuminating Engineering Society of New England.

The Illuminating Engineering Society of New England met at the American House, Boston, November 13, 1906, the meeting being called to order by Dr. Louis Bell. A paper was read by W. E. Holmes on the "Flaming Arc." He gave some very interesting experiences of this lamp in its earliest stages of commercial use. The paper was discussed by Messrs. Cowles, Marks, Bell and Gifford. A. T. Sampson read a paper, written by Major E. L. Zalinski, on "Fixture Design" which was discussed by Messrs. Ryan, Clifford, Bell and Marks. Professor H. E. Clifford read a paper by F. N. Olcott upon "Fixture Location in Residence Lighting" upon which a discussion followed, participated in by Messrs. Cowles, Clark, Bell, Holmes and Sampson.

Digitized by Google

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Automatic Starting Compensator for Induction Motors.

Simple as is the construction of the squirrel-cage type of induction motor, the fact that the larger sizes require a suitable starting device has prevented the simplicity of the motor from being widely

FIG. 1.—COMPENSATOR, SHOWING OIL-IMMERSED SWITCHES.

taken advantage of when automatic methods of control are essential. The automatic starting compensator recently perfected by the General Electric Company for three-phase induction motors will therefore greatly broaden the field for motors of this type, especially in pumping and similar work.

The automatic starter consists essentially of a compensator with two oil-immersed switches, the starting and running positions of which are controlled by two solenoid magnets, inter-connected by a time-limit relay device. One solenoid switch connects the motor to the compensator, while the second solenoid throws the motor directly on the line. The time

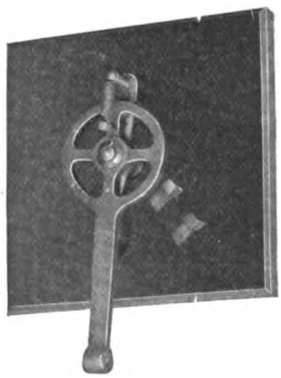


FIG. 2.—SINGLE-POLE FLOAT SWITCH.

allowed for letting the motor come up to speed between the two operations is provided for by an adjustable dash-pot auxiliary switch. An interlocking device prevents both solenoid switches being closed at the same time. The motor is started by closing a small push-button switch.

The arrangement of these various parts is shown in the illustration, Fig. 1. At the left is the solenoid operating the compensator switch; at the right the solenoid which throws the motor directly on the line, while the relay switch is mounted in the centre.

The feature which contributes most to the successful operation of the device is the arrangement of the main solenoid switches by which the operating circuits are broken when the solenoid core is drawn up into the closed position. The cores as they rise, trip a switch in their energizing circuits so that the solenoid coils do not remain in the circuit. Each core is held in the closed position by means of a detent controlled by a small auxiliary solenoid, which when energized merely serves to hold the core up, floating in its magnetic flux. When the motor is running the only coil energized is this small auxiliary solenoid which controls the detent of the line switch solenoid.

Thus all operating circuits except the main line switch and the one small solenoid are open, and there is no disagreeable humming or energy wasted in auxiliary circuits. The solenoids are all wound for single phase so that they can be operated from one leg in the circuit.

In starting up a motor a small push-button switch is closed, energizing the left-hand solenoid which throws the compensator into circuit. At the same time the auxiliary relay switch is lifting its core against the retarding action of the dashpot, and after an adjustable interval of time this switch disconnects the starting solenoid, energizes the right-hand solenoid and thus throws the motor directly on the line. When the motor is running the compensator is cut entirely out of the circuit.

To stop the motor the push-button switch is opened, the small auxiliary solenoid core falls on the detent, thus disconnecting the line switch and leaving all spool circuits opened until the push-button switch is again closed. Failure of current acts in the same way as opening the push-button switch.

This automatic compensator can be supplied where the remote starting and stopping of three-phase induction motors is necessary. In pumping, the push-button switch may be replaced by a float or pressure switch. In the first case a single-pole float switch (Fig. 2) can be used, and when the water is to be controlled by pressure the type M. C. governor, similar to that employed in air-brake work, can be substituted for the push-button switch. These are but two of the many ways of applying the automatic compensator which will suggest themselves.

The automatic compensators described are built for circuits employing a potential up to 550 volts. For circuits operating at higher potentials the General Electric Company provides a series transformer to step-down the voltage for the energizing coils. The compensator coils are provided with the usual taps for adjustment to various starting conditions. External enclosed switches are used in the circuit when the motor is across the running side of the compensator switch.

Educating the Public to a Better Knowledge of Illumination.

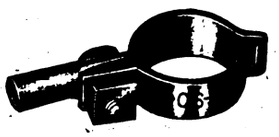
The Holophane Glass Company, New York city, for some time has been carrying on a campaign of education, which, it is safe to say, has very materially increased the knowledge of the general public on the subject of illumination. V. R. Lansingh, general manager of the company, as has been announced in the ELECTRICAL REVIEW, has given many lectures in different parts of the country on the subject in general. Since last fall, however, A. J. Marshall, of the engineering department, has been calling on the large central stations in different cities, carrying with him lantern slides and arranging for lectures on illumination, not only to the central station solicitors, but also, in general, arranging for the public as well as dealers and contractors to be present. Only incidentally is the Holophane system brought in, and it is not given any more prominence than any other system of illumination. This work is of great

Digitized by Google

value to the electrical industry, and is being appreciated by the central station companies. While the Holophane company's schedule is pretty well filled up, the company will make every effort possible to place its facilities in this direction at the disposal of companies with whom arrangements have not been made.

An All-Copper Ground Connection Clamp.

The Chase-Shawmut Company, Newburyport, Mass., has placed on the market the Shawmut all-copper ground connection clamp. This clamp is offered as a means of overcoming the dangers ordinarily associated with secondary distribution systems. The clamp is made of



ALL-COPPER GROUND CONNECTION CLAMP.

two pieces of copper held together with an iron bolt, and is made to fit any size of pipe from one-half to three inches in diameter. A terminal lug is provided, large enough to take a No. 4 wire. This clamp offers simplicity, strength and maximum contact area.

Electric Fixtures.

The Cleveland Gas and Electric Fixture Company, of Cleveland, Ohio, is the manufacturer of a general line of lighting fixtures, with sales departments in Cleveland, Ohio, and Pittsburg, Pa. The company is about completing the erection of a new factory at Conneaut, Ohio, with about 75,000 square feet of floor space and a full equipment of improved machinery. The company will manufacture a staple line of what is designated as the "C" line of box fixtures, which will comprehend all requirements in low and medium-priced fixtures, and to manufacture which the new factory is being provided. A portion of the factory is already in operation, and while the company is at the present time oversold on these goods, it expects to meet all demands with prompt shipments by January 1 and thereafter. The idea of putting up fixtures in as small a package as fourteen and one-half by four and one-half by four and one-half inches is an innovation in the fixture trade, and is being well received by the buyers.

The accompanying illustration shows the arrangement which is being made with this line of box fixtures. This method ensures the keeping clean and untarnished of the fixtures until ready for installation. There can be no lost parts, as each separate part of the fixture is carefully wrapped and put into the package ready for assembling. The boxes are made of strong cardboard, divided into compartments for the various parts of the fixture. All the parts, except the iron pipe, are compactly packed in the box. Each box is labeled with the fixture number and finish. A patent has been applied for on this idea.

METHOD OF ASSORTING AND PACKING "BOX" LINE FIXTURES.

Sixty-five Mile Interurban Line in Texas.

Contracts have been let by the Texas Traction Company for the equipment of a sixty-five-mile electric road between Dallas and Sherman, Texas. The new line will parallel the existing steam road between the two cities and will be one of the longest electric roads in the state. While the apparatus is standard direct current throughout, the equipment, in some respects, presents several features of interest.

The country through which the new line is laid out is flat and rolling, there being no grades exceeding one per cent and a maximum curvature of but three degrees. In order to have a clear headway for operating cars, a private right of way has been established by the company, so that the run between Dallas and Sherman will be made in two hours and thirty minutes. This schedule includes a fifteen-minute run within the city limits of Dallas, where the cars must necessarily be operated at lower speeds. While the main traffic will be of an express nature, stops have been provided about every two miles to take care of the local travel.

Fifteen car-equipments will be provided to maintain the initial schedule. These will be of the standard interurban type, each fifty feet long, and equipped with four GE-73 (seventy-five-horse-power) standard direct-current motors equipped with the Sprague-General Electric Type M system of multiple-unit control. Each car will be further provided with General Electric air brakes and compressors.

Power for the new road will be generated by steam at McKinney, a town located about midway between Dallas and Sherman. The main power station equipment will include two 1,000-kilowatt Curtis steam turbo-generators working under a steam pressure of 150 pounds at the throttle with 125 degrees superheat. The turbines will operate condensing. Current will be generated at 2,200 volts and twenty-five cycles and stepped up for transmission to 19,100 volts. For exciting the fields, two thirty-five-kilowatt generator sets will be provided. The compactness and low maintenance charges of these machines adapts them particularly for exciting units.

The three-phase current from each of the turbo-generators will be transformed in a set of three 330-kilowatt, air-blast transformers. One transformer of the same capacity will be installed as a reserve. To supply air for cooling, duplicate blower sets will be furnished, one set being driven by an induction motor, the other by a direct-current motor. Each blower will have a capacity of 10,000 cubic feet.

One of the special features of interest in the new road lies in the rotary converter equipment. Six substations will be provided, including one at the main station and a portable equipment. This last mentioned substation comprises a special car containing a 300-kilowatt rotary converter, air-blast transformers

Digitized by Google

and suitable switching apparatus for cutting into the transmission system wherever necessary. The portable substation renders unnecessary the duplication of rotary converters at the fixed substations, for the portable equipment can be shifted to various parts of the line and used as an emergency station or auxiliary in case of need.

The substations will be inter-connected by high-tension transmission lines, operated initially at 19,100 volts. Eventually, however, a transmission potential of 33,000 volts will probably be used and for this purpose taps will be provided for Y-connection of the transformers. With the few exceptions noted the new line follows, in general, the standard direct-current practice of the General Electric Company.

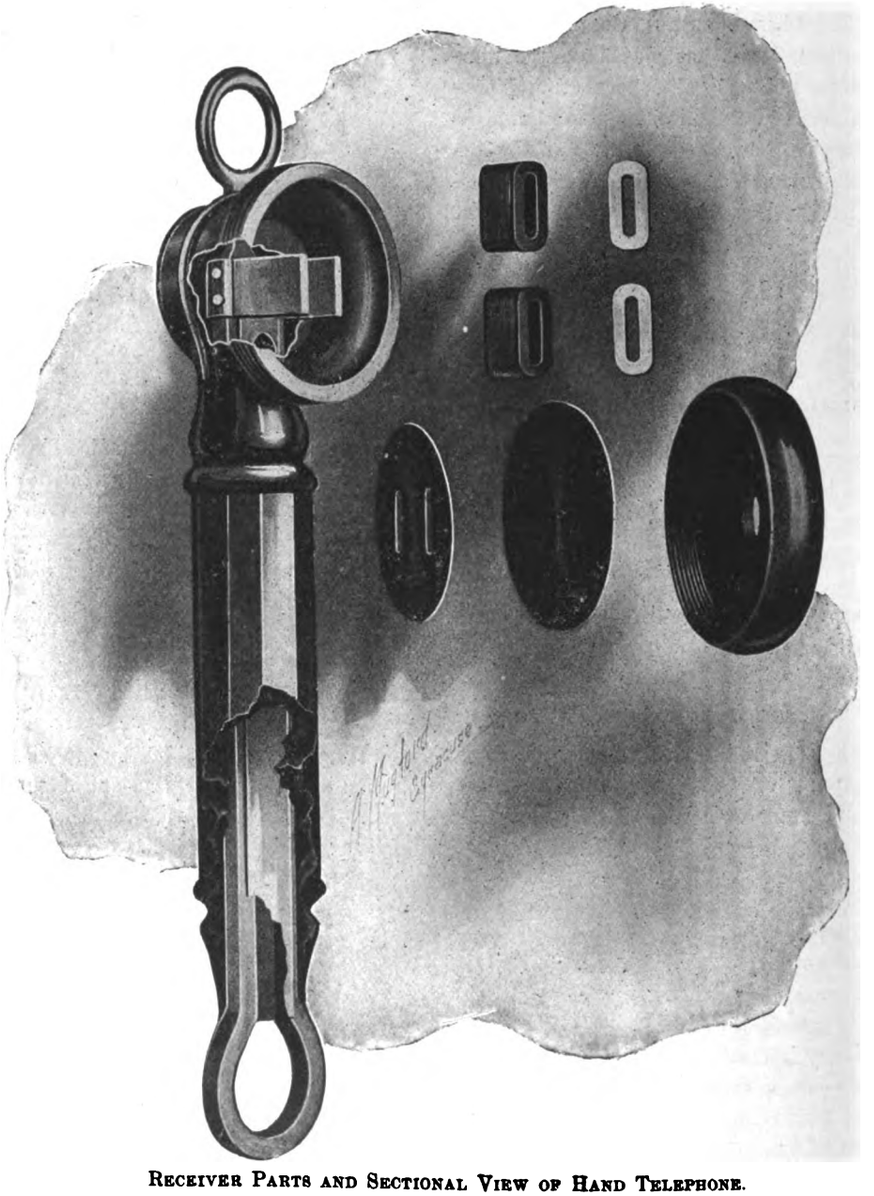
A New Telephone Instrument.

Some eighteen months ago, at the organization of the Wire and Telephone Company of America, Rome, N. Y., it was announced that this company had acquired the patents of S. C. Houghton and F. M. Potter, Jr., and much interest has been expressed in telephone circles as to the product of this company. The Wire and Telephone Company of America has just made its first announcement in reference to the product of its telephone manufacturing department, and it is believed that much interest will be manifested in the telephone equipment shown herewith, which is one of the many types of apparatus which will be manufactured by this company under the name of "Easophones."

As may be seen from the accompanying illustrations the instrument is compact and of pleasing appearance. The apparatus has been designed to satisfy the demand for a hand telephone both for local and long-distance service. The instrument is equipped with a solid back, long-distance transmitter, long horseshoe magnet receiver. A noteworthy feature of the design is the hard steel magnet, which is made unusually long, and which forms the backbone of the instrument. This magnet is of the horseshoe type, and extends from the receiver to the transmitter; and the poles of the magnet, the cores of the electromagnets in the receiver, the solid suspending ring and the transmitter are rigidly interlocked. This unites all the metal parts in one solid form. Over the whole the hard-rubber handle and receiver shell are molded in one piece and vulcanized, producing a telephone that is practically indestructible. In making up the instrument the channel formed by the two arms of the long magnet is sealed with a brass covering, and after the parts have been properly adjusted and the case molded about them, a hole is drilled through the receiver case and the brass covering and the connecting cords drawn through the channel formed by the arms of the magnet.

In forming the handle and receiver case a solid block of vulcanized rubber is built up to make a support for the slip coils, which are placed over the cores of the receiver electromagnets. The leads are then soldered to the coils, and over the slip coils a fibre protecting washer is placed, this being held in position by thin metal escutcheons. The receiver case is then threaded, the magnet cores machined to a positive adjustment, the diaphragm slipped in place, and the receiver cap screwed on. A unique feature of the receiver cap is a sweat ring, which is molded around the aperture, and which prevents the accumulation of perspiration from dripping into the receiver case.

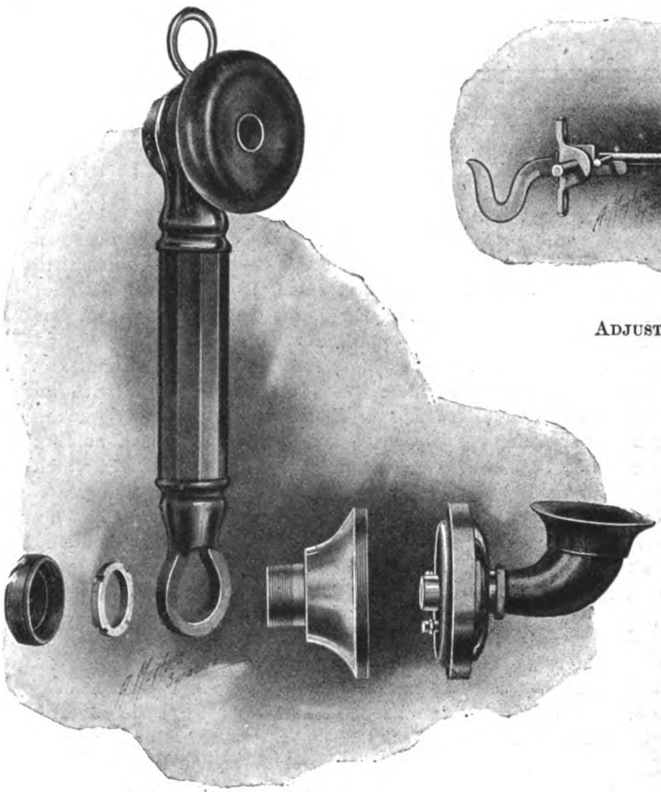
The transmitter case is made in two parts, the shank of the lower being inserted into the round end of the horseshoe magnet and securely drawn into place by means of a locknut and powerful spanner. The upper half of the transmitter case is secured to the lower half by means of a finely cut thread, doing away entirely with holding screws. The cord connections for the transmitter and the pinions holding the damping springs in place are all attached to a metal disc, the arms of which are arranged in tripod fashion, which screws into the upper half of the transmitter case. The transmitter has a carbon cup so mounted as to vibrate freely with the motion of the diaphragm, keeping the granular carbon in an active condition and preventing packing. The mouthpiece of the transmitter is attached



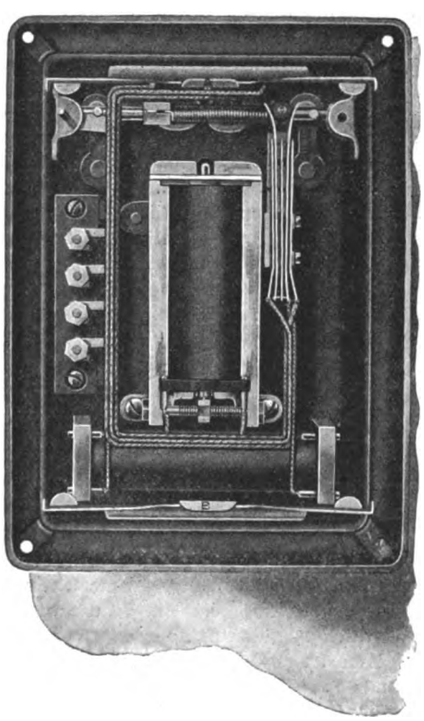
Receiver Parts and Sectional View of Hand Telephone.

Digitized by Google

to a threaded metal nipple, which, in turn, is fastened to the upper half of the transmitter case by means of a thin brass friction disc. This maintains the mouthpiece with relation to the transmitter case, and at the same time allows the mouthpiece to take any position to suit the convenience of the speaker.

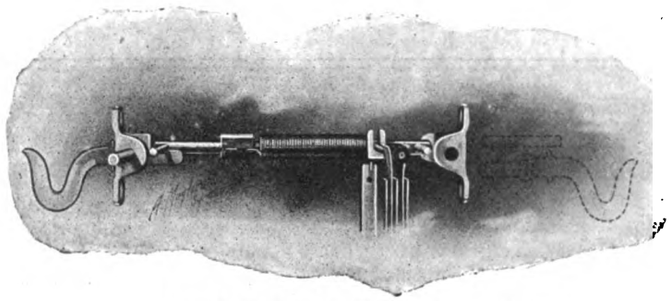


SHOWING TELEPHONE INSTRUMENT AND TRANSMITTER PARTS.



INTERIOR VIEW OF BELL BOX.

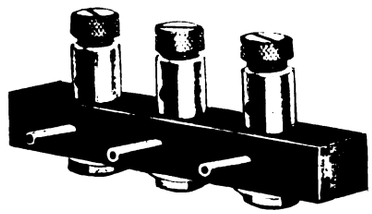
The compact bell box used with this instrument is made of cold pressed steel and contains the switches, condenser, induction coil, ringer movement and cord terminal block. A single-coil ringer has been developed which makes possible a considerable reduction in the size and weight of the bell box. The coil is placed between the arms of the permanent magnet, the coil and magnet being held securely to the bell box by means of metal yokes and distance-pieces. The coil is built up upon a split brass tube, through which the shank of the bell-tapper passes. This shank terminates in a steel spring which is supported upon a threaded adjustment screw and held firmly in place by means of locknuts. With this single-coil ringer the armature of the bell is susceptible to a wide range of frequencies, and requires no adjustment. Another valuable feature in connection with the bell box is the method by which the bells may be finally adjusted without taking down the bell box, and by simply using an ordinary screw-driver. In adjusting the bells the operator is requested to give a long ring, and while the one bell is held firmly, the other is adjusted positively by turning a screw on the outside of the box either to the right or to the left. When one bell is adjusted the other is manipulated in the same way, positive adjustment being arrived at in a very short time.



ADJUSTABLE SWITCH HOOK AND SWITCHES.

The switch hook with this instrument is interchangeable and may be used on either side of the box without any disarrangement of the switches. The Wire and Telephone Company of America also supplies a hook switch which can be mounted on desk or wall independent of bell box, permitting the "Easophone" to be placed wherever most convenient without regard to location of the bell box. A spring tension on the rocker arm of the hook switch is provided by a long helical piano-wire spring. The tension on this spring may be regulated by means of a dowel set in the rocker arm and an adjustment nut which has four cross-cuts in its opposite faces. The induction coil is placed in the bottom of the bell box and is held in place by metal yokes. Both the induction coil and the ringer movement may be easily removed for inspection or repair. The switch hook springs are of the long, parallel type, and contact is made by means of a rolling motion transmitted from the switch hook through a rocker arm.

The condenser forms the back cover of the bell box, and is held in place by heavy brass spring clamps. The bell-box terminal block is located inside the box, and the cord terminal block is fastened to the top of the box. The cord terminal block is equipped with Houghton binding posts. In making the connections from the bell box to the binding posts in the cord terminal block very thin tubes are let through the top of the box through the terminal block and into the binding posts, effectually preventing them from turning. Through these tubes the bell-box connections are made to the binding posts. The construction of the Houghton binding post affords a radical departure in the method of making the connection and contact. The interior of the post is provided with a conical seat, while the lower end of the screw is made cone-shaped, its dimensions corresponding to those of the conical seat. When the screw is turned down upon the connector the wire is rolled and flattened between the two mechanical surfaces. Owing to the shape of the screw and post, although the wire is flattened it will not be cut; consequently there is a broad point of contact and creeping is obviated because of the friction between the conical surfaces.



METHOD OF MAKING BELL BOX CONNECTIONS TO TERMINAL BLOCK.

The Wire and Telephone Company of America has an experienced engineering organization and as telephone contracting engineer is in position to install complete apparatus for intercommunicating systems for houses, office buildings, hotels, etc., in addition to apparatus for local and long-distance central energy systems.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

TO MERGE POWER COMPANIES—Rhodes, Sinkler & Butcher, bankers, of Philadelphia, associated with capitalists of that city, are backing a consolidation of fourteen electric power, traction and light companies in Oregon, Washington and Idaho. The valuation is placed at $6,000,000. Isaac W. Anderson, of Spokane, Wash., is at the head of the concern, the manager being A. L. Welch, of Portland.

MINE TO INSTALL ELECTRIC LOCOMOTIVES—The Boston & Montana company, of Butte, Mont., has contracted for five electric locomotives and a complete underground haulage system. The engines will cost about $2,000 each and are to be delivered in ninety days. They will be of the Baldwin pattern with Westinghouse equipment. The installation of these engines and proper electrical appliances to operate them will do away with the present system of tramming. When the Boston & Montana began operations men were employed to do the tramming, but eventually horses were substituted and are now in use.

HUDSON & MANHATTAN RAILROAD COMPANY MORTGAGE—The state railroad commission has granted the application of the Hudson & Manhattan Railroad Company, which is building the McAdoo tunnels, for consent to the issuance of a refunding mortgage for $100,000,000. The mortgage is to cover bonds to be issued for the same amount, of which $43,000,000 will be held in reserve for the future development of the company, and the remaining $57,000,000 will be used to take up outstanding five and six per cent obligations of constituent companies. The bonds will bear four and one-half per cent interest.

ELECTRIC ROAD SOLD—The Toledo & Western Electric Road, which runs from Toledo to Adrian, Ohio, and from Toledo to Pioneer, Ohio, has been sold to J. R. McNutt, of Cleveland, who headed the syndicate which some time ago endeavored to buy up the stock of the road. Mr. McNutt purchased the road for its floating indebtedness, which is approximtely $400,000. It is stated, however, that the purchaser must assume three mortgages, one of $1,250,000, covering the line between Toledo and Adrian; one of $250,000, covering the extension from Fayette to Pioneer, Ohio, which are underlying mortgages, and a consolidated mortgage of $2,500,000. This latter mortgage is for the purpose of refunding the underlying securities.

NEW OKLAHOMA ELECTRIC ROAD—A charter has been granted to the Oklahoma Railway Company, with $5,000,000 capital, and with headquarters at Oklahoma City, Pittsburg, Pa., and New York city, for purpose of building an electric interurban line as follows: West from Shawnee to El Reno and Fort Reno, with a line from Shawnee to Tecumseh; from Guthrie south to Purcell, and from Yukon southwest to Chickasha, a total of 170 miles. The line is to be built at an estimated cost of $8,000,000, traversing the counties of Pottawatomie, Lincoln, Logan, Oklahoma, Cleveland and Canadian and the Chickasaw Nation. The incorporators are: Frank Wells, O. R. Rittenhouse, G. G. Barnes, J. J. Johnson, Carlos Combs, Fred S. Combs and Edward L. Lawson, all of Oklahoma City.

ELECTRIC TRAINS ON THE NEW YORK CENTRAL—Sixteen electric passenger trains, eight each way, were run over the New York Central tracks between Grand Central Station and Yonkers on December 11. Between Grand Central Station and Highbridge they were operated by electricity. Above Highbridge the electric trains were hauled by steam locomotives. The trains were composed of from three to five cars, and left the New York city end of the line from the new and temporary suburban-traffic station beneath the Grand Central Palace at Forty-third street and Lexington avenue. The service will be continued regularly and gradually extended to other lines of the service, with an extension of the electric zone above Highbridge. As quickly as safety of operation will justify it, the New York Central officials assert, the number of electric trains and the length of their runs under their own power will be increased.

GREAT WESTERN POWER COMPANY—The Great Western Power Company, of California, has filed a mortgage to the Central Trust Company, of New York, as trustee, to secure an issue of $25,000,000 five per cent gold bonds, dated July 1, 1906, and due July 1, 1946, but subject to redemption after five years at 106 and interest. Of this issue, $8,500,000 is outstanding. This company was recently incorporated under the laws of California with an authorized capital of $25,000,000 as the operating company for the Western Power Company of New Jersey. The latter is a holding company with $18,000,000 authorized capital stock, of which $6,000,000 is six per cent preferred, cumulative after five years. It is expected that all the stock will be soon issued. Edwin Hawley is president of the company. The Great Western Power Company expects to furnish power, light and heat to all the towns in northern and central California.

SYRACUSE LIGHTING COMPANY LEASED—At a meeting of the stockholders of the Syracuse (N. Y.) Lighting Company, on December 6, it was voted to increase the capital stock from $3,000,000 to $8,000,000 and to lease the plant and business to the recently formed Onondaga Lighting Company. While the vote was practically unanimous, the new stock can not be issued nor the lease executed until an injunction granted by Supreme Court Justice W. M. Rogers is disposed of. This injunction was secured by former Mayor J. B. Kline, acting as attorney for James M. Bissell, of Hartford, Ct. The representatives of the company asked the privilege of holding the stockholders' meeting as had been arranged, inasmuch as stockholders from out of the city were in Syracuse, and the attorneys agreed to abide by the injunction and not to execute any of the changes upon which the stockholders should agree without due process of disposing of the injunction. With this understanding the meeting was held. The injunction which was granted was served upon Mr. Cummins after the meeting had been held. Before executing the lease and issuing the stock the company will have to make a motion in court to dissolve the injunction. This will probably be done at the time the state commission of gas and electricity has a hearing at Albany in relation to the new Onondaga company. The proposed action of the stockholders must meet the approval of that commission before it becomes legal.

BONUS OFFERED CONSENTING STOCKHOLDERS OF ELECTRIC COMPANY OF AMERICA—Notification of the right to subscribe to the $3,500,000 preferred stock in the proposed American Gas and Electric Company, which the Electric Bond and Share Company is planning to organize as a holding corporation for the Electric Company of America, has been made to shareholders in the Electric Company of America. This purchase right is limited to stockholders in the Electric Company of America who have consented to the consolidation. The right carries with it a bonus of common stock in the American Gas and Electric Company. The first step in the contemplated merger of the Electric Company of America in the American Gas and Electric Company will be taken by the Electric Bond and Share Company, which is planning to secure control of the Electric Company of America by exchanging its collateral trust five per cent gold bonds for the stock of the Electric Company of America. Later, the Electric Bond and Share Company will incorporate the American Gas and Electric Company, which will control and operate the business of the Electric Company of America, and probably that of other electric light and traction companies in New Jersey, Pennsylvania, Ohio, West Virginia and Colorado. This parent company will be capitalized with $3,500,000

Digitized by Google

in preferred six per cent and $3,500,000 in common stcok, as well as with $6,282,000 in collateral trust five per cent bonds. It is believed this announcement that the shareholders in the Electric Company of America will have the privilege of taking preferred stock in the new company will create a much better feeling toward the proposed deal.

MICHIGAN POWER COMPANY FORMED—The Tittabawassee Power Company, capitalized at $1,000,000, has filed articles of incorporation in Midland county, Mich. The incorporators are: George G. Prentis, Theodore H. Hinchman, Jr., Lewis E. Flanders, Benjamin F. Mulford, L. M. White and William C. Manchester, of Detroit, Mich., and Louis E. Rowley, of Lansing, Mich. The company is organized for the purpose of building dams and utilizing the power of the water for the Tittabawassee river at Edenville.

SUIT BROUGHT TO DECLARE ILLEGAL THE FORMATION OF THE METROPOLITAN SECURITIES COMPANY—A suit of similar nature to the Northern Securities merger action has been begun in the United States Circuit Court by D. W. Burrows, of Chicago, to have declared illegal the formation of the Metropolitan Securities Company, into which were merged the Belmont-Ryan traction interests in New York city. The defendants are the Interborough-Metropolitan Company, the Interborough Rapid Transit Company, the Metropolitan Street Railway Company, the Metropolitan Securities Company, the Manhattan Railway Company, the New York City Railway Company, Thomas F. Ryan, August Belmont, Cornelius Vanderbilt, Edward J. Berwind, John D. Crimmins, Andrew Freedman, Thomas P. Fowler, Gardiner M. Lane, F. S. Gannon, R. W. Meade, Oren Root, Jr., Edward W. Sayre, H. H. Vreeland and Charles E. Warren. In his complaint Mr. Burrows alleges that the merger of the traction interests is tantamount to a conspiracy in restraint of trade, and as a holder of 1,400 shares of stock in the Metropolitan Securities Company he asks that the combination be dissolved. He asks, also, that the old stockholders have restored to them their stock, which he alleges the defendants have taken under their ownership. Besides a violation of the stock corporation laws of New York state, which prevent a domestic corporation from combining for the creation of a monopoly, the complainant alleges a violation of Section 168 of the Penal Code, which makes it a misdemeanor to conspire in constraint of trade.

ELECTRICAL SECURITIES.

While the market was unsettled and irregular, with a sharp break in the middle of the week, the general tendency was toward improvement, and nearly all the more important industrials either made slight gains or held to the prices quoted a week ago. There is a very evident disposition on the part of big interests to make every effort to hold up prices until after the turn of the year, in order, likely, with an easing in money rates, to create a bull market and influence animation in public participations. For eleven months of the year, both imports and exports made a new high record for the period. Total imports were $1,186,036,125, against $1,078,011,751, while exports were $1,607,693,550, against $1,427,252,275. The excess of exports in this period was $421,657,430, against $349,250,524 last year. November gold movements resulted in an excess of imports of $6,971,201, against $4,065,472. For the eleven months there was an excess of gold imports of $103,130,624, against $2,138,589 last year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 15.

New York:	*Closing.*
Allis-Chalmers common	16¾
Allis-Chalmers preferred	44¼
Brooklyn Rapid Transit	81⅞
Consolidated Gas	138
General Electric	160
Interborough-Metropolitan common	36¼
Interborough-Metropolitan preferred	73½
Kings County Electric	150
Mackay Companies (Postal Telegraph and Cables) common	72½
Mackay Companies (Postal Telegraph and Cables) preferred	68½
Manhattan Elevated	141½
Metropolitan Street Railway	106
New York & New Jersey Telephone	126
Western Union	85¾
Westinghouse Manufacturing Company	150

The newly elected directors of the Metropolitan Street Railway Company organized by the reelection of all retiring officers.

The Kings County Electric Light and Power Company will issue $1,800,000 more capital stock, bringing the total up to the $10,000,000 authorized in 1905. Stockholders will have the right to subscribe for the new shares at par value in the proportion of nine for every forty-one shares held until 3 P. M., February 1, 1907.

The Brooklyn Rapid Transit Company has placed an order with the Westinghouse Machine Company for the largest stationary steam-power machines ever constructed. The contract amounts to $2,500,000, and calls for five steam turbines of a capacity of 25,000 horse-power each. The Westinghouse Electric and Manufacturing Company will construct five electric power generators of the same capacity as the steam turbines.

The Western Union Telegraph Company has issued its preliminary quarterly report (partly estimated) for the quarter ended December 31, 1906. This shows as follows: net revenue, $1,600,000; bond interest, $332,687; balance, $1,267,313; dividends, $1,217,023, leaving a surplus of $50,290, which added to the previous surplus of $16,959,536, makes a total of $17,009,826. The actual returns for the quarter ended September 30 were: net revenue, $1,660,519; bond interest, $332,687; balance, $1,327,832; dividends, $1,217,024; surplus, $110,809; previous surplus, $16,848,728; total surplus, $16,959,537. The directors of the Western Union Telegraph Company have declared the regular quarterly dividend of 1¼ per cent, payable January 15 to stockholders of record December 24. Books close December 24 and reopen January 2.

Boston:	*Closing.*
American Telephone and Telegraph	136¾
Edison Electric Illuminating	226
Massachusetts Electric	69
New England Telephone	129
Western Telephone and Telegraph preferred	80

The Massachusetts Electric Companies issues its seventh annual report, covering the year ended September 30, 1906. The consolidated income account from operation of the controlled companies shows as follows: gross earnings, $7,518,240; expenses, $4,883,552; net earnings, $2,634,688; charges, $1,594,503; balance, $1,040,185; dividends, $710,406; surplus, $329,779. The amount spent for maintenance was increased by $210,583 over the expenditure of the previous year, and 6 per cent of the gross receipts, instead of 5 per cent as heretofore, an increase of $70,638, was credited to reserve for accidents. Eleven miles of track have been built, forty-seven miles rebuilt, thirty-five new cars, eight plows, etc., purchased and fifteen miles of new wire strung. The depreciation found by the railroad commissioners amounted to $185,370, which was charged off to profit and loss.

Philadelphia:	*Closing.*
Electric Company of America	11⅝
Electric Storage Battery common	69
Electric Storage Battery preferred	69
Philadelphia Electric	8½
Philadelphia Rapid Transit	25½
United Gas Improvement	95⅞

The directors of the United Gas Improvement Company have declared the regular quarterly dividend of 2 per cent, payable January 15 to stock of record December 31.

It is reported that the new financial plan of the Philadelphia Rapid Transit Company has been completed and calls for an issue of $25,000,000 new stock.

At the stockholders' meeting of the Electric Company of America, President Snowden announced that the surplus on hand at the close of the last fiscal year had been expended and that more money had been borrowed for the company's use. Stockholders ratified the agreement made by the directors to sell the property to the Electric Bond and Share Company under conditions heretofore printed. The vote was over 80 per cent in favor of ratifying the plan.

Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	144
Metropolitan Elevated preferred	72
National Carbon common	86½
National Carbon preferred	116
Union Traction common	—
Union Traction preferred	—

Digitized by Google

ELECTRIC RAILWAYS.

OSKALOOSA, IOWA—The Oskaloosa & Buxton Interurban Company has purchased the Oskaloosa Traction and Light Company's plant for $95,000.

EAST ST. LOUIS, ILL.—At a meeting of the East St. Louis city council the McKinley electric railway system was granted a franchise to operate over certain streets inside the city limits.

CHATTANOOGA, TENN.—Contracts have been awarded the West Construction Company by the Chattanooga Railways Company for remodeling and making an addition to the company's power plant at Ridgedale. The contract price is $10,000.

ALBANY, N. Y.—The Buffalo & Lake Erie Traction Company, of Buffalo, a consolidation of the Buffalo & Lake Erie Traction Company and the Dunkirk & Fredonia Railroad Company, has been incorporated. The capital stock is $4,070,000.

MINNEAPOLIS, MINN.—The Robinsdale suburban trolley line has been purchased by the Twin City Rapid Transit Company. This disposes of the last independent line in or about Minneapolis and St. Paul and gives the Twin City entire control.

RENO, CAL.—Senator Francis G. Newlands and Senator George S. Nixon, for the recently organized Reno Development Company, have completed the purchase of the Fleishhacker electric line running from Reno to Sparks, about three miles long. The deal was consummated for the sum of $200,000.

DENVER, COL.—The Colorado & Southern Railroad Company has signed a contract with the Northern Colorado Power Company for electric power to be furnished the railroad for a trolley system between Denver and Boulder as soon as the plant of the power company at Lafayette can be completed.

ATLANTA, GA.—The new owners of the Rome, Ga., traction system are planning to extend the line to Rockmart, in Polk county, a distance of twenty-five miles, connecting with the Seaboard Air Line. The system was recently purchased by a syndicate composed of Louisville, Ky., capitalists, headed by S. S. Busch.

ALAMEDA, CAL.—The city trustees at a special meeting granted F. M. Greenwood an extension of four months in which to deposit with the city treasurer $50,000 cash to guarantee that he will carry out the terms of the franchise granted him some time ago to construct an electric line on Clement avenue, to connect with a projected ferry line to San Francisco.

HARTFORD, WIS.—Surveyors of the Milwaukee Electric Railway and Light Company are laying out the route of an electric line from North Milwaukee to Fox Lake, *via* Holy Hill. It is said that persons anxious to secure trolley service between the points named will donate a right of way in order to expedite the building of the line. Menomonee Falls, Lake Five and Beaver Dam will be touched by the proposed extension.

SALT LAKE CITY, UTAH—More than $3,000,000 will be spent by the Utah Light and Railway Company in the improvement of its street railway, electric lighting and power system in Salt Lake, as rapidly as the work can be done. All franchises held by the company will be fully exercised. In addition to the lines now being operated, the company proposes to run interurban lines to Garfield, North Salt Lake, Sandy and Big Cottonwood.

WATERLOO, IOWA—Articles of incorporation of the Empire Railway Construction Company, capital $250,000, have been filed with the county auditor. This is the building company which is to construct the proposed Chicago, Iowa & Northwestern Railroad, which is to build a line from Anamosa to Austin, Minn., to connect there with the line which the company expects to build into northwestern Minnesota, the route of which has not been definitely selected as yet.

LOUISVILLE, KY.—A corps of surveyors has started work on a survey for an interurban line which the Louisville, New Albany & Corydon Railroad Company proposes to build between New Albany and Corydon. The company operates a steam railroad between Corydon and Corydon Junction, a distance of seven miles, connection being made with the Southern Railway at the junction, and at a meeting of the stockholders held at Corydon the officers were authorized to extend the line to New Albany by way of Lanesville and equip it with electric cars.

STANDISH, MICH.—A deed of trust given by the Grand Rapids Electric Railroad Company, J. W. Boynton, president, has been filed at the register of deeds' office in Gladwin, running to the Cleveland Trust Company, to secure $250,000 for the purpose of constructing an electric railroad from Grand Rapids to Alpena through Gladwin, Standish, West Branch, Tawas, Rose City and other points, also from Grand Haven to points in Ohio. Similar deeds will be recorded in each county through which the road passes.

DETROIT, MICH.—Work on the new electric railroad which is to connect Detroit with Jackson, *via* Dearborn and the River Rouge, has begun near Dearborn and just beyond River Rouge. The road will be a continuation of the Boland line already completed from Jackson to Chelsea and from Jackson to Battle Creek. The president of the company which has charge of the work is C. A. Osborne, of New York city; the secretary, George Meecham, of Jackson, Mich.; N. F. Potter and W. A. Boland, of Jackson, are also identified with it.

KALAMAZOO, MICH.—W. H. Patterson, promoter and one of the directors of the Grand Rapids & Kalamazoo Valley Electric Railroad Company, has received a telegram announcing the sale of the bonds for the building of the road connecting this city with Grand Rapids. He refuses to make known the names of the purchasers, but says that they are people living in New York and Philadelphia, and none of them is interested in any western electric road. The contract was also let for building the road. It requires that work begin March 1 and be completed within a year.

NEW ORLEANS, LA.—Negotiations for the purchase of the Baton Rouge Electric Light and Street Railway Company have been concluded, the financial interests behind Mr. Gottlieb, a Baton Rouge banker, having acquired the property. It is said that capital stock to the amount of $1,000,000 will be issued and that the property will be vastly improved. A new system of lights and street cars will be put in operation as soon as the material can be put on the ground. Bonds will be issued and a Boston firm will underwrite them. It is believed that the same financial backing is behind the proposed New Orleans and Baton Rouge electric road.

HARTFORD, CT.—Engineers have been making preliminary surveys for an important trolley line which the Shore Line Electric Railway Company has a franchise to construct. The corporation, which has an authorized capital stock of $1,000,000, is empowered to build and operate an electric road along the Connecticut shore through the towns of Bradford, Guilford, Madison, Clinton, Westbrook, and Saybrook to the village of Ivoryton in the town of Essex. At Branford the line will connect with a New Haven branch of the Connecticut Railway and Lighting Company's system. The route is through a succession of thrifty towns which are now isolated from trolley communication. It is expected that the section of the road from Branford to Saybrook will be constructed at an early date.

DENVER, COL.—The projectors of a new electric railroad into Denver, running from Platte canon into Englewood and to be known as the Denver & Southeastern, have elected their first board of directors and officers. Behind the scheme for the new road are the owners of the Platte Canon Fuel and Power Company. They announce that they have already completed the grading for their line for four miles down the canon, leaving the sixteen miles between there and the northern terminus at Englewood still to be completed. Plans for a large power-house to be erected at the mines of the company in Platte canon are nearly completed. It is intended to carry both coal and passengers between Platte canon and Denver and ultimately to extend the line up the canon if found desirable. The officers selected are: George I. Cole, president; C. H. Chase, vice-president; I. C. Cockey, secretary; S. B. Thomas, treasurer. All of the officials but Secretary Cockey are said to be residents of Clarke county, South Dakota, and will move to Denver. It is planned to install standard-gauge tracks and very heavy cars for freight and passenger service. The company is at present operating coal mines in the Platte canon and is preparing to enlarge these mines immediately.

Digitized by Google

ELECTRIC LIGHTING.

LOUISVILLE, KY.—The Louisville Lighting Company has purchased a $75,000 turbine, which will double its capacity.

SOUTH HADLEY FALLS, MASS.—The South Hadley Falls Electric Light Company will install a 650-horse-power engine and a 2,000-light dynamo.

BOSTON, MASS.—The gas commissioners have granted the Attleboro Gas and Electric Company the privilege of issuing 115 new shares at $225.

WYMORE, NEB.—The Wabash electric light plant, which was recently given into the hands of a receiver, has been leased to L. E. Watson, of Beatrice.

NATCHEZ, MISS.—On March 17, 1907, the city of Natchez will open bids for furnishing not less than 115 2,000-candle-power arc lights, all-night schedule, on a five or ten-year contract.

PALESTINE, TEX.—Contracts have been let for a new electric light plant to replace the old one which has been outgrown by the town. The machinery will all be in duplicate to avoid breakdowns.

HENNESSEY, OKLA.—Hennessey has granted a franchise to the Hennessey Electric Light and Power Company. The city has the option at the end of ten years of buying the proposed plant at the appraised commercial value.

MENOMINEE, MICH.—Oshkosh, Green Bay and Chicago capitalists have organized a $600,000 corporation to build a large power-house on the Menominee river and transmit the power to Menominee and Marinette for industrial purposes.

MARQUETTE, MICH.—The Stephenson village council has granted to T. F. Goulder, of Ingalls, a thirty-year franchise for establishing an electric light plant. Mr. Goulder intends to put in a plant large enough to supply the needs of the village for years to come.

MANCHESTER, CT.—The power for the lighting of Manchester will soon be furnished by the Hartford Electric Light Company and already plans are under way for the change. The material necessary has been ordered and it is expected that the change will go into effect January 1.

LITTLE FALLS, N. Y.—I. N. Lovenheim, owner and manager of the Consumers' Electric Light Company, announces the discontinuance of business. The lighting contracts now in force have been taken over by the Herkimer County Light and Power Company and fulfilled by that concern.

ROSEBURG, ORE.—It is announced that the Willamette Valley Company has purchased the local water and light plants from G. G. Majors and will take charge immediately. The price paid Mr. Majors above the bonded indebtedness of $20,000 is announced as $30,000. The present plants are to be improved.

NEW YORK, N. Y.—The New York Edison Company, it is stated, will erect a five-story fireproof power-house on a plot on the north side of Sixty-fourth street, east of Third avenue. Plans are being prepared by the company's architect, who is designing a structure similar to the other power-houses in the metropolitan district.

BOSTON, MASS.—The gas and electric light commissioners have issued an order authorizing the Pittsfield Electric Company to issue bonds to the amount of $50,000 and stock to the amount of $75,000, the proceeds to be applied on the payment of debts incurred for the Silver Lake station and for other improvements and additions to its plant.

MILWAUKEE, WIS.—Articles of incorporation have been filed at Madison by the Plankinton Light and Power Company. The incorporators are: H. A. J. Upham, William Woods Plankinton and George P. Miller. Mr. Plankinton, who is president of the new corporation, has made application for a franchise for laying conduits and stringing wires in the Fourth ward.

SUPERIOR, WIS.—At a meeting of a committee from the city council and the directors of the Superior Water, Light and Power Company, the directors expressed a willingness to sell to the city the present light plant. No definite arrangements have been made, but the city will look up the matter of arranging to pay for the plant and the directors will consult with the bondholders of the company. A definite agreement is expected by February 1.

MIDDLETOWN, N. Y.—Four farmers in Stamford township, Delaware county, are considering the project of building a small electric light plant. Foote Hollow is the name of a branch valley of the township, and through it runs a stream across which they propose to place a dam as a source of power. The plant will be in the building of James Stowe and controlled by him. The other three farmers are: O. P. Canfield, W. P. Mervin and Nicholas Thiem.

FERGUS FALLS, MINN.—The city council has authorized the electric light commission to have plans prepared for the construction of a new dam to furnish power for the city electric light plant. The commission, in outlining its future policy, announces that as soon as the dam is constructed, the rate for electric lights in Fergus Falls will be reduced from ten cents to five cents per kilowatt-hour. The present rate has not only taken care of extensions and bonds, but has permitted the accumulation of a surplus of about $19,000.

CANASTOTA, N. Y.—The village board has awarded a contract and granted a franchise to the Central New York Power Company (Trenton Falls power) for lighting the village for a term of five years. Fifty arc lamps, to burn from half an hour after sunset until 1 A. M., except on moonlight nights, will be furnished at $35 a year apiece. There will be five all-night arc lights at $55 each. Quite a number of incandescent lights also are to be furnished, and the total annual expense will be $3,146. The company also agrees to install a plant to furnish gas for heating and illuminating purposes.

ST. LOUIS, MO.—Thomas H. Carter, supervisor of city lighting, has submitted a report to the board of public improvements regarding the expense of a municipal lighting system. According to the figures, it would cost the city $2,523,200 to erect such a plant and $512,980 a year to run it. Last year the lighting service, under contract, cost $548,939.25. This would mean a saving to the city of $35,959.25 a year. Supervisor Carter's report embraces a system that would supply 6,000 480-watt arc lamps for street lighting; 500 thirty-candle-power incandescent lamps for alleys and parks, and about 15,000 sixteen-candle-power incandescent lamps for public buildings. The city at present is using 1,053 arc lamps, 772 incandescent lamps and 17,079 mantle lamps. The municipal plant, according to the figures prepared, would furnish light to many streets not now lighted, and would do away altogether with the gas lamps now used through the greater portion of the city. The report is based on the use of an arc lamp at every street intersection, and with no distance between arc lamps to exceed 400 feet. The municipal lighting system would comprise a main power station to cost $802,500, and three substations to cost $25,000 each. Supervisor Carter figures that it will cost $69.73 a year for each arc lamp under the municipal system. At present the lamps cost $98 a year. The incandescent lamps he estimates will cost $17.20 a year, while under the present contract they cost $19.

OBITUARY NOTE.

FITZHUGH TOWNSEND, A.B., E.E., instructor in electrical engineering at Columbia University, died of typhoid fever on December 11, 1906, at the age of thirty-four years. Mr. Townsend graduated from the academic department of Columbia University in 1893, and later pursued the course of electrical engineering, graduating in 1896. He has been connected with the electrical engineering department of Columbia University as assistant, tutor and instructor since 1897, having been engaged in practical work for one year after graduation. He also spent several summer vacations at the works of the General Electric and Westinghouse companies, and has practiced as consulting engineer and expert in electrical work. For the past four years, he has been particularly interested in the development of a new railway-signaling system, involving many ingenious features devised and perfected by him. This system has been successful and is now being applied on several large railroads. Mr. Townsend was joint author with Professor George F. Sever of a work on "Laboratory and Factory Tests in Electrical Engineering." Mr. Townsend held for a number of years the amateur fencing championship of the United States. He was a member of the Union Club and an associate member of the American Institute of Electrical Engineers.

Digitized by Google

DATES AHEAD.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.

Northwestern Electrical Association. Milwaukee, Wis., January 16, 1907.

Ohio Engineering Society. Columbus, Ohio, January 22-24, 1907.

Jamestown Ter-Centennial Exposition. Norfolk, Va., April 26 to November 30, 1907.

PERSONAL MENTION.

PROFESSOR J. J. THOMSON, who occupies the chair of experimental physics at Cambridge University, England, has been awarded the Nobel prize for physics, amounting to £7,500.

MR. J. B. HAWLEY, formerly with Bruce & Johnston, has opened an office at 5 East Forty-second street, where he is handling the advertising and publicity accounts of technical concerns of this city.

M. HENRI MOISSON, of Paris, has been awarded the £7,500 Nobel prize for chemistry. His earliest work of importance was the isolation of the element fluorine, twenty years ago. An anniversary medal is shortly to be presented to him.

MR. CHARLES W. CHAMBERLAIN, of Concord, N. H., has been made chief inspector of the Holyoke (Mass.) exchange of the New England Telephone and Telegraph Company. Mr. Chamberlain has been connected with the company for the past eight years.

MR. A. L. LINDNER, manager of the Citizens' Street Railway and Light Company, of Muscatine, Iowa, has resigned, his resignation to take effect January 1, 1907. Mr. Lindner states that he is not ready to disclose his plans, but that he will ally himself with a local industry.

MR. JOHN F. MADDEN is to succeed F. L. Fullam as superintendent of the Clinton (Mass.) Gas Light Company when Mr. Fullam takes up his new duties as general manager of the Clinton Gas Light Company and the Leominster (Mass.) Electric Light and Power Company.

MR. B. F. STANTON, of San Jose, Cal., has been appointed superintendent of the local system of the Santa Clara Interurban Railroad Company at Hanchett, Cal., succeeding C. C. Benson, who has been made manager of the entire system, with headquarters at San Jose. Mr. Benson succeeds Richard Emory, who died recently.

MR. C. LOOMIS ALLEN has been appointed general manager of the Syracuse (N. Y.) Rapid Transit Railway Company and of the other electric lines controlled by the Vanderbilt interests. Mr. Allen's jurisdiction will extend over the cities of Syracuse, Utica, Rome and Oneida, and, in addition, the proposed electrified section of the West Shore Railroad's interurban system.

MR. G. J. A. PAUL, Youngstown, Ohio, superintendent of the Sharon & Youngstown, Sharon & New Castle and local traction lines, has been appointed general superintendent of all lines owned by the Mahoning & Shenango Valley Traction Company in Sharon, Youngstown, New Castle, Niles, Warren and South Sharon. He is the first general superintendent the company has had since these lines were merged.

MR. J. B. INGERSOLL, assistant manager and chief electrical engineer of the Spokane & Inland Railway, Spokane, Wash., has also been made general manager and chief electrical engineer of the Inland Empire system. Mr. Ingersoll succeeds Mr. F. A. Blackwell, who resigns to devote more time to other interests. Mr. Blackwell will, however, continue as chairman of the board of directors of the Inland Empire system.

MR. H. C. MEISEL has severed his connection with the Western Electric Company and is preparing to enter the electrical supply and construction business, with a view of handling electrical apparatus in the Southwest. In traveling over western Texas and New Mexico Mr. Meisel has been impressed with the opportunity presented for an electrical-supply business. His headquarters for the present will be at Amarillo, Tex., which town he believes is destined to become a growing distributing centre for western Texas and New Mexico. The business of this section is being handled from Kansas City, Fort Worth and Dallas, which are from 350 to 500 miles distant.

MR. FRANK H. TAYLOR has been elected a director and a vice-president of the Yale & Towne Manufacturing Company by the stockholders of the company. Mr. Taylor was born in Cincinnati, Ohio, and after leaving school entered Haverford College, near Philadelphia, from which he was graduated after a four-year course. He immediately entered Harvard University, from which he was graduated in 1877 with the degree of A.B. Leaving college, Mr. Taylor entered the employ of the George Fox Starch Company, Cincinnati, Ohio, as an apprentice. He advanced through various positions to the post of superintendent, and in 1882 moved to Philadelphia, where he became one of the organizers and treasurer of the Belmont Iron Company, later becoming its president. In 1890 Mr. Taylor accepted the position of manager of the Philadelphia branch house of the Yale & Towne Manufacturing Company. He retained this position for the following seven years. In 1897 he transferred his residence to Pittsburg, Pa., to accept an appointment as sales manager of the Westinghouse Electric and Manufacturing Company. He served three years in this position, and was then promoted to the position of fourth vice-president, serving as such for about three years, being finally elected to the position of second vice-president, which he filled for the following three years or until he resigned in April, 1906. He is a director of the Westinghouse Electric and Manufacturing Company and of the Provident Life and Trust Company, Philadelphia, and a trustee of the Engineers' Club, of New York. As a vice-president of the Yale & Towne Manufacturing Company, Mr. Taylor's duties will relate equally to the manufacturing and commercial sides of the business, and ultimately will include many of the matters which heretofore have been attended to by the president. The present official organization of the Yale & Towne Manufacturing Company is as follows: president, Henry R. Towne; vice-presidents, Schuyler Merritt, Frank H. Taylor; secretary, J. H. Towne; treasurer, A. R. Erskine; general manager, Kirk Brown; general superintendent, Walter C. Allen.

MR. FRANK H. TAYLOR.

NEW PUBLICATIONS.

PROCEEDINGS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION—The proceedings of the National Electric Light Association for the convention at Atlantic City, N. J., June 5, 6, 7 and 8, 1906, have been issued in the usual handsome style, made up in three volumes. The first volume includes the routine business of the convention, a list of the five classes of members, lists of the officers and executive committee, the committee reports and complete copies of the papers and discussion. Vol. ii is devoted to the question box, edited by Paul Lüpke. Vol. iii, which is for distribution to class A members, contains reports of the executive sessions. The frontispiece of vol. i is a handsome reproduction of a photograph of William H. Blood, Jr.

PROCEEDINGS OF THE NATIONAL-INTERSTATE TELEPHONE ASSOCIATION—The proceedings of the convention of the National-Interstate Telephone Association, held at Chicago, Ill., June 26, 27 and 28, have been published and issued in book form by the International Independent Telephone Association of America, the new name of the National-Interstate association. This book contains a detailed record of the daily convention proceedings, the papers and reports of committees, including standard forms of accounting, with a full account of the banquet held at the White City on the evening of June 27. There is also a complete list of officers and committees, the names of all those attending the convention, a summary of important data according to states, with considerable other data of value to all interested in the independent telephone movement.

EDUCATIONAL NOTE.

REGISTER OF CORNELL UNIVERSITY—Cornell University, Ithaca, N. Y., has issued the register for the year 1905-1906. It contains the usual descriptions of courses offered at the various colleges and a catalogue of students.

Digitized by Google

INDUSTRIAL ITEMS.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, is mailing to some of its friends a beautiful souvenir photo.

JOHN L. GLEASON, Jamaica Plain, Mass., patentee and manufacturer of "Fancleve" molding and conduit boxes, is distributing a very attractive calendar for 1907.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, New York city, is calling attention to its Christmas tree outfits for both incandescent lighting and dry-battery circuits. The literature on this subject will be sent to any one interested upon request.

THE BECK FLAMING LAMP COMPANY, New York city, is moving its office and factory to 80 Greenwich avenue. The company will occupy a large, well-equipped factory and will be in a position to manufacture its new type of flaming-arc lamps in the near future.

THE DAYTON GLOBE IRON WORKS COMPANY, Dayton, Ohio, has ready for distribution a pamphlet descriptive and illustrative of head-gate hoists. This includes hoists operated by means of a lever inserted in a winch wheel, crank and pilot-wheel-operated hoists, and several special designs.

QUEEN & COMPANY, INCORPORATED, Philadelphia, Pa., have published a very complete catalogue and price list of thermometers, pyrometers, hydrometers, barometers and weather bureau apparatus. In addition to complete price lists and dimensions there is given a great amount of literature concerning the various instruments.

THE SPRAGUE ELECTRIC COMPANY, New York city, has issued a pamphlet entitled "The Electrical Equipment of a Modern Hotel." This describes and illustrates the equipment in the Hotel Gotham at Fifth avenue and Fifty-fifth street, New York city. The electrical equipment, including motors and generators, was furnished by the Sprague Electric Company. The company is also distributing a handsome pamphlet describing its electric hoists and cranes.

THE MOORE ELECTRICAL COMPANY, Newark, N. J., announces that the treasury department of the United States has recently contracted with it to light the entire west side of the mezzanine floor of the New York post-office with the Moore light. This installation will consist of more than a thousand feet of Moore tubing. The Moore tubes, it is announced, will not use more than twenty kilowatts per hour, and the maker states that the illuminating effect will be increased about five times. It is said that this installation will displace 525 sixteen-candle-power incandescent lamps. The opposite side of this floor is now lighted with mercury vapor tubes, so that there will be available a very interesting demonstration of the qualities of both these forms of illuminants.

NEW MANUFACTURING COMPANIES.

CLEVELAND, OHIO—The Ohio Electric Specialty Company has been incorporated by P. C. Greenwall, F. C. Hackett, Walter S. Lister, Elizabeth Lewis and L. M. Henders. The capital is $20,000.

DOVER, DEL.—The Austin-Smith Engineering Company, of Baltimore, Md., has been incorporated with a capital stock of $50,000 to manufacture, buy and sell electrical and mechanical appliances.

CAMDEN, N. J.—The Electric Store Service Company has been organized to build and install automatic carrier systems. The capital is $120,000, and the incorporators are: M. E. Sturges, Franklin A. Smith and E. R. Sutton.

PORTLAND, ME.—The Livermore Pay Station Company has been incorporated to manufacture telephone and telegraph appliances. The president is C. H. Carter, of Arlington, Mass.; treasurer and clerk, L. L. Height, of Portland, Me.

MILWAUKEE, WIS.—The Battery and Power Company, a $500,000 corporation, has been formed in Milwaukee by Frank Gregory, of Marinette, Wis.; A. H. Wegner and Charles Marnitz. The company claims to have a very cheap, powerful and durable battery.

COLUMBUS, OHIO—The Jonah Battery Company, of Toledo, has been incorporated with a capital stock of $150,000 by J. N. Bick, A. W. Bick, L. M. Fox, H. F. Bossard and Marion Bossard. The company will manufacture electric batteries, motors, dynamos, etc.

TRENTON, N. J.—The Newark Gas and Electric Fixture Company has been incorporated with a capital of $25,000, to deal in gas and electric fixtures. The incorporators are: Charles L. Beck, Charles O. Geyer and F. C. Ferguson. The registered office of the company is at East Orange, N. J.

ALBANY, N. Y.—The Mohawk Electrical Supply Company, of Utica, has been incorporated with the secretary of state, to do an electrical jobbing business. The capital stock is $25,000 in shares of $100 each. The directors are: George A. Redman, J. Frank Morse and Eleanor M. Morse, of Utica.

Record of Electrical Patents.

Week of December 11.

837,951. TELEPHONE CALL REGISTER. Joseph J. O'Connell, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. Filed July 19, 1902. Registration is effected through a traveling transmitter mechanism and a counting train.

837,994. MAGNETIC SEPARATOR. James C. Winder, East Point, Ga., assignor to E. Van Winkle Gin and Machine Works, Atlanta, Ga. Filed May 5, 1906. Three magnetic bars connected to an equal number of poles of an electromagnet are inserted in slots in a non-magnetic cable.

838,005. ELECTRICAL CIRCUIT INTERRUPTER. Albert M. Bullard and William H. Matthies, New York, N. Y., assignors to Western Electric Company, Chicago, Ill. Filed September 9, 1905. Two relays, each of which in opening resets the other.

838,006. AUTOMATIC-EXCHANGE CIRCUIT. Albert M. Bullard, New York, N. Y., assignor to Western Electric Company, Chicago, Ill. Filed March 10, 1906. A method of combining manual and automatic exchanges.

838,017. FORMER FOR ARMATURE COILS. William H. Foot, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed May 8, 1905. An adjustable former.

838,021. CONTROLLING MEANS FOR ELECTRIC MOTORS. Fletcher D. Hallock, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed June 2, 1905. Renewed January 20, 1906. A drum controller working in connection with a contact disc.

838,028. PHANTOM TELEPHONE SYSTEM. Thomas P. Jordan, Dallas, Tex., assignor to E. H. Cary, Dallas, Tex. Filed October 3, 1904. Renewed December 20, 1905. A method of arranging circuits for preventing cross-talk.

838,034. ELECTRICAL MACHINE. Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed February 21, 1905. The armature and conductors are placed in two series of slots at different depths, the number of conductors in each slot varying inversely as the depth.

838,048. ELECTRIC MOTOR. Samuel L. Nicholson, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed September 25, 1905. The armature is of greater length than the field, and is adjustable longitudinally.

838,090. AUTOMATIC SWITCH MECHANISM. Augustus C. Durdin, Jr., Chicago, Ill., assignor to Erwin & Company, Chicago, Ill. Filed January 13, 1906. A quick-break switch operated by fluid pressure.

838,115. TELEPHONE METER. Newman H. Holland, Brookline, Mass., assignor of one-half to Charles Bate, Quincy, Mass. Filed January 31, 1902. A meter arranged to prevent the use of the transmitter except when released at the exchange.

838,117. TELEPHONE SIGNAL. Thomas P. Jordan, Dallas, Tex., assignor of two-thirds to George A. Carden, Dallas, Tex. Filed June 15, 1906. A resetting drop.

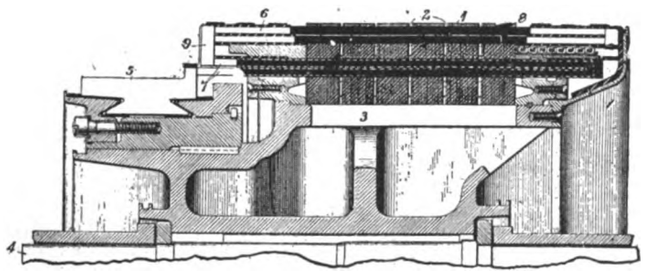
838,133. SINGLE-PUSH-BUTTON AUTOMATICALLY CONTROLLED ELECTRIC-ELEVATOR SYSTEM. Frederick W. Newell, Hastings-upon-Hudson, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed June 19, 1905. The speed of the car is automatically controlled by the load.

Digitized by Google

838,136. COMBINED TELEPHONE AND DISTRICT MESSENGER SYSTEM. James G. Nolen, Chicago, Ill., assignor of one-half to Frank B. Cook, Chicago, Ill. Filed November 26, 1902. A method of attaching a messenger call system to a telephone circuit.

838,138. AUTOMATIC APPARATUS FOR PREVENTING COLLISION OF RAILWAY TRAINS. Maurice Privat, Angoulême, France. Filed January 23, 1904. An electrically controlled, automatic brake-setting system.

838,139. TELAUTOGRAPH APPARATUS. Foster Ritchie, Acton Hill, London, England. Filed March 12, 1904. A pen-lifting mechanism.



838,084.—Electrical Machine.

838,144. DYNAMOELECTRIC MACHINE. William Stanley, Great Barrington, Mass. Filed May 22, 1905. The rotor and stator windings are connected together, external means being provided for impressing alternating electromotive forces upon them.

838,163. HIGH-TENSION INSULATOR. Frank G. Baum, San Francisco, Cal. Filed October 24, 1905. A main section of insulator, furnished with petticoats, supports a supplemental insulator having vertical ridges which allow them to be washed by rains.

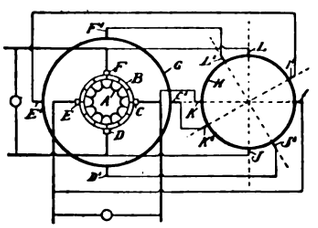
838,165. BATTERY CELL. John W. Brown, Cleveland, Ohio, assignor to National Carbon Company, Cleveland, Ohio, a corporation of New Jersey. Filed June 4, 1906. One electrode is separated from the cell by a non-porous partition which is removed when the cell is put to use.

838,171. ELECTRIC-SWITCH BASE. Nathan W. Crandall, Hartford, Ct., assignor to the Perkins Corporation, Hartford, Ct., a corporation of Connecticut. Filed February 27, 1906. A locking plate is secured to the front face of the base.

838,175. CONTROLLER FOR THE TROLLEY POLES OF ELECTRIC CARS. Alfred J. Edwards, Auckland, New Zealand. Filed August 22, 1906. The pole is held in position by a weight.

838,177. ELECTRICAL CONTACT SHOE. Thomas Fildes, Richmond Hill, N. Y., assignor to George Cook, Allendale, N. J. Filed February 20, 1906. A shoe with inclined edges.

838,192. TELEGRAPHIC RELAY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Filed February 26, 1906. A siphon recorder.



838 144.—Dynamoelectric Machine.

838,235. ELECTRIC FUSE. Leonard B. Buchanan, Woburn, Mass. Filed April 2, 1906. An enclosed fuse surrounded by amorphous silicic oxide.

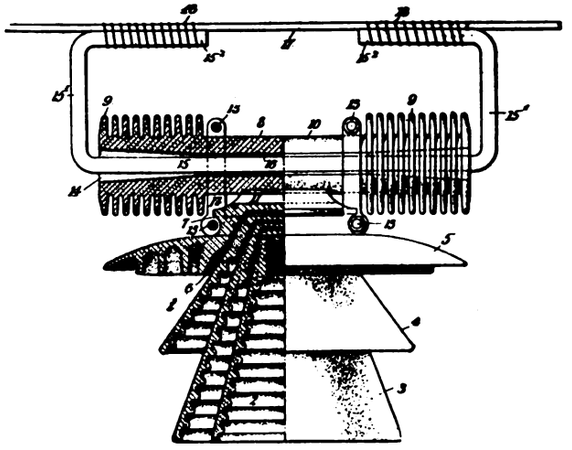
838,244. AUTOMATIC RINGING DEVICE FOR TELEPHONE-EXCHANGE SYSTEMS. William W. Dean, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. Filed January 16, 1906. A high-resistance ringer, connected in parallel with a low-resistance telephone, is automatically cut out by a thermal device at the exchange.

838,251. SPARK-COIL BOX FOR MOTOR-VEHICLES. Russell Huff, Detroit, Mich., assignor to Packard Motor Car Company, Detroit, Mich. Filed September 27, 1906. A method of mounting a spark-coil.

838,273. ELECTRIC-WAVE-FORM TRACER. Robert Rankin, Ithaca, N. Y. Filed August 23, 1905. A modified cathode-ray curve tracer.

838,280. MERCURY-VAPOR LAMP. Hans V. Slim-Jensen, Copenhagen, Denmark. Filed April 25, 1905. Renewed November 14, 1906. An auxiliary receptacle, attached to the lamp tube, contains mercury and is perforated at the surface of the mercury in the tube.

838,304. LIGHTNING ARRESTER. Frank B. Cook, Chicago, Ill. Filed May 9, 1906. A thin dielectric of softenable material is interposed between suitable electrodes.



838 163.—High-Tension Insulator

838,315. CONTROL OF ELECTRIC MOTORS. William Geipel and Frederick M. T. Lange, Southwark, England. Filed January 15, 1906. A controlling rheostat which permits a considerable portion of the resistance to be cut out when starting.

838,362. RECEIVER FOR TELEPHONES. Louis Steinberger, New York, N. Y. Filed January 16, 1905. The insulating material of the receiver has a comparatively massive end.

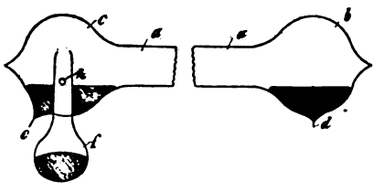
838,372. GALVANIC BATTERY. Benjamin J. Blameuser, Chicago, Ill., assignor to Chicago Compound Battery Company, Chicago, Ill. Filed June 7, 1905. A container for the electrolyte is placed in the bottom of the cell.

838,393. GOVERNING DEVICE FOR DYNAMOS. Charles A. Eck, Newark, N. J. Original application filed August 12, 1903. Divided and this application filed June 15, 1905. Renewed May 29, 1906. A dynamo with longitudinally adjustable armature, the motion of which when attracted by the field-magnets tends to disengage the driving mechanism.

838,404. RELAY. Max R. Hanna, Schenectady, N. Y., assignor to General Electric Company. Filed May 26, 1906. An alternating-current relay for railway-signaling systems.

838,407. SAFETY DEVICE FOR BOOSTERS. John D. Hilliard, Jr., Glens Falls, N. Y., assignor to General Electric Company. Filed July 2, 1904. A reverse-current circuit-breaker for boosters.

838,410. ELECTRIC MEASURING INSTRUMENT. Otto Holz, Schenectady, N. Y., assignor to General Electric Company. Filed July 14, 1905. A frequency indicator actuated by interrupted current.



838,280.—Mercury-Vapor Lamp.

838,423. METHOD OF PRODUCING ELECTRIC COILS. Isidor Kitsee, Philadelphia, Pa. Original application filed May 3, 1905. Divided and this application filed June 15, 1906. Conducting material spread upon a non-conducting surface is divided spirally to form a continuous conductor.

838,482. INSULATOR FOR LINE CONDUCTORS. James M. Weed, Denver, Colo. Filed August 10, 1905. The insulator proper is supported on a tubular pin and holds a wire-supporting pin.

838,495. BLOCK-SIGNAL APPARATUS. Alexander Bevan, Providence, R. I. Original application filed February 10, 1906. Divided and this application filed October 25, 1906. An electromagnetically operated target signal.

838,500. WIRE-CABLE CLAMP. John H. Cook, New York, N. Y., assignor to Henry B. Newhall, Plainfield, N. J. Filed October 21, 1901. The clamping bolts are attached permanently to one jaw.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 26. NEW YORK, SATURDAY, DECEMBER 29, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON
NEW ENGLAND OFFICE, ... 95 MILK STREET

LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE
TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single copy, 10 cents. Back numbers, beyond one month, each	.25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS.

EDITORIAL:
The Engineer and Nature . . . 1041
Testing Electrical Materials . . . 1042
The Electric Drive . . . 1043
Wireless Telephony for the Deaf . . . 1043
Street Lighting Fiesta at Oakland, Cal . . . 1044
New York Electrical Society . . . 1044
Electrical Resistance of Alloys . . . 1044
The Whitney Development on the Yadkin, by Julian S. Miller . . . 1045
The Physical Meaning of Power-Factor and the Significance of a Power-Factor Less than Unity without Phase Difference . . . 1047
Selection and Testing of Materials for Construction of Electric Machinery, by J. Epstein . . . 1048
Allis-Chalmers Steam Turbine and Generator in New Rochelle Station of Westchester Lighting Company . . . 1055
West Virginia Independent Telephone Association . . . 1055
A Noteworthy Example of Modern Illuminating Engineering . . . 1056
Importations of India Rubber . . . 1058
Electric Lighting Plant for Ridgefield, Ct . . . 1059
Gas Turbines . . . 1061
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 1062
Gift to Union College . . . 1063
METHODS OF GETTING NEW BUSINESS—"Advertising Electricity," iv, by Frank B. Rae, Jr . . . 1064
Mr. Arthur Vaughn Abbott . . . 1066
INDUSTRIAL SECTION:
Western Electric Company's New Special Design Short Arc Lamp 1067
The Anderson Electrical Time Switch . . . 1067
Electric Tower Control of Surface Track Switches . . . 1068
"Harvard" Outlet Boxes . . . 1069
The "National" Steel Tube Cleaner . . . 1070
Electric Service Supplies Company Announcement . . . 1070
Plant of the Dean Electric Company, Elyria, Ohio, Sold . . . 1070
Municipal Telephones for Manitoba . . . 1070
CURRENT ELECTRICAL NEWS . . . 1071
RECORD OF ELECTRICAL PATENTS . . . 1077

Copyright, 1906, by Electrical Review Publishing Co.

THE ENGINEER AND NATURE.

Engineers seem to be looked upon by laymen as heartless, cold-blooded persons without any artistic feeling whatever. They are supposed to look merely upon the utilitarian side of problems, dismissing as of no importance whatever all questions of harmony and beauty. When they see a waterfall they see nothing but so much water falling down and converting its potential energy into heat, and the only thought that this arouses is how much power can be obtained there.

Possibly the engineer himself is somewhat to blame for this attitude of the public. He is rather apt to dwell upon the usefulness of nature's resources than upon their beauty; but this is not necessarily because he does not appreciate the latter, but because he has been trained to value highly the former. While enjoying the beauty of a majestic waterfall, he may also take pleasure in estimating just how much power could be obtained there. He thinks how much work might in this way be performed, and, perhaps, if he is sentimental, he may wonder how many toiling hands might thus be relieved of drudgery and set to doing work of a higher character. And when every one else is talking about the wonderful beauty of the scene, is it not natural that he should point out the features which others do not appreciate? His attitude is rather that of one who sees both sides of the question and presents that neglected by others, rather than that of one who sees only its money value.

In an interesting address delivered by Sir Alexander B. W. Kennedy before the Institution of Civil Engineers, of Great Britain, an abstract of which appeared in the issue of the ELECTRICAL REVIEW for December 22, the speaker, among other topics, touched upon this one: The relation of engineers and engineering to nature. Admitting that engineers are sometimes guilty of disfiguring nature, he thought that actually the disfiguring was less than is generally believed. He was not inclined to admit that the conversion of an upland valley bottom into a lake, or the construction of a dam, thus bringing blue water where boggy peat land was before, was doing any harm to nature; nor that a fine masonry dam is an eye-sore. Moreover, since such waterworks are necessary for cities and can not be obtained otherwise, the engineer should not be blamed unless he does the work with wanton disregard to all appearance. Water storage for power purposes can hardly be put upon the same high plane, but if the net result of the whole is to give employment to hundreds of men in places where hitherto no one could maintain himself, the schemes are justified, even at the expense of ruling a straight line across the landscape. If there is anything iniquitous in the utilization of water power, every one is involved

Digitized by Google

in the guilt accompanying the utilization of our coal fields, compared with which the hydraulic works are microscopical.

Speaking particularly about railroads, Sir Alexander said that while it might have been better, possibly, if we had stuck to stage coaches, and never gone traveling, the world itself has elected otherwise. This being the case, it is the duty of the engineer to supply the necessary roads, and it did not seem that in all cases were they disfigurements. While the speaker often wishes that the Swiss railways would burn smokeless coal, he admired the trail of white steam, which is more in keeping with the landscape than the trail of dust which marked the course of the stage coach. It is possible that this smoke may be banished from Switzerland by adopting electric traction, but in that case the steam would go also. It frequently happens that the railway itself, while perhaps not a thing of beauty, is much less disfiguring than the town through which it passes; and for this the engineer is not to blame. Those who are guilty there are the architects and builders, who would perhaps be among the first to point out the ugliness of a railway cut. We have heard a great deal in this country about the value of natural beauty and the unappreciative engineer. No one will deny that certain majestic scenes are of enormous value, but generally they give pleasure to but a few; while by accepting nature's gifts and converting them into something a little more useful a much larger number of people would be benefited. This may not be sufficient excuse for destroying or even damaging nature's pictures, but it is an idea that should always be borne in mind. Perhaps a straight line of railway is not artistic, but it is certainly much less disfiguring than the lines of advertising signs which are erected on the adjacent property which is supposed to be injured by the road. However, railway companies and others engaged in large work do to-day pay more attention to artistic questions. The road is beautified wherever possible, and dignified, and even beautiful, buildings are erected. Yet some cold critic no doubt will say that this is because the engineer of to-day realizes that such methods have some value in themselves.

TESTING ELECTRICAL MATERIALS.

On another page of this issue will be found, somewhat condensed, an interesting paper by J. Epstein, recently read before the Institution of Electrical Engineers, of Great Britain. Mr. Epstein has had a large experience in this work, and his views are valuable, not only for themselves, but because they show German practice in the selection and testing of materials for the construction of electrical machinery.

In such work, naturally, laboratory methods are of great value, for only in this way can the manufacturer obtain an idea of the value of any material before it has been used. New lots of iron should be tested for their magnetic properties, insulating material for its dielectric strength and resistivity, copper for its conductivity—in fact, all the materials used should be subjected to some sort of examination. This has become the custom in all important works, and information obtained in this way will often determine whether a consignment of material is acceptable or must be returned. It is probable that the material used in constructing electrical machinery is subjected to more severe tests before it is accepted than that used in any other industry.

However, as Mr. Epstein points out, these preliminary tests must not be given undue weight in determining the value of the materials for construction purposes. An insulation with a low dielectric strength is not suitable for high-tension apparatus; and, on the other hand, it does not follow that because the dielectric strength is high the material will be suitable; in fact, its mechanical properties are just as important as the electrical, and the latter, as a rule, can only be determined by the test of use. In selecting iron it is, of course, desirable to have one with good magnetic qualities; yet in the design of a machine it is generally necessary to allow, in the calculation, for poorer materials. Some companies make a practice of testing the iron as it is delivered and grading it, so that when any particularly severe requirements are made they can be met. A rather interesting point was made in the paper, that the purer the copper, the better; while, on the other hand, iron is improved by the presence of small amounts of certain impurities. Sometimes a material having particularly good qualities is not as suitable as one not quite so good. A carbon brush, for example, with a low coefficient of resistance, will decrease the commutator friction losses, but it will also probably, due to its higher conductivity, increase the electrical losses of commutation, and may in this way result in a less efficient arrangement. In selecting any material these various characteristics must be borne in mind and one balanced against the other to obtain the most satisfactory results.

After the materials have been selected the most important test is that which determines whether the new machine, as completed, fulfils all the requirements. It is often desirable to test each part of the machine by itself, but this should be merely a test to detect faults so that they may be corrected before the machine is assembled. Tests are frequently made for the insulation of various parts, but it is thought not to be desirable to carry these tests too high, not because an excessive potential overstrains the dielectric, but because such a test, if prolonged, may bring about chemical changes due to surface or other discharges, and in this way actually develop faults which would otherwise not exist.

The final test to determine whether the machine will pass or not is, of course, to examine its performance under specified operating conditions. A certain efficiency is required, and in order that the insulation may not deteriorate the temperature of the parts must not become too high. There are accepted standards for these requirements, which are in general adhered to; but, as is pointed out, it does not follow that because a machine does a little better than was asked that it is so much more valuable. If it will run several degrees cooler than was expected, the difference is on the right side; but the temperature limits set are low enough, and unless the machine is to be overloaded frequently it will probably have no longer life than had it

Digitized by Google

merely met the requirements. Moreover, a slight gain in efficiency, while good, should not be given undue importance, because there are so many other phases in the operation of a power-house where the question of efficiency is neglected. Instead of calling for the highest possible efficiency for the dynamo it might be better in many cases to use a somewhat cheaper machine here and pay more attention to other parts of the equipment. The boiler house is frequently neglected in this respect.

Mr. Epstein advises determining the efficiency of electrical machinery by measuring the losses. This is a common practice. The advantages are the small amount of power to be generated and measured. Errors made here have little effect upon the final value of the efficiency, since if the total losses are ten per cent, an error of ten per cent in any measurement means considerably less than one per cent in the final value. The accuracy thus made possible compensates, no doubt, for the slight change in efficiency which may take place if determined under actual load conditions. For determining the temperature rise of the machine, which really determines its rating, approximately full-load conditions must be obtained. This is one of the difficult problems with which the shop has now to contend; but means are being found for doing so without unnecessary waste of energy. While such tests determine the proper rating of any machine, low temperatures in general do not add anything to its value to the manufacturing company, as the price has already been agreed upon, and in operation this quality is simply a reserve seldom to be called upon.

THE ELECTRIC DRIVE.

The advantages of the electric drive for shops have been pretty thoroughly discussed again and again. They are many and result in a more efficient production and utilization of power and a general improvement in shop conditions. Each character of shop, however, presents its own problems, and in all of these there are generally some special features which make the electric drive particularly advantageous.

The new method of driving has made possible an important development in shop practice—that of carrying the machine to the work, instead of the work to the machine. To-day, when heavy work is to be done, it is very frequently the rule to carry it out by a number of light, portable tools, which are taken to the work. Several of these may be in use at one time, thus reducing the time required for completing the job. Moreover, since the tools are considerably lighter than the work, much time and labor is saved by adopting this method. Frequently, cases arise in which the work is difficult if performed in any of the older ways; but, by means of a light, portable, electrically driven tool, the necessary machine work can easily be done.

There is another method in shop work which impresses the visitor, and which may lead him to inquire whether it is a relic of old practice or has been found to be, on the whole, the most satisfactory. This is the placing of enormous masses of metal upon which work is to be performed upon moving tables and moving the work against the tool. For example, one frequently sees enormous castings, weighing from fifty to a hundred tons, slowly and majestically sliding back and forth, while one or two tools, weighing a few pounds apiece, scrape away a little excess material from certain spots. Such a method must be very expensive, because the machine itself must be large, and the motor capable of moving and reversing the load must be powerful. Why should not the tool itself be moved, for certainly the same rigidity of structure could be secured for the work with a much lighter moving load. The introduction of the electric motor into shop practice has indeed brought about many important changes, but in very many cases the motor is considered merely as a supplementary device to be hitched to the old tool, and the full advantage which might be derived from the use of the new driving mechanism has not been seized. We are likely to see still further progress in shop driving in the next few years, particularly in places where the motor is not merely a new device in an old shop.

WIRELESS TELEPHONY FOR THE DEAF.

The possibilities of wireless telephony have been the subject of comment for some years past, but only recently have plans which seem to offer solutions been suggested. These, it is reported, have well advanced in the experimental stage, as messages have been transmitted more than twenty miles. Interest has naturally been renewed in the subject, and there is one phase of it which is particularly attractive. A letter has been received asking us what are the possibilities of adapting a wireless telephone system to help the deaf. The microphone has been found very useful in this way, but it has several serious disadvantages. One of these is the cord attachment between the transmitter and the receiver. Another, which is really more serious than at first sight would appear, is the necessity for the person to whom the deaf one talks to speak into a telephone instrument. This is really a hindrance to conversation. It is embarrassing and requires a good deal of practice before one can do it easily. Our correspondent asks whether it would not be possible to use one of the wireless systems, thus doing away with the cord and making the movements of the deaf person as independent as those of one wearing eye-glasses. This one step alone would be a great help, but if, further, the transmitter could be constructed so that it was not necessary for one to speak directly into it, conversation would be much easier and the serious disability of the deaf largely removed.

It is not at once apparent just how this much-to-be-desired plan can be brought about. The systems at present employed require a good deal of apparatus, which is much too complicated for such purposes; but it does not require a great stretch of the imagination to conceive of a small transmitter placed on a convenient table, the mechanism of which is driven by a noiseless motor, and which to the ordinary eye would not attract particular attention. This might be sensitive enough to transmit clearly words spoken some distance from it. The receiving device would, of course, be carried by the afflicted person. Or we may go still further and imagine a small transmitter carried in the vest pocket, which transmits to the ear sounds which it receives. There are, no doubt, a great many difficulties to be overcome before such a desirable device is to be had, but that there would be a field for it no one will question.

Digitized by Google

Street Lighting Fiesta at Oakland, Cal.

Oakland has been considered a residence city, being located across the Bay from San Francisco and related to the latter as Brooklyn is to New York.

After the disaster in San Francisco, Oakland increased in population from 110,000 to 225,000 inhabitants and immediately assumed a cosmopolitan appearance. It had long been the terminus of transcontinental railroads; also had a deep sea water-front, yet it remained residential in character. It had its Chamber of Commerce and Merchants' Exchange, yet there lacked progressiveness and unity of civic interests. The advent of new industries and increased population awakened the merchants. They came together through their two commercial organizations, and decided that the business streets must be well lighted. Even though the stores were closed evenings, except Saturdays, still by lighting up every night, the thoroughfares would become a promenade for the people and artistic display of goods, in bright windows, would enhance trade.

Plans were discussed. The arc was discarded. The streets should have ornamental lamp posts. One near each corner, making two including the cross street, and one in the centre of each of the 200-foot blocks. The design adopted is pleasing in appearance and practical in application. It stands ten feet high with a sixteen-inch frosted globe in the centre and two twelve-inch globes, one on each branch. The standard is made of cast iron painted a dark brown and the relief filigree work shaded a deep green. The colors are such as not to show hand prints or scratches. The effect is exceedingly ornamental—massive yet graceful. The top globe contains a cluster of four sixteen-candle-power incandescents and there are three in each branch. The total light flux is small compared to the same wattage in an arc, yet with the blaze of light from the store windows, it is surprising to note the balancing effect of this light at the curb. The electroliers are certainly ornamental; day as well as night, being a relief to the straightness of street lines. The property owners paid for the electroliers, costing $85 each, by a voluntary tax of $1.20 per front foot which allowed for streets and a very few owners who would not contribute. Some owners paid for the placing of additional electroliers. The city pays for the current, which is supplied by the Oakland Gas, Light and Heat Company.

This was all worked up that the first night of illumination should be celebrated by a "Lighting Fiesta." The occasion came off December 14. The streets were made brilliant with lights. Wires were stretched between the electroliers which are supplied underground, and strings of incandescents, sixteens and eights, were strung to the buildings. Electric signs and specially worked out designs added their part; likewise the show windows. The main streets, Broadway and Washington and cross streets, almost a mile, were a mass of people—150,000. The fiesta parade was composed of floats representing the various business houses. Campbell Grocery Company—a number of stuffed camels and Scotch bagpipes playing the Highland air, "The Campbells are Coming," and coming behind were a string of their delivery wagons throwing out samples. A produce dealer, showing a rack of dressed fowls, fish, crabs, etc.; tailoring floats, lumber floats, bands of music and red fire. Autos and touring cars with electric flash signs, mounted marshals of the various divisions had batons flashing various colored lights. Such as this composed the fiesta parade and held the crowds for the hour it took to pass, and then the sidewalks became a moving mass until long after midnight.

All this enthusiasm was developed in what was supposed to be a demure town —no other event than the lighting of street posts. It put into circulation thousands of dollars for that night by the merchants awakening to the realization that an attractive store front, a bright window and a well-lighted thoroughfare is the cheapest and best advertisement.

What Oakland has done, following other cities, is just what other cities can do to stir themselves into commercialism.

New York Electrical Society.

The 264th meeting of the New York Society was held Wednesday, December 19. A. O. Benecke, of the American Instrument Company, Newark, N. J., lectured on "Electrical Measuring Instruments." Mr. Benecke covered much of the ground traversed by recent investigators in the field of electrical measurement, and brought out many new and instructive points of the subject. The following members were elected: John W. Brooks, Sydney F. Weston, Edward H. Waldo, F. P. Thorp, F. H. Leonard, Jr., Nathan Fleischer, Albert C. Boeri, Aldred K. Warren, Chas. H. Hadlock, Kingsley G. Martin.

Electrical Resistances of Alloys.

At a recent meeting of the Physical Society of London a paper "On the Electrical Resistances of Alloys" was read by Dr. R. S. Willows. Lord Rayleigh has given a theory intended to account for the high resistance of alloys compared with that of the constituent metals (*Nature*, June, 1896, and Collected Papers, vol. iv, p. 232). According to this theory, when a current is sent through an alloy it sets up a series of Peltier effects at the junctions of the dissimilar metals, and hence also a back electromotive force. Since these effects are proportional to the current, they are indistinguishable from a resistance under ordinary conditions. It is this spurious resistance that may account for the difference in behavior of an alloy and a pure metal. The author attempted to put this in evidence by measuring the resistance of an alloy with direct and also alternating currents. At the instant of reversal of the latter the back electromotive force will assist the external electromotive force, and hence more current will pass, *i. e.*, the resistance will apparently be reduced. A bridge method was used, the frequency varying between 10,989 per second. No spurious resistance could be detected. If it were present its temperature coefficient would probably differ from that of a pure resistance. The method was therefore used between temperatures 100 degrees centigrade and that of liquid air, but again with negative results. A minimum accuracy of 0.02 per cent was attained.

Professor J. A. Fleming said Lord Rayleigh's theory was ingenious, but it presupposed a coarseness of structure in the alloy. An alloy was probably a substance of the nature of a solution with a fine structure, and it was difficult to see how thermo-electric electromotive forces could be brought into play without discontinuity of material.

A. Campbell said that shortly after Lord Rayleigh advanced his theory he made some experiments to try to detect if alloys showed changes of resistance when tested with alternating and direct currents. The alloy selected was ferronickel, as it was expected that this would show the effect strongly, as the constituents give a strong thermo-electric electromotive force. No difference could be detected between the apparent resistance with the direct current and with alternating current of frequencies up to eighty per second (the usual correction for contact difference being found and applied).

Digitized by Google

The Whitney Development on the Yadkin.

One of the Most Important Hydroelectric Projects Now Being Carried Out in the Southland.

By Julian S. Miller.

MUCH has been written about electrical power development in the Charlotte section of the Carolinas. The newspapers almost daily carry stories of the great work that has been and is being undertaken. A great deal of this development is being accomplished by local mills for their own use; and regarding this, little is heard save in a general way. But by far the greatest of these undertakings are those of the Southern Power Company, with headquarters in Charlotte, N. C., and the Whitney Reduction Works, of Whitney, N. C. It is the great development undertaken by the latter company that will be treated in this article.

THE MAGNITUDE OF THE PROJECT.

Almost everybody has heard of the Whitney company and knows in a general way that it has for its purpose the developing of a great water-power on the Yadkin river. The public, however, has little conception of the magnitude of the work now being done and what remains yet to be accomplished. So enormous, indeed, is the project that one familiar only with small things is completely amazed when he sees for the first time a bare outline of the work. It requires hours of careful scrutiny about the scene of operations before the greatness and significance of the undertaking are realized even to the slightest degree. The extent of the work, the boldness and audacity of the proposition, the infinite nerve behind it, and the enormous sum of money to be expended make the ordinary citizen feel very small and insignificant when the vastness of the scheme as a whole is contemplated.

THE BEGINNING OF THE WORK.

For countless years the Yadkin has been roaring down a precipitous course, wearing huge boulders smooth as glass, wasting energy of ample power to turn every wheel for one hundred miles in its vicinity. Men saw it and thought of the great waste of power, but nothing was done. Ten years ago Captain E. B. C. Hambley, the right man, perceived the opportunity presented and set himself to the task of perfecting a scheme to harness the river and develop its water-power. A company was formed with the immense capital necessary to carry out the idea, and is now engaged in making ready to transform the waste of energy into productive power. It required seven years after the organization of the company for its plans to mature. One year ago the first real work was commenced and it will perhaps be more than a year hence before the completion of the first part of the work proposed. Millions of dollars have been expended already and millions more will be expended. When all is finished there will be generated sufficient electric power to run every factory now operating within a radius of 100 miles of the plant in this, the busiest manufacturing seat of the New South. There will be additional power sufficient to supply with electricity any new manufacturing industry that may be established in this territory, for electric car lines in and between the different towns in the proximity of the plant, and enough for every other purpose which electricity may serve.

PENNINGTON POWER PLANT, WHITNEY, N. C., TO FURNISH ELECTRIC LIGHT FOR WORK ON DAM AND CANAL.

THE MEN AND MONEY IN THE MOVEMENT.

The concern doing this work is headed by George I. Whitney, of Whitney & Stevenson, Pittsburg bankers, E. B. C. Hambley, of Salisbury, who conceived the plan of development and who was vice-president and general manager until his demise last summer. The capital of the company is $10,000,000, and the total valuation of the various properties is estimated at $9,000,000. The main offices of the concern are at Salisbury. F. L. Stevenson, of Pittsburg, is treasurer and J. J. Kennedy, of New York, chief engineer. The various properties of the concern include more than 15,000 acres of land lying along the Yadkin, adjacent to the water-power site. The company has enormous resources, is liberal and progressive and, perhaps, surpasses all other agencies combined looking to the industrial development of North Carolina, and it is a simple fact that in the end it will accomplish more for this state than any man or any company of men ever wrought for the public weal in the Commonwealth's entire history. It will create a new land and contribute immeasurably to the new civilization which the South is fast establishing.

LEADING SPIRIT OF THE MOVEMENT.

To see far enough into the future to tackle the job of acquiring such immense property held by a multitude of interest marks E. B. C. Hambley as a man of uncommonly broad and prospective view. Mr. Hambley, an Englishman, came to North Carolina many years ago and engaged in the mining business. He had been for a long time one of the most potent factors in the industrial development of the state, and this new undertaking, while by all odds the greatest of his many enterprises, is not by any means the first great work he has accomplished for North Carolina development. He was an engineer of world-wide fame. Since his death last summer the local management of the company has largely been in the hands of John S. Henderson, of Salisbury, who was

Digitized by Google

at that time, and is yet, attorney for the concern.

PURPOSE OF THE PROJECT.

The conversion of the dynamic force of the Yadkin into about 110,000 electrical horse-power is the object of the Whitney company. Water power will be developed at two different points on the river a few miles of each other, and the energy thus harnessed will be converted into electricity. The full significance of this proposition may be better realized, perhaps, when it is stated that the manufacturing industry of the territory roundabout uses now about 100,000 horse-power, hence the result of the Whitney company is that all these industries and many new ones may be operated by the electric power generated at the power-house at a great saving in costs.

PLAN OF OPERATION.

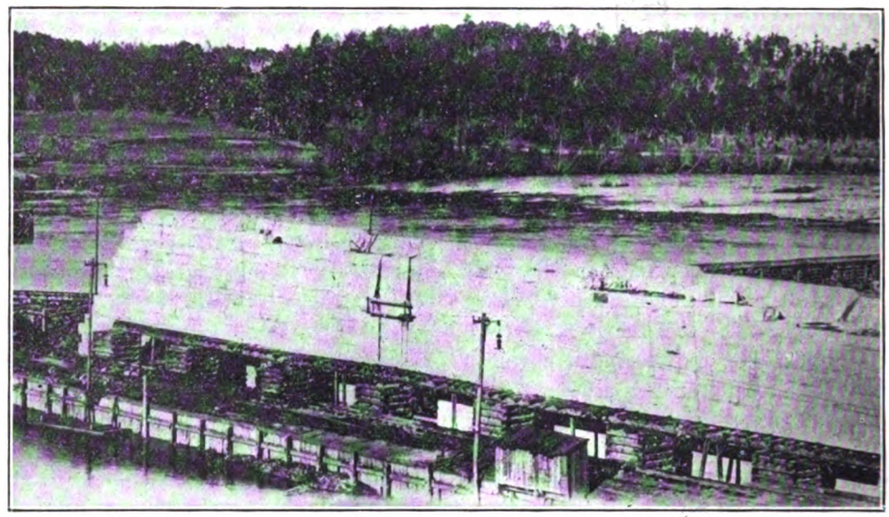
The first proposition of the company is to develop some 46,000 electrical horse-power in the immediate vicinity of the town of Whitney by means of a dam across the river, and a canal which will deliver the water to the power-house. Apparently about half the river bed has been reclaimed by means of a coffer dam. Behind this breastwork the first part of the dam is being built. It will be 1,000 feet long, thirty-eight feet high, twelve feet thick at the top and fifty-eight feet in width at the base. It will rest on the solid rock bed of the river, anchored for all time. The dam is of massive granite masonry, in Portland cement mortar, of stone averaging ten tons each. The granite in the dam alone is estimated to be worth $1,500,000. This dam will impound 15,000,000 gallons of water drained from an area of 4,100 square miles. The river at this point has an estimated minimum flow of 1,700 cubic feet of water per second. The dam will deliver the water into a canal which will have a capacity of 3,300 cubic feet of water per second. The canal will be 140 feet wide, twenty feet deep and will be constructed across country four and one-half miles to a point just above the narrows of the Yadkin, where it will deliver the water under a head of 120 feet to six turbines, each of which will be connected with an alternating-current generator of 6,700 horse-power capacity, with a maximum capacity of twenty-five per cent more. The power developed here will be available the early part of 1907.

Current will be transmitted by copper wires to distant customers at 30,000 and 60,000 volts, and to customers within ten miles at 10,000 volts. The cost of the construction of the dam and canal, installation of machinery, transmission lines, etc., will be at the rate of $100 per horse-power. The entire work done to date, including the acquirement of property, has cost $2,500,000, and as much more will be expended before the company has completed what it set out to do. One thousand men are working all along the line day and night and $100,000 is being paid out monthly.

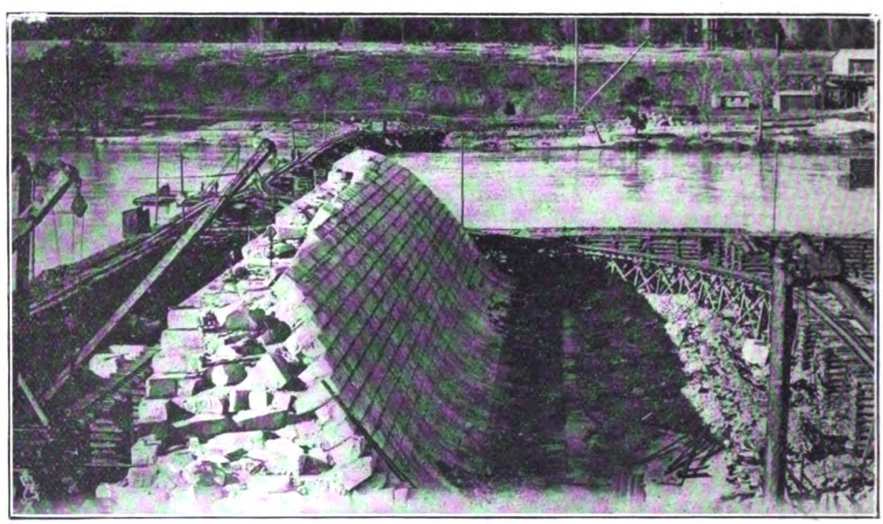
The remainder of the 110,000 electrical horse-power to be developed will be available at a later date. At a point above the dam the company has another site where it will develop 30,000 additional horse-power, and down below the Narrows there is still another capable of producing 36,000 horse-power. Some writer was of the opinion about ten years ago that ten or twenty thousand horse-power might be developed along the Yadkin at these points. A day is at hand when there will be enough power produced there to run Piedmont Carolina.

LOCATION OF THE ENTERPRISE.

The scene of operations of the Whitney company is along the Yadkin river in Stanley county, not far distant from the point where Stanley, Rowan, Montgomery and Davidson counties touch each other. Whitney, field headquarters for the army of workmen, is a new town of about 2,000 people. It has been built and is owned by the company. It is pleasantly situated near the river and occupies a portion of an extended town site that will be dotted with dwellings and mills at some distant date. Lights and water are supplied by the power-house already built. The town is reached from Salisbury by the Southern Railroad, the company's own railroad joining the Norwood branch of the Southern at New London. There are two other rail-



MAIN DAM, UNDER CONSTRUCTION (50 000 HORSE-POWER) WHITNEY, N. C.



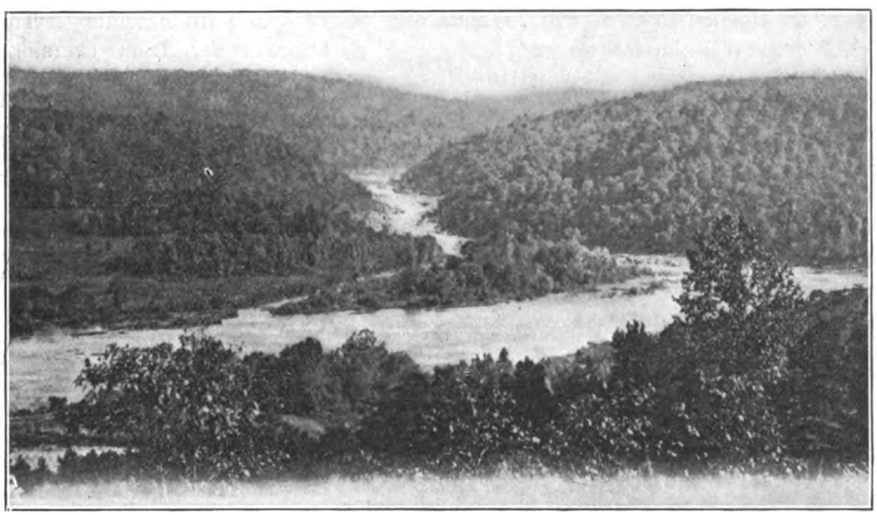
MAIN DAM, UNDER CONSTRUCTION (50,000 HORSE-POWER) WHITNEY, N. C.

Digitized by Google

roads proposed and when these are completed Whitney will enjoy railroad facilities to the fullest extent. There are already telephone and telegraph lines running into the town. There is an abundance of pure water in the town, the surrounding scenery is mountainous, drainage excellent and the climate, like that of all other sections of the Piedmont region, is superb. The town is situated about mid-way between Washington and Atlanta and can be reached in ten hours from either city. It is the nucleus around which one of the most important manufacturing centres in America will be built and the town in time will become one of large population and great wealth.

"THE NARROWS."

The "Narrows," the scene of all this development, is probably the most remarkable natural power in the southern watershed. In the vicinity the Yadkin has a fall of 129 feet in four and one-half miles; at the "Narrows" it falls ninety feet in a little over a mile. Starting at the lower end of the Narrows gorge the river has in ten miles a fall of more than 200 feet, or more than twenty feet to the mile. As it approaches the gorge formed by the encroachment of the Uwharrie mountains upon its channel, it suddenly plunges into the head of the "Narrows," through which it passes for a distance of about three miles, compressed into an inconceivably swift torrent, having a width of not more than sixty feet. Through this gorge the river has cut its way over volcanic rocks.



VIEW OF THE "NARROWS" OF THE YADKIN RIVER, FROM PALMER MOUNTAIN, WHITNEY, N. C. WIDTH OF RIVER ABOVE "NARROWS" IS 1,800 FEET, AT THE "NARROWS," 60 FEET.

THE CHIEF FEATURE OF THE DEVELOPMENT.

After all has been said, the most important feature to North Carolina about this whole matter is what it will save in the production of manufactured articles. Some idea may be gained from a few figures approximately made. The cost of developing horse-power by steam with coal at $3.60 per ton is from $35 to $50 per horse-power per annum. It is estimated that in this territory there is now being used 100,000 horse-power developed by steam. It is estimated, furthermore, that it costs $4,000,000 annually to produce this power. Supposing that the Whitney Reduction Company will furnish this power at $25 per horse-power annually, it will mean a saving to the manufacturers of this section of North Carolina $1,500,000 yearly, and at the same time, if the company can realize sixty per cent of the cost of steam power, its income from the sale of electricity alone is estimated at more than $630,000 a year, gross. Within four years the Whitney company will work an economic saving to Southern industries that will amount to more than the sum expended and required in developing the power. In a generation at these rates more than $50,000,000 will be saved, or more than $150,000,000 in a century.

In 1880 North Carolina had forty-nine mills, consuming 28,000 bales of cotton. To-day she has more than 250 mills, consuming 550,000 bales, some of these mills being the best equipped and largest in the world. North Carolina shows an increase of 197 per cent in the value of her manufactured cotton products. Valuable latent resources are being developed and there is a great influx of outside capital seeking investments, and every sort of development is forging forward with remarkable rapidity. One of the most potent factors in connection with the commercial activity will be the furnishing of permanent and cheap power from the Yadkin.

The Physical Meaning of Power-Factor and the Significance of a Power-Factor Less Than Unity Without Phase Difference.

The term "power-factor" is defined by Professor Alfred F. Ganz, who also shows how it is derived and what is the effect when the wave-forms of current or electromotive force are not harmonic. It is shown that the power-factor, when defined as the ratio of the average power, as measured by a wattmeter, to the product of the effective values of current and electromotive force, is a maximum when the synchronous harmonic components are in phase, and that only the fundamental harmonics of the current wave produce real power, while the upper harmonic components produce so-called wattless power. When the current wave is not harmonic the current may be zero at the same instant as the electromotive force, so that there would apparently be no phase displacement; yet the ratio of true to apparent watts might show a power-factor considerably less than unity. The phase displacement might also be measured with reference to the maximum values of current and electromotive force, but this displacement is less easily determined, due to the flatness of the curves. Power-factor should also be considered in measuring pulsating direct currents, since the products of the average values of current and electromotive force will give a result greater than the actual power as measured by a wattmeter. An instance of this kind is offered by the mercury vapor rectifier, in which the current wave is considerably distorted.—*Journal of the Franklin Institute (Philadelphia), December.*

The Virginia Portland Cement Company, of Fordwick, Va., is about to add 2,000 barrels per day capacity to its plant, which will be one of the largest cement plants in the South. Many improvements will be made in the buildings and machinery; there will be a new power-house, and the existing mill will be driven by electricity. In the power-house two turbines are to be installed, and the boiler capacity, increased by 1,500 horse-power, will now aggregate 2,000 horse-power. The whole of the old and new machinery will be driven by electricity. The consulting engineers of this plant are W. B. Barstow & Company, of New York and Portland, Ore., who have also been retained as consulting engineers for the new plant of the Seneca Button Company, at Poughkeepsie, N. Y., which is to be operated electrically throughout; and for the Bergen Point Chemical Works, Constable Hook, N. J., which are about to be equipped with a new light and power plant.

Digitized by Google

SELECTION AND TESTING OF MATERIALS FOR CONSTRUCTION OF ELECTRIC MACHINERY.[1]

BY J. EPSTEIN.

The material which plays the most important part in the construction of electrical machinery is copper, which must be used in its purest state in order to obtain a good conductivity. Provided therefore that copper possesses the requisite conductivity, its suitability for electrical purposes is assured.

In measuring the resistance of copper the temperature of the sample to be tested must first be allowed to assimilate itself to that of the laboratory, and no readings should be taken until the sample has acquired the temperature of its surroundings.

The cross section of round wire is generally obtained by means of a micrometer. In cases where the diameter is very small, weighing may be resorted to. With wire of a section other than circular, allowance must be made for the rounded edges. From a large number of readings taken in the author's laboratory it was found that for the usual sizes of copper strip the cross section may be taken as equal to $(h - 0.35) \times b$ where h and b represent the greater and smaller axes of the strip in millimetres.

The conductivity of copper being dependent on its purity, and the manufacture of pure copper having long been practicable, it follows that no great improvement in high conductivity drawn copper is to be anticipated in the future. Therefore, although copper wire and bars are the most important materials in dynamo construction, the determination of their qualities presents little difficulty in the laboratory, as but few tests are required for this purpose.

The specific conductivity of cast copper may, on the other hand, vary from about forty per cent to eighty-five per cent in the Matthiessen scale. When a young laboratory assistant finds the conductivity of a piece of cast copper to be eighty-five per cent he would be likely to consider it excellent, but if the experienced workman detects porosity he will rightly pronounce it bad; in such a case, as in many others, one is apt to be misled by a purely physical test made in the laboratory.

Resistance materials, like German silver, manganin, etc., show even greater variations than copper, the specific resistance varying from 0.3 to 0.8 unit. Whether a higher or lower specific resistance is more suitable for the work is a matter of calculation. When the resistance has been decided upon, special tests and experiments are needed to discover what alloy will give the best results as regards stiffness, elasticity, ageing, etc. The proper function of the laboratory is to ascertain if the dimensions and specific resistance are in accordance with the specification.

In contrast with copper, where the purest is the best, the quality of iron is by no means always depreciated by the introduction of foreign elements. On the contrary there is great scope for improvement by introducing other substances, such as carbon, silicon, aluminum, etc. There is another point which makes the question of iron more complex than that of copper; with copper we are interested only in its conductivity, whereas in the case of iron there are three magnetic and electric qualities of importance, namely, magnetic permeability, magnetic hysteresis, and electrical conductivity.

As long as the magnetic flux is constant, permeability alone is of importance. Although there are some kinds of cast iron or cast steel which are practically non-magnetic, one can as a rule obtain from every good foundry cast iron suitable for electric machines. The higher the permeability and the higher the point of saturation, the better of course the iron. In designing a machine for a given flux, both iron and copper will be saved and efficiency will be gained by using an iron of good permeability and having a high degree of saturation. If, however, after construction the iron proves superior in these respects to what was expected, it will be too late to take advantage of this, as the structural details of the machine will have been settled. The speed of motors will be less than the required speed, which will have to be compensated for by introducing an additional resistance, while with dynamos it will be necessary to vary the field resistance. Therefore, to use iron of better magnetic quality than one ordinarily expects only leads to trouble and expense.

To a certain extent the quality of the delivered material will necessarily vary, and accordingly we must calculate the ampere-turns for the worst quality expected, and make allowance by constructing the variable field resistance for the best quality. What is therefore required and appreciated is an iron of high constant quality.

It is important in comparing the materials and factors of safety to refer to the right factor. In investigating the permeability of ordinary cast iron, the author would recommend, as a characteristic figure, to take the number of ampere-turns per centimetre required for B = 9,000, and, as regards special steel, those required for B = 17,000. For measuring the permeability of cast iron and steel the ballistic method appears the most convenient. The best results would be obtained by using large rings, having a radius approximately equal to five times the thickness of the actual ring coil, but for practical reasons the yoke arrangement is to be preferred. As remanence is not of much importance, the magnetization curve obtained by reversing the magnetizing current should be noted. This curve has the advantage over the hysteresis curve obtained step by step, that each point is in itself absolutely correct and does not suffer from cumulative errors.

The question of remanent magnetism in field frames is generally of secondary importance, as consideration of this only becomes necessary when dealing with some self-regulating machines, such as boosters, etc.

Besides the physical laboratory tests, the mechanical inspection of cast steel is very important. For instance, holes in the steel may increase the magnetic resistance of the poles or yoke and cause dissymmetry in the magnetic circuits, which in the case of a continuous-current dynamo will produce sparking or heating in the armature.

Although every magnetic and electric property of the iron sheets used in the construction of armature or transformer cores plays its part, yet the permeability and the saturation are not of such importance, as it is necessary to work with a low saturation of the sheets in order to avoid losses and heating.

The hysteresis can be measured by taking the magnetization curve through a complete cycle, and by measuring the specific resistance of the material directly by a Wheatstone bridge; but the modern and better practice is to measure the total losses due to hysteresis and eddy currents together, the sample being tested under working conditions.

By varying the frequency the well-known straight line curves are obtained which discriminate between the losses due to hysteresis and eddy currents at constant induction. The losses themselves are measured with a wattmeter, special care being taken that the instrument is correct for low power-factors. As the

[1] Abstracted from a paper read before the Institution of Electrical Engineers of Great Britain, November 22.

Digitized by Google

amount of energy to be measured is very small, precaution must be taken against the occurrence of losses in the instruments.

The apparatus used by the author for such researches was constructed eight years ago. It was the first standard apparatus for testing iron sheets approved

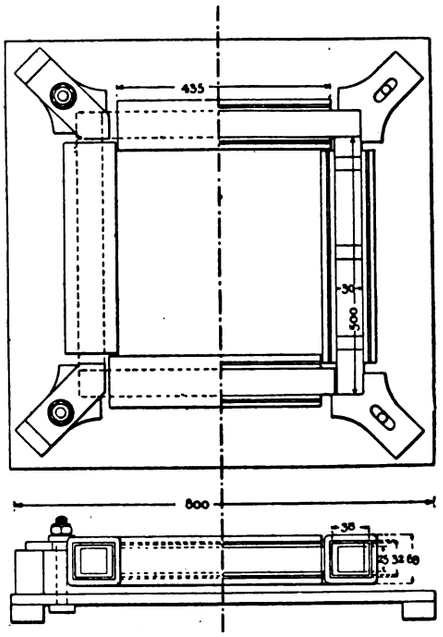


FIG. 1.—STANDARD APPARATUS FOR TESTING IRON SHEETS.

Total No. of coils	600
No. of coils per core	150
Length of iron sheets	500 mm.
Width of iron sheets	30 "
Weight of iron sample to be investigated	10 kg.
Cross section of wire, 2 wires parallel	2×3.5 mm.
Resistance of the apparatus	0.184 ohm.

of by the Verband Deutscher Electrotechniker at their meeting at Dresden, where they had the pleasure of meeting their English friends. To get a good commercial average value the apparatus is constructed to take a ten-kilogramme

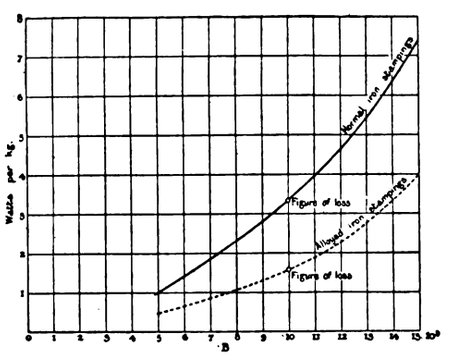


FIG. 3.—COMPARISON OF OLD AND NEW SHEETS.

sample, which according to the rules of the German Committee must be made up from at least four different sheets. Small samples taken from different sheets, or from different parts of the same sheet, differ sometimes by as much as twenty per cent. The form of the apparatus is shown in Fig. 1. There are four coils for magnetizing the four cores of sheets under test, each insulated by thin paper in the same manner as in transformer cores, and at each corner, where the cores meet, a layer of paper, 0.2 millimetre thick, is interposed. This thickness does not affect the exactness of the results, as even when a layer up to one millimetre was tried, there was no appreciable difference in the readings. Naturally, in order to obtain the best readings the magnetizing current should be adjusted to as low a value as possible.

Some years ago iron works were not accustomed to test iron sheets for dynamo work. When they tried to do so, they found that their results rarely agreed with those of the dynamo manufacturer, on account of the variety of methods and of their complication and inaccuracy. It was therefore important that the manufacturer and consumer should mutually agree upon a method of testing which should be as simple as possible. To settle this the Verband Deutscher Elektrotechniker appointed a committee which decided to adopt the wattmeter method. When samples of iron were sent to laboratories of different firms, it was found that the losses measured for one induction and one frequency agreed fairly well, but there was great trouble as soon as an attempt was made to draw the straight line curves for separating hysteresis and eddy currents. Therefore, although we knew that in order to obtain the exact characteristic of iron it was necessary to test it at least in two particulars, namely for hysteresis and eddy currents, we abandoned the attempt and decided instead to take as a characteristic the loss measured with B = 10,000 lines per square centimetre and fifty cycles. In the German rules this value is called the "figure of loss" (Verlustziffer). The adoption of this standard has proved very useful during the last few years. Since the eddy currents decrease with rising temperature the figure of loss was determined for a standard temperature of thirty-six degrees centigrade. The commercial 0.5 millimetre sheets made the last few years changed by about 0.2 per cent for each degree centigrade, while the modern sheets show practically no variation. In comparing different kinds of iron the electrical engineer naturally examines them under varying inductions and frequencies, and the manufacturer will now also do the same, as he gradually gets accustomed to making magnetic tests. Only with irons of analogous composition, the conductivities of which are almost equal, is there any direct proportion between the above figure of loss and the "Steinmetz" coefficient. Fig. 2 shows this ratio as found for sheet iron of two different alloys.

For practical work it is best to make use of a diagram which shows the losses per kilogramme at different frequencies. To present a comparison of the old with

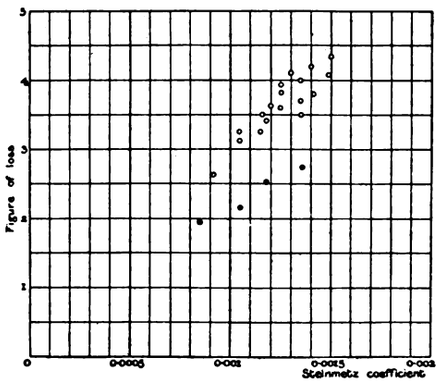


FIG. 2.—RATIO FOR SHEET IRON OF TWO DIFFERENT ALLOYS.

the new kind of iron sheets, the diagram, Fig. 3, has been drawn. The curves are plotted for fifty cycles, and the lower one is that for a modern sheet of special alloy, while the upper curve represents a sheet which was until lately considered as being of first-rate quality.

Aging is defined by the German rules for iron as the percentage variation of the figure of loss caused by keeping the sample at a temperature of 100 degrees over 600 hours. Fig. 4 shows the effect of aging with a good and with an inferior sheet of iron, marked A and B respectively. The upper curves refer to the hysteresis, the lower to the eddy currents. From these it is seen that aging is only due to the rise in value of the hysteresis. Though at the beginning the

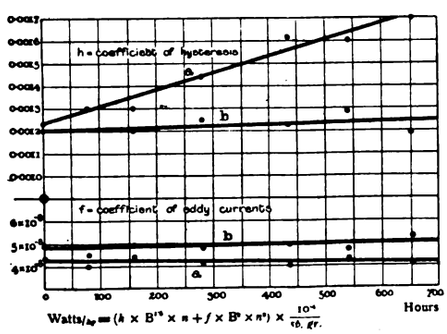


FIG. 4.—EFFECT OF AGING.

figure of loss of sample A is practically the same as for sample B, after a long run it exceeds the figure of loss for B.

There is no difficulty in obtaining ordinary stampings, whose aging will be within a miximum of fifteen per cent.

Notwithstanding the importance of the aging test, the dynamo maker is unable

Digitized by Google

on account of time to wait for the result; all that can be done is to keep records of his observations and to utilize the results of his tests when he wishes to obtain another supply.

The testing of the resistance of insulating materials used in the construction of dynamos is not so important as might appear. The old-fashioned axiom that high resistance insulation was a guarantee for good quality, which formerly proved right for special cases, does not now hold good. Insulation difficulties are scarcely ever due to low insulation resistance, but more often to surface leakage, which may be avoided by using only dry materials and by suitable design.

It is necessary, however, to test all insulating materials for disruptive strength, and this constitutes, for high-tension work especially, the most important electrical test. Nevertheless, the more experienced one becomes in the practical testing and theory of disruptive strength, the more difficult it appears to obtain accurate figures which are comparable with those of other investigators.

Most of the high-tension insulating materials, like micanite products, varnish cloth, impregnated paper, etc., are not at all homogeneous. By means of the piercing test the strength at the weakest point is ascertained. The larger the test piece, the greater will be the number of weak points covered, and the greater is the probability of obtaining specially low values.

The effect of increasing the area of the test-piece is not only to increase the probability of detecting weak spots, but the increase in the capacity of the electrode also has the effect of lowering the piercing pressure. A standard electrode has been adopted by the author's firm for testing dielectric strength, which for practical reasons was taken at $25 \times 25 = 625$ square centimetres. To minimize the local stresses, the edges are rounded off.

The importance of testing most carefully mica tubes for high-tension machinery can not be too much emphasized. In the Felten-Guilleaume-Lahmeyer laboratory every mica tube is tested up to at least double the working pressure, the tube being covered with tinfoil and filled with metal rods. As the factors of safety taken are so high that failures even under more severe tests very seldom occur, the electric phenomena are controlled by noting the heating effect of dielectric hysteresis.

The conditions of testing must be identical. For example, when the mica tube is filled with iron rods it becomes warmer than when copper rods are used, for the reason that the heat conductivity of iron is less than that of copper. In the same way the length of the exposed portion of the tube has a distinct influence on the result.

Our standard practice is to fill up the tubes with iron rods and to cover them in such a way that the exposed portion of the tubes equals twenty per cent of the length under test. About thirty tubes are then laid one against the other. Mica tubes, however, which may be able to resist this particular test will still be unsuitable for the work if they show inferior mechanical strength or deformation at higher temperatures.

Much has been said about the danger arising from the generation of nitric acid

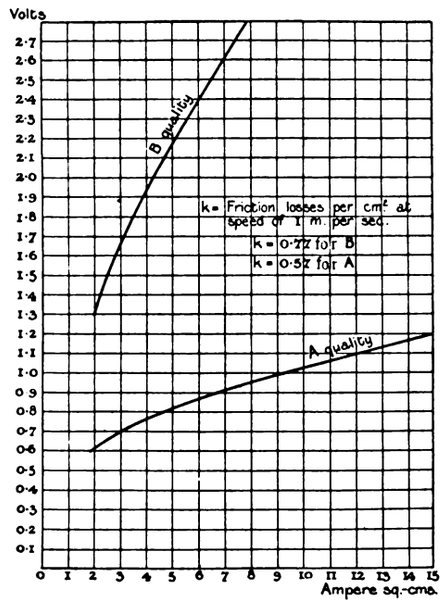


FIG. 5.—VOLTAGE REQUIRED FOR PAIRS OF CARBONS AT DIFFERENT DENSITY OF CURRENT.

in mica tubes. This phenomenon has also been observed in our laboratory while testing mica tubes filled with cotton-insulated wires under extra high pressure. At first, experiments were made with cotton-covered materials impregnated with different kinds of shellac or paraffin, and the effect in question was soon noticed, even when using the purest materials. Both the thickness of the tubes and the testing pressure were then varied, and tubes of different manufacture were also used. Tests carried out during the last three years have shown that for our practice at pressures up to 10,000 volts, the limits of thickness and of quality to be kept in order to avoid generation of nitric acid lie within the limits which had been adopted by us from other electrical and mechanical reasons. Although there are methods by which this phenomenon may be overcome, the author has not found it necessary within his own practice to use them, but he quite agrees that when stresses are higher, owing either to higher potentials against earth or to the nature or dimensions of the materials used, special precautions should be adopted.

In testing carbon brushes the most important details to be considered are durability, absence of any vapors developed through heating, smoothness of running, low friction and low wear and tear, and also the homogeneity of the carbon.

As to electrical features, a high surface resistance may be an advantage in a high-voltage machine, but the reverse in a low-voltage. Fig. 5 illustrates the voltage required for pairs of carbons at different density of current, and the watts lost by the friction per square centimetre at a speed of one metre per second. The figures were taken with a specific pressure of 100 grammes per square centimetre. Further experiments showed that on a well polished commutator the A quality carried about five amperes per square centimetre without glowing, and the B quality carried about ten amperes, but to be on the safe side we do not work at a higher current density than nine amperes per square centimetre with the A quality, and 4.5 with B. For high-tension work, however, it was found necessary to use carbons of the B quality, as low-resistance carbons gave bad commutation, the brushes being apt to heat, due to parasitic currents, and to glow at apparently normal current density.

The chief details to be considered in the electrical testing of complete electrical machines are insulation, temperature rise, efficiency regulation, commutation and power factor, both for different loads and for overload.

In dynamo practice as a rule the result of poor insulation is not the loss of energy but the production of an "earth," with the possibility of shocks to those in attendance, the disturbance of telephone apparatus, etc., and the risk that in time it may cause a breakdown due either to local heating or to electrolytic action. In the latter respect, a 2,000-ohm leakage on a 500-kilowatt, 240-volt dynamo would be altogether harmless if equally distributed, while the twenty-nine watts would be dangerous to the insulating material if the whole of the leakage were concentrated at one spot. To a certain extent, therefore, the interest is not so much in the megohms but in the question as to whether there is any local leakage. That is to say, suspicion would arise if the total

Digitized by Google

amount were greater than might reasonably be expected, all other factors being normal.

A great improvement was effected by using fibrous materials, such as leatheroid, in connection with low-tension and especially with continuous-current dynamos, on account of their elastic and mechanical strength. Mica insulation, which is indispensable for high-tension machines, is excellent when used in thick layers, but on account of its inflexibility and brittleness it is not at all suitable for use in thin layers, especially when it is necessary to bend it. The purely electrical test of a newly erected machine is likely to give better results with a mica insulated continuous-current armature than with an armature insulated with leatheroid; but with mica there is more risk of local faults, which are due to the embrittling effect of the continual heating and cooling and occur chiefly at the corners.

What is really wanted is reliability which can be guaranteed by practical experience on the part of the manufacturer, and not by a simple physical test alone. A machine, even when built with the most suitable material, has to undergo on completion an insulation test with a higher voltage than its normal, in order to ensure a reasonable factor of safety. It is desirable that a machine be able to stand any surges that may possibly arise under working conditions, but to insulate a machine in such a manner as to safeguard it against lightning discharges would not, as a rule, prove advantageous or commercial.

The probability of the occurrence of surges in a plant of given output increases with an increase in voltage. Although from this point of view the factors of safety to be taken ought to increase with the voltage, in practice the opposite is actually found to be the case, this being due to mechanical and electrical reasons. A certain thickness of insulation is necessary in order to gain mechanical strength and stiffness, and it is not good practice to use mica tubes thinner than two millimetres, otherwise they will not stand the mechanical stresses.

Thus at lower pressures the factors of safety are unnecessarily high, simply on account of mechanical reasons. The ratio between the thickness and the piercing pressure increases with the former. Consequently, to increase the factor of safety to a given amount will affect the construction of a 10,000-volt machine much more than that of a machine of 5,000, not to mention the difficulties which arise owing to the excessive space in the active zone be taken up by insulation of great thickness. We require for our mica tubes a safety factor of five or ten, in order to ensure safety against accidental weakness of the material. For this reason an additional thickness must be adopted, which, as will be easily understood, will not increase the factor of safety of thicker tubes to the same extent as that of thinner tubes. Having to take account of the fact that single layers may be faulty, it is necessary to increase the number of layers in proportion as the total thickness of the insulation is diminished.

Again the weak point of an extra high-tension machine is often not to be found in the insulating tubes themselves, but at the ends outside the slot. This space for a given pattern is about the same in a 1,000 as in a 10,000-volt machine, therefore the factor of safety here decreases as the voltage increases.

Another weak point which becomes apparent with the rise in voltage is the electrical stress between different layers of the single coils; the number of coils being usually fixed by the number of poles, the stresses inside the coils increase with the voltage, and therefore the factor of safety also diminishes in this direction as the voltage increases. Accordingly the test pressures ought not to be in the same ratio for all voltages, and the following rules, drawn up by the Verband Duetscher Elektrotechniker for the testing of insulation of machines and transformers, appear to be of the best practical value:

Working pressure = P.

For P <	5,000,	test pressure	applied	for	half-hour	= 2 P.
" 5,000 < P <	10,000	"	"	"	"	= P + 5,000
" P >	10,000	"	"	"	"	= 1½ P.

In first-class works, however, the finished machines are tested at a higher pressure than is provided for by those rules, and the single parts are tested, before being fitted, at a still higher pressure.

As far as the author's own experience goes, he has never held the view that a high-pressure test weakens a dielectric in the same manner as excessive mechanical stresses weaken an elastic metal. It often happens that a material stands a few minutes' test and then suddenly breaks down. This is generally due to a puncturing, or in some cases to a carbonizing, effect. On account of the variation of the dielectric factor of the materials employed and of the geometrical form of the electrodes, the stresses of the dielectric vary, and if there are any points where these exceed the disruptive strength, the dielectric punctures and carbonizes. This increases the stress in adjacent parts, and the average stress per centimetre, consequently other parts become punctured in turn. It is therefore advisable not to exaggerate testing pressures, but rather to seek safety in well selected and tested materials and in careful and thorough construction. The object of putting the finished machine under a pressure test before starting up would then be to detect any accidental fault which might possibly have arisen during transport or erection.

In all cases the conscientious building up of the machine on the part of the designer is a better guarantee than the voltage test made on a newly erected machine. It must be borne in mind that this latter takes place under the most favorable circumstances, while on the other hand an experienced designer will consider the unfavorable conditions which may arise in actual practice.

Although two machines, constructed with different creeping distances, may stand the same normal pressure test, it may be that one is much better suited for practical work than the other. This can not be ascertained by increasing the voltage of the pressure test. It may happen that the weakest point of the clean machine is the piercing point of the insulation. This would in no way be altered by increasing the creeping distance, but the machine of ample design would puncture at the same pressure as the inferior machine, given that both were clean. With a well-designed machine the factors of safety are of course not taken against pressures which may arise in actual practice under ideal circumstances, but against pressures which may be met with in actual practice under unfavorable circumstances, and would differently affect the various parts of the machine. Above all the factors of safety are chosen to prevent troubles which might lower the insulation value, such as dust in central stations, moisture in mines, and deposits in rooms with very moist atmosphere, etc.

Ten years ago good machines used to run without any appreciable rise of temperature, due to the fact that, experience in those days as regards commutation, regulation, materials, etc., being limited, disproportionately high factors of safety were taken. The machine was considered faulty if any part of it heated up beyond thirty degrees or forty degrees centigrade. At the present day the only reason why

Digitized by Google

we are interested in the temperature is the harm it may ultimately do to the machine, and especially to the insulating material. From experiments made on samples of cotton-covered wire by the National Physical Laboratory of Great Britain, 125 degrees centigrade was taken as an approximately safe limit. With an engine-room temperature of thirty-five degrees centigrade there would thus be left a margin for heating of about ninety degrees centigrade.

The temperature of the outside of the machine is easily measured with a thermometer, and in making special researches the inside temperature can be measured by a thermojunction, a method, however, which is impracticable for actual work. The temperature inside the coils varies to a great extent with the construction. Heat is generated equally in the body of the coils and passes to the outside and so to the surrounding air poles, pole-pieces, etc. There is a remarkable drop of temperature in every layer of insulation, this drop being proportional to the thickness of the layer and to the local intensity of the flux of heat. It would not be worth while to treat the problem by theory, based on the specific heat-conductivity of cotton, etc. Even though we can not measure the maximum temperature inside a machine, when the latter has been built—and strictly speaking this is what interests us—the change of resistance offers a very convenient means for ascertaining the mean temperature. According to the regulations of the Verband Deutscher Elektrotechniker the average heating of magnet coils is measured by this method. A mean temperature rise of sixty degrees is permitted, which corresponds to an increase in the resistance of twenty-four per cent. This mean value also corresponds, as a rule, to a temperature rise of forty degrees centigrade at the exterior, measured by a thermometer. For machines constructed on the same pattern the variation of the ratio of mean to outside temperature, as measured by resistance and thermometer, respectively, is very small, as shown by the following table:

AVERAGE VALUES OF TEMPERATURE RISE IN DIFFERENT MOTORS.

H. P.	Heating of the Field-coils as Measured by :—		Temperature as Measured by Resistance.
	Resistance.	Thermometer.	Temperature Measured by Thermometer.
	Mean Temp.	Outside Temp.	
20	54°	32°	1.68
24	50°	30°	1.68
30	45°	27°	1.66
40	55°	33°	1.65

With armatures there is no material difference between the inner and outer temperature, since the winding consists only of a very few layers. Consequently it is not worth while to go to the inconvenience of indirect temperature measurements with direct-current armatures; particularly since the measuring of the resistance becomes complicated and inaccurate, especially in the case of series parallel armatures. The German regulations therefore provide in these cases for thermometer measurements. They limit, however, the permissible temperature rise to fifty degrees centigrade.

It has been found impossible to establish, from experiments, a universal ratio between the temperature rise after continuous running and after a six-hours' run. It is desirable, therefore, in drawing up general rules, that these should not refer to any arbitrary time, but to the stationary temperature after continuous running.

In actual tests either the increase in temperature should be followed up in order to see when the highest temperature is reached, or such running time should be allowed as has proved sufficient for machines of similar type.

With machines for long intermittent service the period of the service should be used as a basis, while with machines for short intermittent service one should endeavor to take into consideration the special character of the work. In order to avoid complications, however, it is customary in the latter case to take as a basis a one-hour continuous run.

The greater the heat capacity of the mass of the motor in comparison to its radiating capacity, the more will these values differ from the real value.

If there is no opportunity for fully loading the machine, an idea of its thermal characteristic may be obtained by the well-known method of running it alternately with a higher voltage and with a higher current, so that in each case the full losses are obtained.

The object of the heating test is solely to ascertain that the recognized standard limits for the heating are not transgressed. Whether the temperature of a machine increases twenty degrees centigrade or fifty degrees centigrade is otherwise wholly immaterial, and it would be entirely premature to draw a conclusion as to the ample design of the machine from the increase of temperature alone. A cooler machine is certainly an advantage, inasmuch as it may be used in warmer localities, but apart from this a low temperature rise is of no practical value if the machine can not be overloaded owing to its commutator beginning to spark, its regulation being insufficient, or perhaps on account of its mechanical construction, or owing to being driven by a gas engine. It is not even certain with regard to the thermal qualities that if of two machines A shows thirty degrees centigrade and B forty degrees centigrade increase of temperature with normal load, that A will allow of a higher overload than B, before the permissible limit of fifty degrees centigrade is reached. This might actually not be the case if A worked with small iron losses, with great copper losses, and with high magnetic field saturation.

Finally much depends upon the reason why one machine heats more than another. If, for example, in a gas-driven plant one of two similarly constructed machines runs at a temperature of fifty degrees and the other at thirty degrees, the difference being due alone to the fact that the armature openings have been covered in the former case to prevent the entrance of gases and dust, the machine with a fifty-degree rise is to be preferred to the other cooler machine. Extraordinarily low temperature may no doubt be preferable under certain conditions, if, for instance, a very exact constancy of field is required, with low saturated magnets, but, as a rule, if the temperature does fall below the given limit this does not constitute any particular advantage.

The efficiency of electric machines is defined by the ratio between input and output of energy. The output is, as a rule, mechanical or electrical, the input the same, or a combination of both. The accuracy of mechanical measurements, both by brake for output and by indicator or hydraulic tests for input, is much behind the accuracy of electrical measurements. It is therefore good practice to avoid mechanical measurements, and to check by electric measurements the losses defining the difference between input and output. However, even when dealing with input and output of electrical energy alone from such machines as transformers, converters, and motor-generators, etc., more accurate results are obtained by testing the losses than by comparing input and output. In the first place an inaccuracy of an instrument of one per cent will affect the result by one per cent in comparing input with output, whilst the same inaccuracy in measuring the losses will affect the value of the efficiency by one-tenth per cent at a maximum. For sup-

Digitized by Google

posing that the efficiency may be about ninety per cent, an inaccuracy of one per cent in measuring the losses will influence the value of efficiency only to one-tenth of one per cent, the losses themselves being about ten per cent of the input. Besides this, instruments for measuring the losses are mostly more reliable and the arrangements less complicated. As the designer calculates the losses, and these are tested in a simpler and more reliable way, the guarantees ought to be based on them, as it is important that they should be of a kind which both the designer and the user can check.

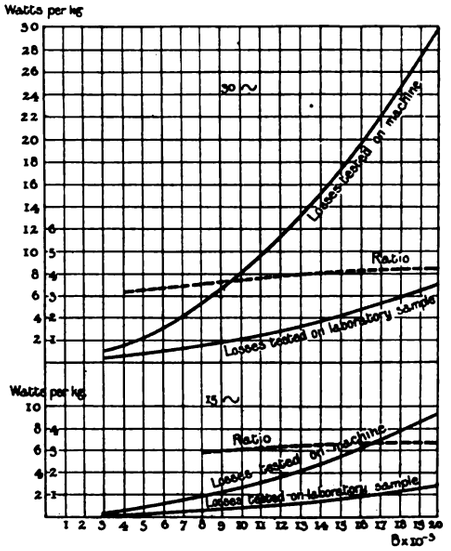


FIG. 6.—MACHINE LOSSES.

To check the copper losses at full load in armatures, the resistances ought to be measured after a regular normal run. To correct the resistance for the heating at half or three-quarter load is unnecessary, as at these values an inaccuracy of the copper losses scarcely affects the efficiency. Special care must be taken with continuous-current armatures in regard to the different brush contacts, and to the exclusion of the contact resistance of carbons. The results will scarcely be exact within a few per cent, but an error of even five per cent would affect the total losses only by about 1.5 per cent, and the efficiency by not more than 0.1 per cent. In special cases, where heavy current armatures are concerned, the resistance may be calculated from the copper dimensions.

As regards the testing of iron losses a very simple method was announced last year in the technical press. To investigate those of a several thousand kilowatt alternator small samples of the iron used in the armature were reserved and tested in the laboratory at the same inductance and frequency as in the machine. By multiplying the figures with the ratio of weights of the iron in the armature and of the sample, the iron losses in the armature were supposed to be checked. Every experienced designer who has ever compared actual losses in machines with the losses calculated on the above basis is aware that the method is faulty and that the results will be too low.

What are guaranteed as iron losses in machines are not the losses which occur in the unfinished iron, when the lines of force are uniformly distributed in exactly the way which the designer has prescribed in the armature core, but the additional losses due to varying density, dispersion, and above all to hysteresis and eddy current losses in other parts of the machine, whether solid or laminated. The data necessary for the computation of the losses can only be obtained by thorough research, and not alone by simple measurements on a test-piece in the laboratory.

Thus in the early days of dynamo manufacture a difference between the losses calculated by the Steinmetz formula and those found by tests on machines was observed, to compensate for which the multiplication of the theoretical losses by

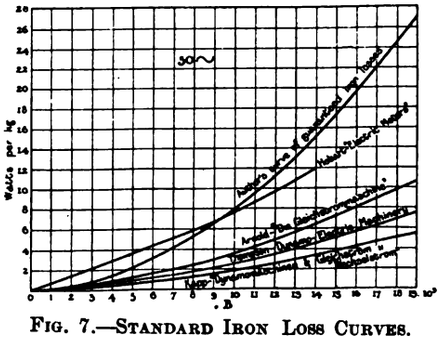


FIG. 7.—STANDARD IRON LOSS CURVES.

a certain factor was proposed. Fig. 6 refers to observations made at that time on continuous-current machines. The full lines show the losses as found by testing laboratory samples and as measured on actual machines. For a varying induction both for fifteen and thirty cycles the ratio between losses in the machinery and losses in the laboratory samples increases both with the frequency and the induction, as will be seen by the dotted lines. This is principally due to the fact that there are more eddy currents in a dynamo than in a laboratory test-piece.

Assuming that eddy currents vary with the square of both the frequency and the induction, while hysteresis varies directly with the frequency and with the 1.6 power of induction, it will be seen that it is impossible to find a constant factor which will give the exact actual losses by multiplication of the theoretical factors. To emphasize the difference as much as possible, the curves are based on measurements taken from out-of-date machines; but similar results will be found in modern machines. We therefore see that to calculate the iron losses of a machine we must take into consideration the machine running under normal conditions, and to calculate the iron losses either for the purpose of designing a machine or for guarantees we must base our calculations on curves of losses as determined from actual machines.

The most thorough method of guaranteeing a machine consists therefore in basing the guarantee on the most unfavorable values, obtained from previous machines of similar construction. Such values will be found to differ to a very considerable degree from those deduced from theoretical considerations.

In illustration of this some curves of iron losses are given in Fig. 7, which are taken from a few of the best standard works on electrical machine construction. The figure also contains a curve of loss, designed by the author as a basis for guarantees. Naturally the efficiency which has been calculated for a certain machine is very greatly affected by the choice of the curve of iron losses. The curves in the next figure (Fig. 8) have been taken as a basis for the calculation of the efficiency of a certain machine. As may be seen, differences occur of three per cent at full load and of five per cent at half load.

In order, then, to establish a comparison of guarantees as regards iron losses and to enable any one to judge the comparative value of different machines, it is essential that these guarantees should be calculated on identical lines. Because otherwise in specifying the efficiency of a machine a low efficiency is often not so much due

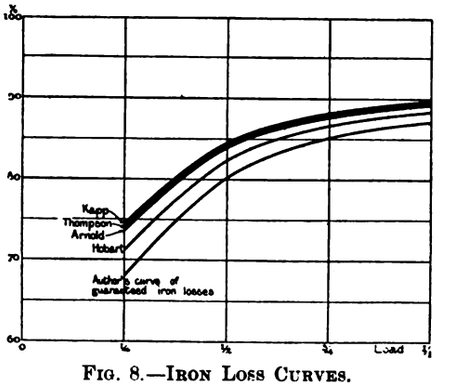


FIG. 8.—IRON LOSS CURVES.

to the fact that the machine offered is an inferior one as that the specification has been worked out in a more thorough and conscientious manner.

Iron losses can be accurately tested with

Digitized by Google

transformers or motor-generators. In motor-generators the iron losses are easily tested. With continuous-current machines special care must be bestowed on the position of brushes. Fig. 9 shows the variation observed on a machine running as a motor with different sparkless positions of brushes. In the case of motors the manufacturer for his own information can separate friction and iron losses by different methods, but the buyer will be satisfied with a combined test. With engine-driven generators indicator tests give the no-load losses of the set and the losses due to excitation and magnetization. The inaccuracy of light-load indicator diagrams is diminished, but not altogether avoided, by throttling the steam to work with lower pressure.

If the voltage available differs a little from normal a correction may be made, assuming that the losses vary with the square of the voltage. This assumption is correct in most cases, so that it is not worth while to refer to any special laws with regard to the relation between hysteresis loss and the eddy current loss.

Testing is simplified if the efficiencies of engine and generator are not guaranteed separately but combined. In this case the result will be obtained by indicating the engine and measuring the output of the generator. The simplicity of this method and the importance of the result of this test for the buyer has brought it into frequent use. Sometimes the iron losses can be tested in a more accurate way than by the indicator method, if the generater can be disconnected from the steam engine and if a second set is available to run the first when fully excited. If required in this test the separation of friction from iron losses can be effected either by varying the induction and extrapolation or by the running-down method.

Though the accuracy of electrical measurements is much higher than that attainable in other branches of engineering, we must bear in mind that it is not absolute. Even with continuous-current tests special care is required to measure current or voltage with 0.5 per cent. In dealing with high-pressure wattmeters it is very difficult to get within one per cent though the readings may be accurate within 0.1 per cent.

Taking into account the inaccuracy of mechanical measurements, it appears absolutely necessary in the case of efficiency tests to allow a margin of error; up to two per cent being commonly agreed upon. Even higher margins must be allowed in hydroelectric plants, particularly when working with a small head of water.

Efficiencies measured directly and indirectly coincide, as a rule, within the limits of the error of the observations, which is about one to 1.5 per cent. The author therefore prefers the simple and more exact method of the separate loss measurements. It is, moreover, his opinion that this method should be used for calculating guarantees, as it is important that guarantees should be capable of being checked in a simple and unobjectionable manner.

There is no difficulty in ascertaining power-factors. Due consideration should be taken that possibly differences exist between the phases in two or three-phase plants, caused either by a slightly unbalanced line or in certain cases by an unbalanced motor winding, which frequently can not be avoided if the motor is designed so as to be separable into two or more parts. The simplest way

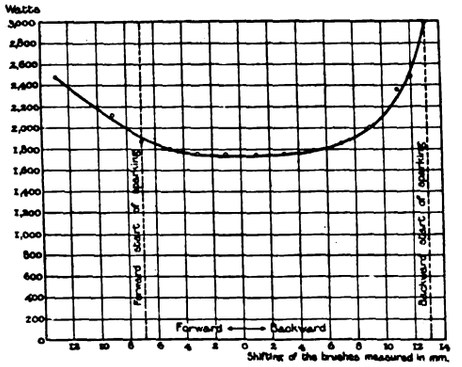


FIG. 9.—VARIATION OF MACHINE RUNNING AS A MOTOR WITH DIFFERENT SPARKLESS POSITION OF BRUSHES.

to obtain the power factor is by the two-wattmeter method. Slight inaccuracies of the wattmeters may be eliminated if necessary by interchanging them.

As a particularly good regulation is essential with transformers, it should not be obtained by reducing to a minimum the distance between the high and low-tension coils. In comparing transformers for a very high voltage the author prefers one with ample distance between the high and low-tension coils, even if the regulation is poorer. Apart from special cases, such as machines for electric furnaces or tramway machines to work in parallel with buffer batteries, the closer the range of the regulation of generators the better. The very small values, however, as a rule are not attainable, on account of the variation of the speed of prime movers. Furthermore, one must not lose sight of the fact that with direct-current dynamos and motors a too great degree of regulation might produce oscillations and fluctuations between machines working in parallel, and small variations of voltage will influence the amperes to a great extent.

The overload capacity for motors must be tested both as regards starting and running. In calculating the torque of alternating-current motors one must not lose sight of the fact that if the torque varies with the position of the rotor the user has to reckon with the lowest value.

For measuring the torque the most convenient method is perhaps to start against a spring balance attached to a rope passed over a pulley, and to allow the motor to choose a position, but more accurate results are obtained by adjusting a lever in different positions and allowing it to raise a weight.

The overload capacity of alternating-current motors is often ascertained in the simplest way by lowering the voltage until the motor ceases to run. In motors for pumps, fans, ventilators, and such-like, where a variation of the torque will never occur in actual service, it is this overload capacity (stability when the voltage falls) which is of chief importance to the user.

Machines, as a rule, are not intended to run with a continuous overload, though it may be important for them to be able to do so for a short time. According to the German regulations machines should, as a general rule, be tested with a twenty-five per cent overload for half an hour, and with forty per cent overload for three minutes.

It is perhaps enough if these prescribed conditions are fulfilled, and that the manufacturer should not be pressed to guarantee better results. In building up his machine, he should take all precautions to ensure that it works well under normal conditions, and should not risk impairing it in this respect by introducing an undue overload capacity.

No doubt a sparking machine is bad, but even if the machine under test does not spark, this does not mean that it is good. It often happens that a machine which runs, say, fairly well to-day will give trouble after some months of actual work. What is required, and what can not be checked by a mere test, is reliability. This reliability in the first place is guaranteed by the strength of the mechanical construction. A machine running under good mechanical conditions may give trouble if these conditions change through wear and tear, just as in testing the materials for a machine we must not lose sight of the fact that the electrical part, although important, is only a part, and that a machine to be good must be sound

Digitized by Google

both from an electrical and a mechanical point of view. It is needless to state that there exists a number of methods and instruments for testing a machine electrically, but it is rather more difficult to test the mechanical part. The simplicity and the exactitude of electrical measurements are important for the progress of the industry, but one is apt to overestimate the points which can be checked without difficulty, to the detriment of those which can be checked only by experience.

It is necessary to have certain standards by which to simplify and strengthen the manufacture in general. As far as necessary in the present paper, the author has followed the German standards, partly because they are familiar to him, and partly because he considers them good. A machine must fulfil certain requirements, otherwise it is bad. But if these requirements are exceeded, the degree of excess is not necessarily a criterion of the quality of the machine as a whole, nor even of its value in respect of any particular requirement which may be exceeded. A 500-volt, direct-current machine, which will stand a 3,000-volt insulation test, may not have so good an insulation as another which the manufacturer would trust with only 1,000 volts. For such a machine will never be called upon to stand 3,000 volts in service, whereas copper and coal dust and want of cleanliness in caring for the machine are conditions which are likely to occur. The fitness of the machine to withstand these may be guaranteed by a thoroughly well-considered design, based on experience as to what may prove the weakest point under bad circumstances. The same applies to sparkless running. If two new machines run sparklessly with a final test within the overload limits as given, say, by the German regulations, the experienced designer, in comparing them, will not ask if he can go ten per cent higher with A or thirty per cent higher with B, but he will ask how the sparkless running is obtained and definitely guaranteed.

If with B the sparkless running is due to a scrupulously accurate adjustment of the brushes, to the employment of only a certain quality of brush, or to the absolute truth and steady running of the bearings and a highly polished commutator, whereas if with A it is due to structural details, such as the use of compensation poles, ample dimensions of the cross connections and commutator, the designer will recognize in A a better machine in every way, and even a cheaper, though its price will naturally appear higher.

Efficiency as far as motors are concerned is very important in connection with a central station, where you have to pay a high price for power, but as regards generators this point is often overestimated. It does not pay to trouble about one-tenth of one per cent if it can not be checked with accuracy and if you are losing efficiency in your engine and boiler house. Insist upon efficiency in your boiler house and renounce a few tenths per cent of efficiency in your machine, if by this it can be improved as regards regulation, overload capacity or safety. For instance, we often decrease to a great extent the efficiency of low-tension, direct-current machines by increasing the number of brushes. With a lower number of brushes the machine would stand all that is required by the specification, and all that can be checked by the test, but we prefer a machine fitted with a greater number of brushes, as it will stand both an overload and bad attention. The latter is a very important point, as there is a great difference between a machine enduring a test under testing conditions and being able to withstand all irregularities which may happen in actual service, however strong and safe it may be in every respect. Features like this can only be guaranteed by good design based on ample experience, good selection and checking of the materials, and conscientious work in all matters connected with the tendering for and the construction and erection of the machine.

From the foregoing observations it is clear that one must not depend only upon measurements in order to form a due estimate of the capabilities of a machine; nor must one regard it as a better machine the better the values that are obtained.

Such theoretical calculations must always be supplemented by taking due account of the constructive details of the machine, and also of the experience gained from acquaintance with machines of similar construction and origin. Hence the importance of selecting the most suitable materials and of testing them in a practical manner. There is also another personal reason which has led the author to deal in this paper with the testing of materials on the one hand and the testing of machines on the other, namely, that he may be regarded as defending the interests of the consumer in the one case and those of the manufacturer in the other, and having come to the same conclusion from both points of view, this may serve to strengthen his arguments. Good factors can not be based on the amount by which the standard values are exceeded, but the practical points must be considered. Where accurate measurements are possible, such measurements should be made by all means; but at the same time the qualities which can not easily be gauged and are equally important must not be lost sight of. In all cases where measurements do not suffice one must take into account the workmanship, and, above all, make use of the experience obtained from similar objects based on the same lines.

Allis-Chalmers Steam Turbine and Generator in New Rochelle Station of Westchester Lighting Company.

The Westchester Lighting Company, serving a large residence and suburban section extending from Long Island Sound to the Hudson river and from the Borough of the Bronx to Tarrytown, has a modern central station plant at New Rochelle, a feature of which is an Allis-Chalmers steam-turbine generating unit now being installed. The electrical power generated here, supplying the towns and villages connected to the company's system, is three-phase, sixty cycles, 13,200 volts, and is used mainly for lighting purposes. The power-house is of steel and brick contruction, supplied with an equipment of six water-tube Sterling boilers, 250 horsepower each, in three batteries, and two Babcock & Wilcox boilers of 524 horsepower each, which furnish the steam power for the turbine and engine equipment. Coal is brought up the channel in barges to the company's docks, where it is hoisted and conveyed by automatic coal-handling devices to a bin of large capacity situated outside the power plant. Coal is conveyed from the bin to steel charging cars through chutes, the cars running on tracks directly to the furnace doors in the boiler room.

The main generating units are operated condensing, the reciprocating engines and the new Allis-Chalmers turbine being equipped with jet condensers. The condensing water is taken from Echo Bay through a large suction pipe which is connected through a continuous service foot valve. The 1,500 kilowatt Allis-Chalmers steam turbine unit is provided with an interesting condenser arrangement.

West Virginia Independent Telephone Association.

The annual meeting of the West Virginia Independent Telephone Association will be held at Wheeling, W. Va., in April next.

Digitized by Google

A Noteworthy Example of Modern Illuminating Engineering.

The artificial lighting of the engineering laboratories recently dedicated at the University of Pennsylvania affords an excellent example of the results obtained in that growing branch of the electrical art —illuminating engineering. Every room in this modern structure has been the subject of careful study from the lighting standpoint and as a result the new laboratory is without doubt the best lighted in the world.

Both arc and incandescent lamps have been combined to produce this result; arc lamps of the enclosed type with concentric diffusers being used for illuminating the larger areas while the Gem high-efficiency lamps with Holophane Pagoda shades, and ordinary incandescent lamps, used singly and in clusters, have been

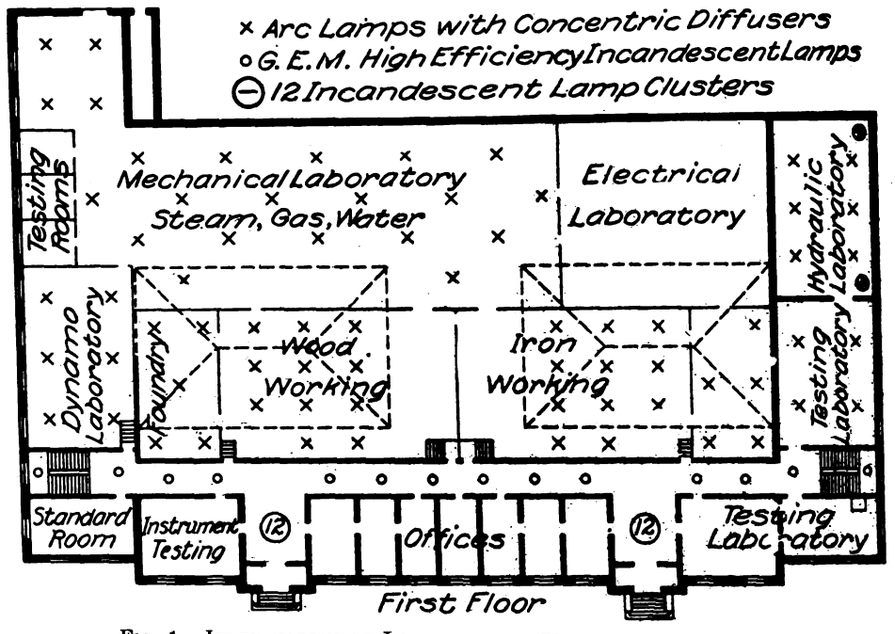


FIG. 1.—ILLUMINATION OF LABORATORIES, WORKSHOPS AND HALLWAY.

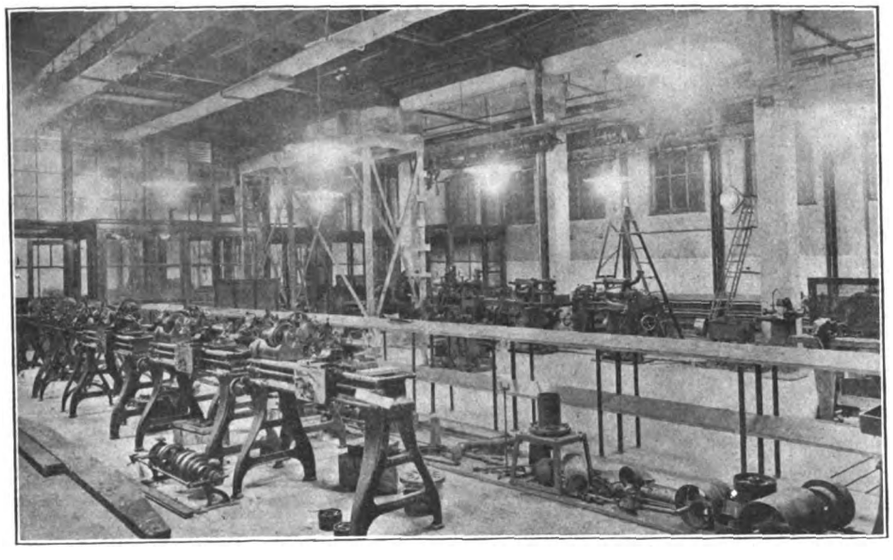


FIG. 2.—MACHINE SHOP.

adapted for lighting hallways, lecture rooms, etc. The lighting equipment was installed by the General Electric Company.

The new building, with basement and three stories of rooms having various lighting requirements, presents a nice problem for the illuminating engineer, and the installation because of this varied character is typical of modern lighting practice. Within the building are machine shops, drawing rooms, laboratories, offices, lecture rooms and library; each group exacting certain lighting values.

The basement, containing rooms for storage, lockers, etc., is lighted by ordinary incandescent lamps and requires no special mention. On the first floor, however, the illuminating plans are noteworthy. Here are located the principal mechanical and electrical laboratories and the shops, as well as various small laboratories and offices. The mechanical laboratory, with heavy machinery and wide-open spaces, requires a general, brilliant illumination with the light so diffused as to prevent shadows behind machines. For this purpose enclosed arc lamps have been installed of the type made by the General Electric Company, equipped with concentric diffusers. The diffuser consists of a circular sheet-iron reflector, in the form of a broad inverted cone, the white enamelled surface being corrugated in concentric circles, designed so as to distribute the light from the arc below to best illuminate the floor beneath.

In the wood-working, iron-working and forge shops, and in the dynamo, testing

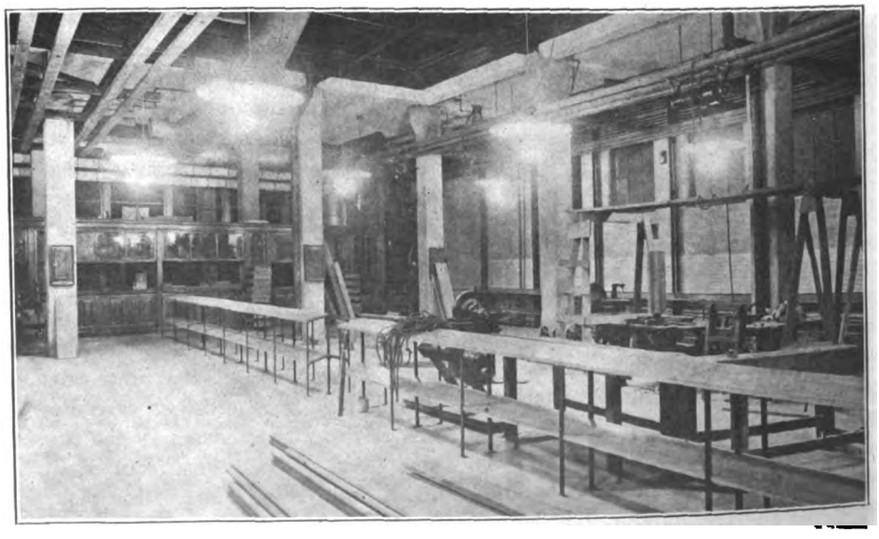


FIG. 3.—WOOD-WORKING SHOP.

Digitized by Google

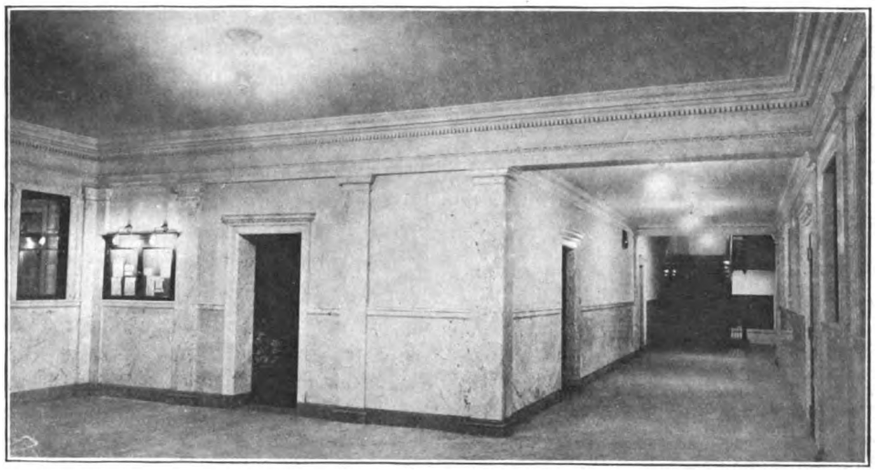


FIG. 4.—HALLWAY.

and hydraulic laboratories, on the first floor, conditions prevail similar to those obtaining in the mechanical laboratories. Arc lamps with concentric diffusers are therefore used, arranged as in Fig. 1. The excellence of this illumination can be seen in Figs. 2 and 3, which are reproduced from the original photographs taken by the light of the lamps. The absence of shadows and the even distribution of the light are particularly marked. Scattered incandescent lamps are available for lighting parts of machine and work.

The hallways form another problem in lighting which in this instance has been interestingly worked out by the use of high-efficiency incandescent units combined with a concentrating reflector. The units are of the No. 4 Gem type, utilizing 187 watts and concentrate 180 candlepower in a downward direction by means of No. 5 Holophane Pagoda reflectors. This method of lighting is well adapted to the long, comparatively narrow corridors, and the excellent results so obtained are indicated in Fig. 4.

In Figs. 5 and 6 are shown the lighting plans of the second and third floors, respectively. On these floors the draughting rooms present the most interesting feature. From the nature of the case, the illumination in these rooms must be the best—pure, brilliant and well-diffused—so that work can be done accurately by artificial light. The enclosed-arc lamp with concentric diffuser has been selected for this purpose with the result shown in Fig. 7. This illustration is also taken from a night photograph and the sharpness of the illumination obtained combined with the evenness of the distribution, is striking.

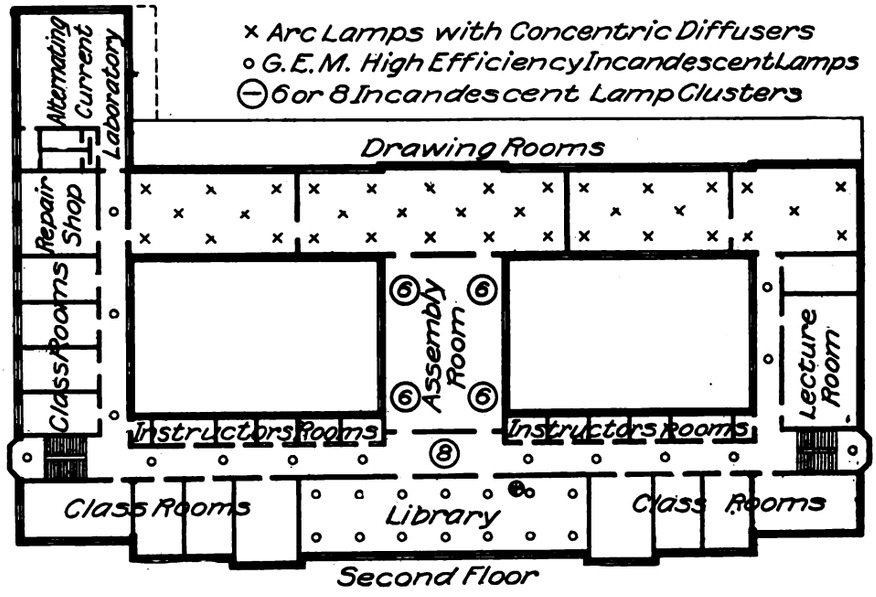


FIG. 5.—ILLUMINATION OF DRAUGHTING ROOMS, ASSEMBLY ROOM AND HALLWAY.

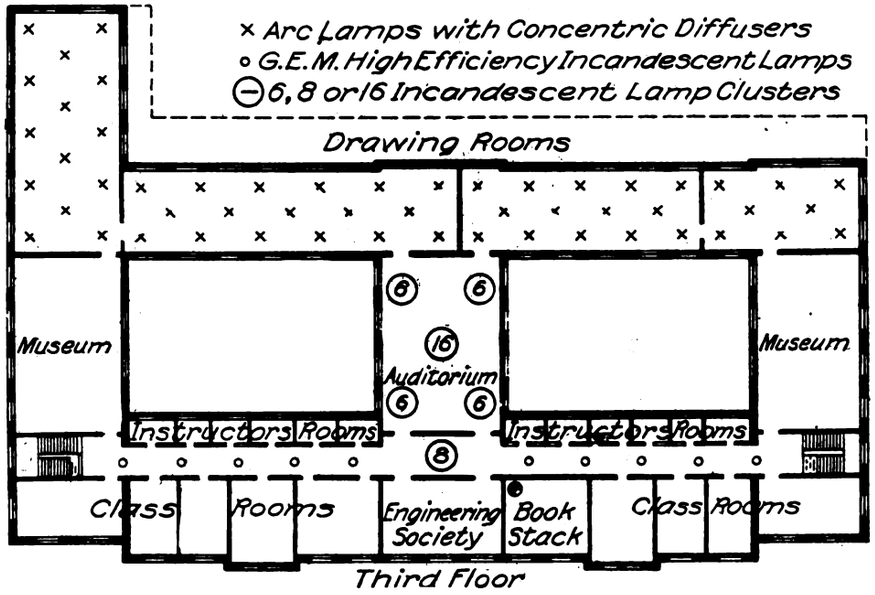


FIG. 6.—ILLUMINATION OF DRAUGHTING ROOMS, AUDITORIUM AND HALLWAY.

Aside from the drawing rooms, the rooms on the second and third floors incorporate other instructive features in illuminating engineering. The assembly room on the second floor is lighted by four six-light incandescent clusters, located as shown in Fig. 5. The illumination so produced is soft and even, the chief requirement being a soft general illumination which does not distract the eyes. The library on the same floor is lighted by Gem units, as are the halls on this floor and in the first story. The light here is stronger than in the assembly room, but at the same time is soft and well diffused and restful, quite in keeping with the purpose of the room.

On the third floor are the museums and auditorium, both lighted by incandescent lamps arranged in clusters. General il-

Digitized by Google

lumination is, of course, the chief requisite here. The hallway on this floor is lighted by Gem units. In order to make the comparison of illuminating value more convenient, the accompanying tables have been prepared showing the character and dimensions of the room, the unit of illumination and the watts per square foot. It will be seen that the drawing rooms require the greatest amount of light, averaging 2.65 watts per square foot, while the shops come next with an average of 1.8 watts per square foot of floor area. With these figures as a basis it would be quite possible to figure the amount of current necessary to light any building satisfactorily to meet different conditions, providing the floor area were known.

FIRST FLOOR.

Room.	Unit of Illumination.	Dimensions of Room.	Watts per Square Foot.
Mechanical laboratory	22 arc lamps with concentric diffusers	Main, 162′ x 63′ Bay, 37′ x 39′	1
Electrical laboratory	2 high-efficiency, 187-watt G.E.M. units, 94 16-candle-power incandescent lamps	72′ x 63′	1.22
Dynamo laboratory	6 arc lamps with concentric diffusers, 18 16-candle-power incandescent lamps	62′ x 38′	1.82
Workshops	52 arc lamps with concentric diffusers, 42 16-candle-power incandescent lamps	213′ x 51′	1.84
Hydraulic laboratory	6 arc lamps with concentric diffusers, 13 16-candle-power incandescent lamps	63′ x 38′	1.68
Testing laboratory	14 arc lamps with concentric diffusers, 11 16-candle-power incandescent lamps	46′ x 38′	1.6
Testing laboratory offices, standard room, etc.	84 16-candle-power incandescent lamps	6,300 sq. ft.	0.72
Corridors	14 high-efficiency, 187-watt G.E.M. units, 24 16-candle-power incandescent lamps	3,741 sq. ft.	1.05
	SECOND FLOOR.		
Drawing room	18 arc lamps with concentric diffusers	58′ x 31′	2.45
	14 arc lamps with concentric diffusers	93′ x 31′	2.68
	8 arc lamps with concentric diffusers	58′ x 31′	2.45
	5 arc lamps with concentric diffusers	46′ x 31′	1.92
Library	14 high-efficiency, 187-watt G.E.M. units	98′ x 28′	1
Assembly room	24 16-candle-power incandescent lamps	44′ x 63′	0.48
Corridors	12 high-efficiency, 187-watt G.E.M. units, 8 16-candle-power incandescent lamps	11′ x 300′	0.81
	THIRD FLOOR.		
Drawing room	14 arc lamps with concentric diffusers	87′ x 38′	2.33
	17 arc lamps with concentric diffusers	110′ x 31′	2.6
	13 arc lamps with concentric diffusers	80′ x 31′	2.88
	9 arc lamps with concentric diffusers	59′ x 31′	2.7
Museums	24 16-candle-power incandescent lamps	62′ x 39′	0.55
Auditorium	40 16-candle-power incandescent lamps	2,772 sq. ft.	0.8
Corridors	10 high-efficiency, 187-watt G.E.M. units, 8 16-candle-power incandescent lamps	11′ x 300′	0.7

Arc lamps five amperes, 110 volts direct current.

FIG. 7.—DRAUGHTING ROOM.

Importations of India Rubber.

The value of India rubber imported into the United States in the crude state in the year about to end will aggregate nearly or quite $50,000,000. If to this is added the value of old and scrap rubber intended for manufacture, the total for the calendar year 1906 will considerably exceed $50,000,000. In the ten months ending with October the imports of crude rubber were valued at $41,500,000, and as the imports for the single month of October were valued at $5,000,000, it seems probable that the total for the year will be over $50,000,000. The value of rubber imported in the calendar year 1896 was but $15,500,000, or less than one-third of the prospective total for the year 1906. In 1896 the average value per pound was forty-four and one-half cents. In 1906 the average value per pound was seventy-seven cents. It will be seen from these figures that the average import price of crude rubber has advanced seventy-three per cent during the last decade, due chiefly, it may be assumed, to the increased demand for rubber to be used in the manufacture of bicycles, automobiles and the various appliances required through the greatly increased use of electricity as applied to lighting, transportation and the manufacturing industries.

In addition to the importations of rubber in the crude state there were brought into the United States ending with October more than 18,000,000 pounds of old and scrap rubber for remanufacture, and 12,500,000 pounds of gutta joolatong, an article similar to rubber, which is mixed with India rubber for use in the various industries. In addition to this there were imported 326,053 pounds of gutta percha, used chiefly in the manufacture of submarine cables.

Brazil is the chief contributor to the India rubber supply of the United States, the quantity imported from that country in the ten months ending October amounting to 26,750,000 out of a total of 33,500,000 pounds. Other contributors are as follows: United Kingdom, from its different dependencies, 8,500,000 pounds; Germany, 3,000,000; other European countries, 7,000,000; Mexico, nearly 3,000,000; Central America, a little over 1,000,000; and the East Indies, over 2,000,000 pounds.

Digitized by Google

ELECTRIC LIGHTING PLANT FOR RIDGEFIELD, CONNECTICUT.

AN INTERESTING DESCRIPTION OF A SMALL CENTRAL STATION.

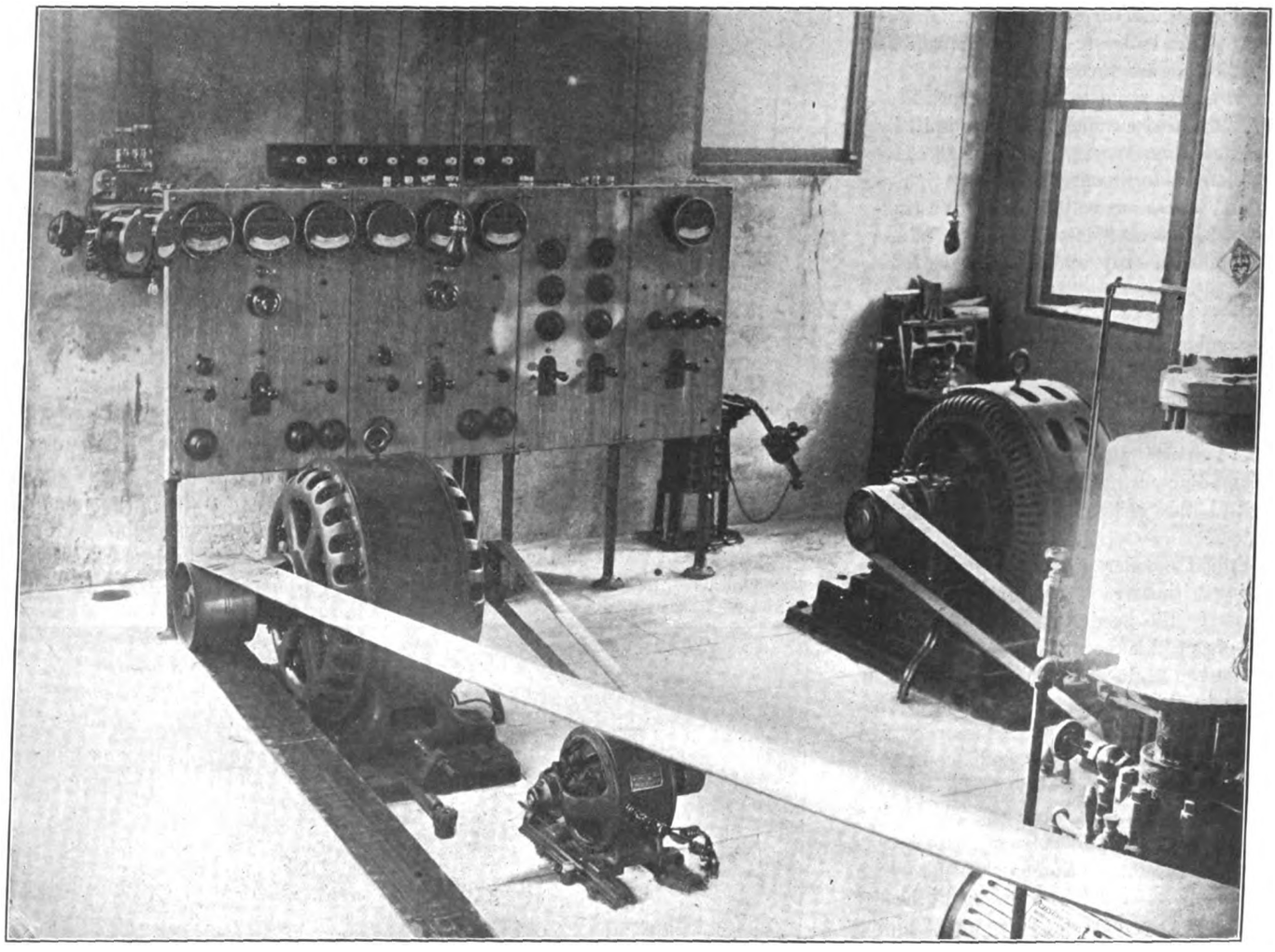
The establishment of an electric lighting plant for a town of only 500 inhabitants would seem to be almost a commercial absurdity, but as is frequently the case, statistics are no index of the earning capacity of a property. This problem, however, was presented in establishing an electric lighting plant in the Borough of Ridgefield, Ct., which has recently started operations with every indication of a successful commercial venture. The establishment of the plant was brought about by the demand for electric lighting for a summer colony composed mostly of wealthy New York business men who are settled in the hills surrounding the village.

The company was organized locally and all of the necessary capital obtained from the residents who desired electric lighting. The board of directors contains the names of some of New York's prominent business men, and the company was started under the most favorable auspices.

The site for the plant was selected with reference to obtaining coal from a railroad siding and water from a small brook on the property, and is located on the highway at the Ivy Crossing. About ten acres of land was purchased by the company to secure this site, giving them the opportunity to erect a dam for water storage purposes in case this should be required, and a house for the operator of the plant. As the site selected for the power-house is about twenty feet below the level of the main line, the siding which terminates in a trestle forms a gravity system for handling the coal from the cars to the level of the boiler-room floor.

The building decided upon was 70 by 27 by 18 feet in the clear, and is built of reenforced concrete, having a division wall between the engine and boiler room protected by fire-doors, and numerous windows make a light and airy power building. The concrete roof is protected from the weather by a substantial tar and gravel roofing, the gutters being made as part of the roof with cast-iron leader pipes.

The coal pocket is constructed of twelve-inch by twelve-inch yellow timbers, and has a capacity of 150 tons of coal. A concrete floor is used, and the roof is continuous except where necessary to open for the track; this part of the roof being protected by folding doors. The floors of the power-house are all concrete, and the company considers the building so nearly fireproof that no insurance is carried.



INTERIOR VIEW SHOWING SWITCHBOARD AND DYNAMOS—ELECTRIC LIGHTING PLANT, RIDGEFIELD, CT.

The boiler-room equipment consists of two 125-horse-power, 125-pound boilers built by the Ames Iron Works. These are set in battery with ample buck-stays and tie-rods both longitudinally and transverse. High grade fire-brick made by the Ostrander Fire Brick Company were used to line the entire fire-box. Immediately over the boilers a Siamese flue connection having dampers in each up-take and

Digitized by Google

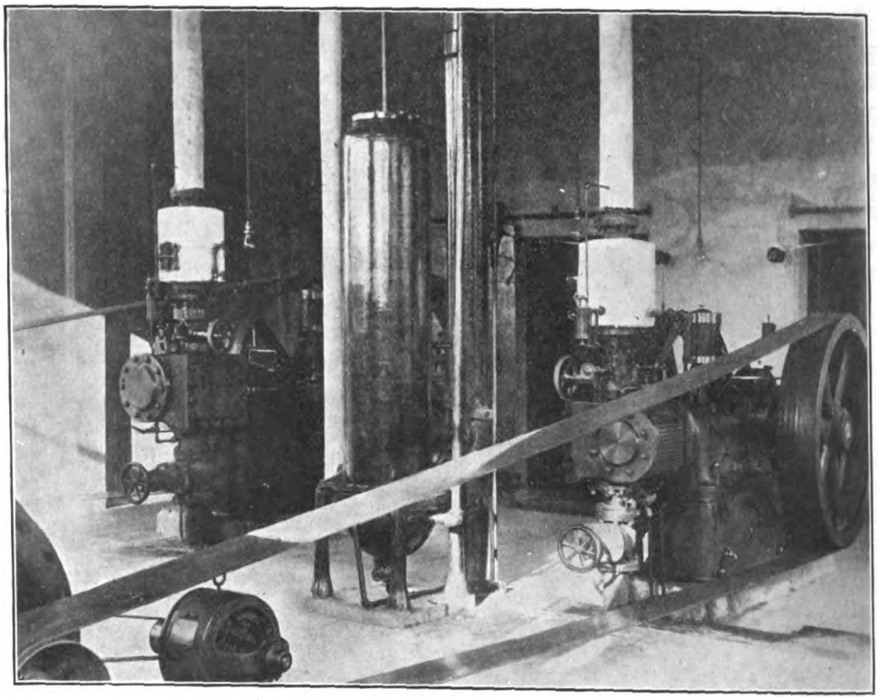
a main damper in the stack, connects with a ninety-foot steel-guyed stack forty-two inches in diameter. Thirty feet of this stack is made of one-quarter-inch plate and the balance of three-sixteenths-inch plate. It is fitted with a painter's trolley, and a guy-band up two-thirds of the height, the guys for which are carried to surrounding trees and rocks. A Keiley damper regulator is used for controlling the draught, and the water supply is secured by means of a steam-driven duplex boiler feed-pump made by the C. H. Wheeler Manufacturing Company. In addition to the boiler feed-pump, Metropolitan injectors are furnished.

The engine-room equipment consists of two high-speed automatic engines built by the Ames Iron Works, one rated at sixty-five horse-power, and one at 120 horse-power. These are belted to two Westinghouse 2,300-volt, sixty-cycle, three-phase generators of fifty and seventy-five kilowatts capacity, respectively, having belted exciters. A switchboard made by the Westinghouse Electric and Manufacturing Company having four panels controls the electrical output, and is fitted with the usual switches and indicating instruments. A reactance regulator made by the Adams-Bagnall Company is supplied to control the series incandescent lighting system.

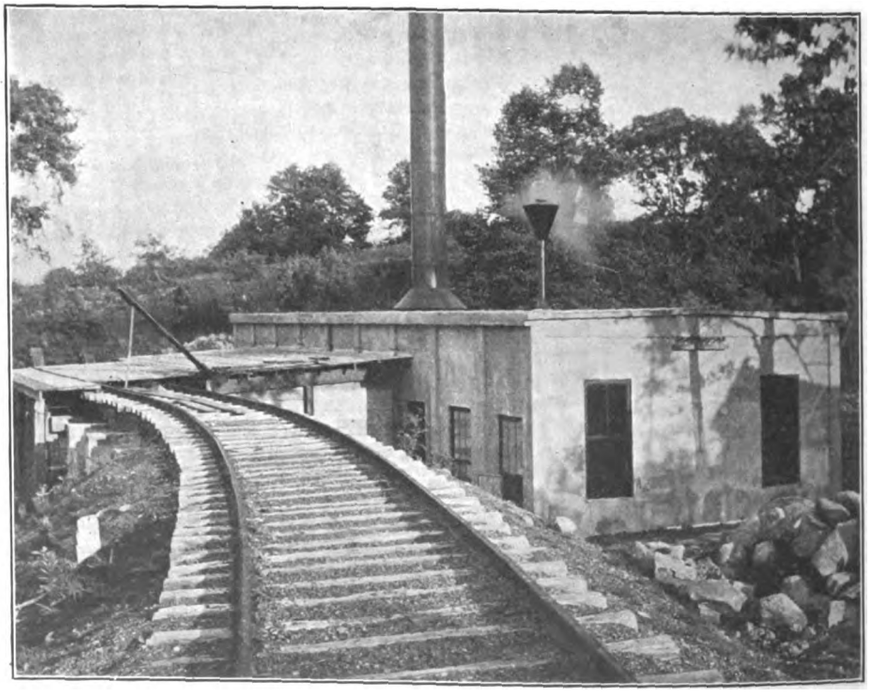
From the boiler outlets full weight steam piping with extra heavy flanges is carried across to the header in the boiler room, and from this header by separate pipes to the two engines. By means of a division valve in this header and the other valves in the piping either engine can receive steam from either boiler and one-half of the plant can be operated should an accident occur to the piping. The boiler feed-pump is supplied from a small auxiliary header under the main header which also acts as a drip to the main header controlled by a trap. The water piping is carried from the pump to the feed-water heater in the engine room and returned to the boiler through a feed and check valve. The injectors are inter-connected independent of the heater. The exhaust piping from the engines is carried to a duct under the floor covered by cast-iron plates and through a straight line of pipe to the roof where it is capped by a Patterson exhaust head. The heater is of the Patterson-Berryman type, used on the induction plan, and a valve is placed between it and the exhaust pipe to allow for cleaning. A liberal use of valves has been made so that different parts of the apparatus can be taken out for cleaning without disturbing the operation of the plant. All of the piping, valves and fittings are made by the Crane Company. The high-pressure piping has extra heavy fittings, made up with copper gaskets, and flanged valves are used for all sizes over three inches. The trap on the high-pressure drips is located in the extension of the exhaust-pipe duct at the lowest point in the system, and is connected to separators located directly over the engine throttles. These separators are of the vertical Patterson type, and are supplied with gauges and flanged fittings.

A tool chest having a supply of the necessary repair tools, and a Hall oil filter and an engineer's desk comprises the equipment of the engine room.

From the generators lead-covered cable in conduit is carried under the engine-room floor to the switchboard. From the switchboard terminals the circuit wires are carried directly against the rear wall of



ELECTRIC LIGHTING PLANT, RIDGEFIELD, CT.—SHOWING METHOD OF BRINGING STEAM PIPING TO ENGINES.



ELECTRIC LIGHTING PLANT, RIDGEFIELD, CT.—EXTERIOR VIEW SHOWING COAL-HANDLING SYSTEM.

Digitized by Google

the building to lightning arresters, and through porcelain tubes to the junction pole outside of the building. From this junction pole they are carried along the highway about a mile and a half to the main street of the village. From this point they divide and some are used for lighting and some for power supply to the Ridgefield Water Company for operating their pumping station.

The pole-line work consists of about ten miles of wooden poles thirty feet in length and seven-inch tops, set five feet in the ground, four-pin cross arms, with one-and-one-half-inch locust pins, and triple petticoated Brookfield glass insulators are used. These are held in place by two seven-inch lag-screws and twenty-inch galvanized iron braces. Along the main street twenty-five and thirty-foot iron poles are used. These poles have five-inch bases and were set five feet in the ground, surrounded by eighteen inches of concrete. They are fitted with four-pin malleable iron arms and neat tops, presenting a very attractive appearance on the main street where the wooden poles were considered objectionable.

No. 6 copper was carried for the lighting circuit to the centre of distribution and No. 8 copper was used for other connections. This copper was of Benedict & Burnham's KK brand triple braided, with a paraffine finish. The street lighting system consists of fifty twenty-five-candle-power incandescent lamps mounted on iron poles with one-and-one-half-inch pipe brackets. Copper hoods and porcelain reflectors are used. High-tension cut-out circuits made by the General Electric Company are provided to disconnect any lamp which may fail. The lamps themselves are of the Sawyer-Man type, having a rating of twenty-five candle-power at forty volts. House connections are made by step-down transformers located on the poles. A voltage of 113 at the lamp was selected in order to obtain the advantages of prompt shipment of lamps, as the demand for this particular voltage is not as extensive as either 110 or 115 volts. In all cases of customers, connected meters are installed. These are of the glass-case type, which were considered desirable so that the customer could observe its workings. All of the transformers and meters were supplied by the Westinghouse Electric and Manufacturing Company. At suitable points on the lines lightning arresters are erected, and on all sharp turns and end poles guy wires are placed.

The electrical equipment of the pumping station consists of two thirty-five-horse-power motors geared to triplex single-acting pumps. The motors are operated at 220 volts, and two banks of three transformers each are supported on poles outside of the building and connected to the motors through high-tension switches and meters. The high-tension switches were used so that there would be no transformer loss, except when the pumps were in operation. The pumps are operated against a head of 185 feet, and the motors are of the General Electric type L make, which has a starting resistance in the armature controlled by a lever. They bring the pumps up to speed without serious jar to the distributing system.

Owing to the high class of the installation and the objection by the residents to trimming any of the trees it was necessary in numerous cases to cross the highway in order to avoid tree-trimming. All the refuse from the holes dug for the poles was required to be carted away and the grounds around the power-house were graded and sodded, giving the whole a finished appearance. A neat house for the operator of the plant has been erected near the power-house, as there were no other available dwellings.

Everything was done to make the plant as efficient in its operation as possible, and the arrangement of the machinery was made with this end in view, so that one man operates the plant without difficulty and with minimum labor.

The plant was designed by and installed under the supervision of E. R. Knowles, of New York, as consulting engineer, and Bellman & Sanford executed the complete contract, which included the building, the machinery, pole-lines, transformers and meters; everything complete and ready to operate from the coal-pile to the customer's wiring.

Gas Turbines.

The difficulties confronting those inventors endeavoring to develop a practical gas turbine have been discussed by Frank Foster. The first problem is that of providing an efficient air-compressor. Reciprocating compressors are more efficient than centrifugal compressors, but if they are adopted one of the main advantages of the gas turbine—the absence of crank shafts and reciprocating parts—is lost. From the purely mechanical point of view the ideal arrangement consists of a compressor of turbine construction mounted on the same shaft as the gas turbine to which it belongs; but such an arrangement has a low efficiency—probably not more than fifty per cent in the case of the compressor. If several stages in the compressor are adopted a higher pressure may be obtained, thus increasing the initial combustion and the available work. But the increase in negative work is also much greater. For instance, by increasing the work spent on the compressor by 100 per cent there is a gain of only one and one-half per cent in useful work. These figures, of course, depend a good deal upon the particular conditions adopted. From these considerations alone it is seen that, assuming all chemical and physical difficulties to be overcome, the outlook for the gas turbine is not bright, and is particularly poor when the equipment includes a turbo-compressor. The next problem consists in devising a combustion chamber which will withstand continuously high temperatures and pressures. It is this continuity which makes these high temperatures difficult to handle. In reciprocating internal-combustion engines the high temperatures are only periodic, and as a result the combustion chamber never attains a very high temperature. For the turbine combustion chamber fire clay is unsuitable. Magnesia and kieselguhr are superior to fire brick, carborundum and sand, but both of these materials deteriorate with time and shrink largely. Carborundum is considered to be the most suitable material for linings. Various engineers who have attacked this problem have used this material as an inner lining, surrrounding it with magnesia or some other material. In this way the relative expansions of the shell and the inner carborundum lining are provided for. It is said that such an arrangement has been used satisfactorily with continuous temperatures of about 3,200 degrees Fahrenheit, and is thought to be capable of withstanding temperatures of 5,000 degrees Fahrenheit. It is necessary to reduce the temperature of the gases before they are admitted to the turbine. To do this it is customary to mix them with steam. Cold air might be used, and would be more efficient were it not for the difficulty of compressing the air.

Authorities differ in their ideas of the maximum practical temperature to be allowed in the turbine. Neilson estimates 1,300 degrees Fahrenheit; Sekutowiez computes the maximum temperature at 800 degrees, and Rey at 600 degrees Fahrenheit. Atkinson has stated that any metal with iron in its composition commences to oxidize at 750 degrees. At present it seems that 600 or 700 degrees Fahrenheit is the practical limit of continuous temperature. However, a small DeLaval turbine has been used as a gas turbine with gas temperatures before and after reaching the nozzle of 3,270 and 750 degrees Fahrenheit, respectively. At present our knowledge is insufficient regarding the flow of gases at high temperatures to enable us to design nozzles precisely.—*The Mechanical Engineer (London), December* 8.

Digitized by Google

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Protective Apparatus for Wireless-Control Systems.

Edouard Branly has been developing a system of controlling mechanisms at a distance by means of electric waves and has found a necessity for devising a method of protecting the apparatus from atmospheric discharges or other foreign influences. This device depends upon the rotation at a constant speed of a contact-maker on the device controlled. This consists of an insulated wheel carrying upon its surface two or more pairs of electrical contacts placed opposite each other. Two brushes bear upon the wheel so as to complete a circuit each time a pair of contacts passes under them. The contacts may be spaced upon the periphery in different ways, but the arrangement adopted must agree with that of a similar apparatus at the controlling station. This contact wheel revolves at a slow speed, carrying with it a cam. The method of control depends upon the complete revolution of the contact-maker before the local circuit governing any of the controlling devices upon the apparatus is closed. It operates in this way: A single discharge sent out from the controlled station starts the contact-maker on the receiver into rotation. The speed is slow—about one revolution in twenty seconds. If, when the following pair of contacts is under the brushes, a second impulse is not received, the contact-maker is at once checked and returned to the first position. Similarly, if, as the third and fourth pairs of contacts, etc., pass under the brushes, electrical impulses are not received, the device will be turned back to the starting point. In this way a complex signal is required to cause the contact-maker to make a complete revolution, and thus bring into action the local controlling mechanisms. If foreign signals get in they act simply to start the contact-maker through the first or possibly second stages of its rotation, and it is very improbable that any such disturbances would cause the device to complete a rotation. The correct system of signals is easily sent out from the control station by the rotation of a similar contact-maker.—*Translated and abstracted from L'Électricien (Paris), December* 8.

The Metallic Arc.

An elaborate study of newer forms of arc lamps has been made by Isador Ladoff. He here discusses the so-called metallic arc, particular reference being made to the magnetite arc. Usually the magnetite electrode of this lamp is made by packing a thin iron tube with a mixture containing twenty-five per cent of titanic acid, five per cent of chromate of iron, a little potassium fluoride, the balance being black oxide of iron. The tube serves not only as the container for the battery, but as a conductor, because the battery has a high resistance. One difficulty of this construction is due to the non-homogeneity of the mixture, which causes the arc to vary and fluctuate, and makes it impossible to secure a perfectly uniform color. To get over these difficulties the chemical composition of the electrode should be homogeneous, and it should be compact and a conductor itself. Unfortunately, magnetite is a relatively poor conductor and gives an arc of low intensity. It contains impurities which are difficult to get out, and which affect the arc deleteriously. There is also an oxidation which takes place during operation, which lowers the luminous intensity of the arc. Titanic acid is also a poor conductor. This is the only material which is desirable in the electrode for the production of light, but, unfortunately, it can not be used alone on account of its very high resistivity. For this reason the amount of material which one can cause to pass into the arc is limited, and thus the intensity of the arc is relatively low. Carbide of titanium can not be employed, because it decomposes in the arc and does not give much light. In constructing these electrodes titanium is wanted because of its rich spectrum. The chromate of iron is used to increase the life of the electrode, while the potassium fluoride makes the arc more stable. In an endeavor to produce an electrode giving better results, electrodes have been made of various oxides, which were then reduced. It is not advisable to use more than ten parts of the oxide of titanium; otherwise the arc becomes unstable. The proportions adopted were eighty parts of magnetite, twenty parts of hematite, and seven to eight parts of titanic oxide. The ingredients were finally pulverized and a mixture made with water and glycerine. From this paste electrodes were pressed out, dried and baked at 500 degrees. They were then carried to 1,200 or 1,300 degrees in a gas furnace. It was found that a slight addition of boric acid seemed to increase the life of the electrodes, but reduced the luminous intensity. Greater stability of the arc was obtained by adding various salts of potassium. The resistance of these electrodes was very high, varying from 45,000 to 600,000 ohms. This could be reduced to a few ohms by covering it with a coating of graphite. Results are given of a number of experiments made with these electrodes; also with electrodes formed of a mixture of the oxides and of homogeneous carbon. The ferro-titanium electrode produced by the process just described gave in all cases much better results than either of the other two. A three-and-one-half-ampere, fifty-volt arc using a ferro-titanium electrode, gave 510 mean spherical candles. The titanium oxide electrode gave 283, while the carbon gave eighty-four. The watts per candle were approximately 0.6, 0.7, and 2.5, respectively. The voltages for the three arcs were 48.3, fifty-five and fifty-nine. The life of the ferro-titanium electrode was one hour and thirty-two minutes per centimetre; that of the titanium oxide electrode, one hour and thirty-six minutes, and that of the carbon electrode, one hour and seven minutes. A lamp taking 6.6 amperes gave for the same electrodes 968, 737 and 243 mean spherical candles, relatively; while a 9.6-ampere lamp gave for the ferro-titanium, 1,136 mean spherical candles, and for the carbon, 485. The titanium oxide electrode fused with this current and could not be employed. Distribution curves are given for the three types of electrodes. Those using the titanium electrode throw out a considerable part of the light in a horizontal zone.—*Translated and abstracted from L'Éclairage Électrique (Paris), December* 8.

A Special Potentiometer for the Standardizing Laboratory.

A potentiometer having special features, and designed particularly for a standardizing laboratory, is described here by H. B. Taylor. As this potentiometer is to be used in Pittsburg, where the air is very

Digitized by Google

damp and is never clean, extra insulation is necessary, which is obtained by covering up all metal parts except where mounted on the top of the case. All extra parts are arranged to admit of easy cleaning. Each metal terminal is mounted on a separate hard-rubber base three-tenths of an inch high, which fits closely to the rubber top of the potentiometer box. They are cemented to the top by white shellac, and the metal parts are separated by an air space of one-quarter of an inch, so that the surface distance between them is 0.87 inch. Where special protection is needed within the box the wires and coils are provided with hard-rubber washers. Nearly all inside connections were made of bare wire of a size large enough to stay rigidly in position without any other support. After all connections had been made, all parts were given several coats of white shellac. The customary method of construction, which uses an odd number of ohms, corresponding to the odd voltage of the standardizing cell, was adopted. That used is a Weston standard cell with an electromotive force of 1.0198 volts. The resistance across which it is connected is 10,198 ohms. Special adjustment was made by means of a coil containing 198 ohms, but this is easily changed when it becomes desirable to use any other standard cell. The potentiometer coils are arranged in five straight rows, and the connections are brought out to brass terminals at the top. The movable contacts are mounted on hard-rubber blocks, which slide along the top of the brass contact pieces. A transverse slot in the lower part of each block serves to increase the surface distance between brushes about one inch. Clips are provided which guide the blocks and also indicate the points where contacts are being made. A diagram of the connections is given. For the sake of simplicity in operation, as well as to promote insulation, two sets of keys are used, or two keys with a two-way switch.—*Abstracted from the Electric Journal (Pittsburg), December.*

The Snowdon Hydroelectric Installation of the North Wales Power and Traction Company, Limited.

A description is given here of an interesting hydroelectric system in North Wales which supplies power to a number of industries and which is expected to build up other new ones. The plan originated from a holiday tour of a well-known engineer, who was impressed by the potential possibilities of two small lakes, Glas-Lyn and Lynn-Llydaw, situated about halfway up the eastern side of Snowdon. The scheme utilizes the 1,100-foot drop from these lakes into the valley below, where a power-house has been built and a system of high-tension transmission passing over the mountains to supply energy to the large slate quarries for which Wales is famous. Further, an electric railway is now nearing completion, and electric lighting systems are being put in, all of which will be supplied with power from the new plant. The water is drawn from Lynn-Llydaw, from which a pipe line descends to the power-house. This lake occupies a declivity on the mountain side. The lake has a surface of 120 acres, and is approximately 1,400 feet above sea level. The intake works consist of a six-foot tunnel a few hundred feet long, piercing the rocky margin of the lake. This terminates in a duplicate pipe line. The inlet to the tunnel is thirty feet below the lake surface, and is controlled by sluice valves. The pipe line is about one and one-quarter miles in length and gives an effective head of 1,140 feet. The descent is steep and is at an angle of forty-five degrees just above the power-house. The two pipe lines taper from thirty inches at the top to twenty-seven inches in diameter at the bottom. At the upper portion riveted steel pipe is used; at the lower portion the pipe is welded. The pipes are in eighteen-foot lengths, laid on wood sleepers and carefully anchored to concrete blocks. Measured distances have been laid out, providing fixed points which will enable any movement of the pipe to be detected. Either of the two lines would supply the normal output of the station, and there is sufficient reserve in the lake to run the station for 180 days without any rain whatever. The average rainfall is about 200 inches. At present there are four 1,500-horse-power twin-impulse turbines coupled direct to three-phase, 1,500-kilowatt-ampere, 10,000-volt, fifty-cycle generators. The water pressure due to the head is about 500 pounds to the square inch. The discharge from this gave trouble at first, but was finally taken care of by causing it to fall into a pool of water. The wheels are regulated by hydraulic governors acting upon needle nozzles. The alternators have twelve poles and are of the revolving field type. The rotating parts are supported on three bearings. There is a generator switchboard containing the control apparatus and the instruments for the generators. A feeder board, consisting of ten panels, controls the output of the station. The conductors back of the board are of bare copper wire carried on porcelain insulators. Oil switches are used, and each line is protected by a choking coil and a horn lightning arrester. In addition there are permanent water-type, excess-pressure discharges installed at each end of the switch room, which connect to the bus-bars. The attendants are protected by wooden platforms mounted on porcelain insulators. The station is at present lighted by a step-down transformer, but it is the intention to put in a small direct-current lighting unit for this purpose. The high-tension lines pass out from the station through inclined ports, where they are supported on porcelain leading-in insulators fixed in paraffined wood partitions. There are twenty-six miles of transmission line already up. Various pole-line constructions have been adopted in carrying out the work. For the most part creosoted wooden poles are used, sunk six feet in concrete and spaced about forty to the mile. The wires are placed two feet apart and supported on triple-petticoat insulators. They are carried on cross-arms in the usual triangular arrangement. At certain points where the line is heavy A poles have been erected, supporting the cross-arms. In other places two vertical poles are used, carrying at the top several cross-arms. A lattice pole construction has been used at one point, while for certain lines a single pole is employed with the insulators arranged vertically on one side. A good deal of difficulty was met in constructing the transmission line, due to the rough country, and to much boggy ground. The most important users of this power at present are the quarries, one of which takes nearly 2,000 horse-power. This mine employs five 200-horse-power motors, which replaced steam engines for drawing slate up the inclined shafts. There are two 150-horse-power motors driving an air compressor and a pump. These industries are supplied with power through local transformer substations.—*Abstracted from the Electrical Review (London), December 7.*

Gift to Union College.

President Andrew V. V. Raymond, of Union College, Schenectady, N. Y., announced, on December 13, at the nineteenth annual dinner of the Alumni Association, that the college had received a gift of $25,000 from the General Electric Company, and that only $20,000 more is necessary to secure Andrew Carnegie's gift of $100,000.

The dinner was held at the Hotel Manhattan, New York city. Among the guests of honor were Dr. Henry M. Leipziger, Samuel R. Thayer, Charles E. Patterson, the Rev. Dr. T. S. Hamlin, Cornelius E. Franklin, the Rev. Dr. Samuel S. Seward, Andrew W. Gleason and Eli Perkins.

Digitized by Google

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

ADVERTISING ELECTRICITY.—IV. ADVERTISEMENT WRITING.

BY FRANK B. RAE, JR.

CLEVERNESS IN ADVERTISING.

A few years ago writers of advertising won their reputations on the basis of what was known as "cleverness." Cleverness, in an advertising sense, seems to have meant facility in turning the English language inside out. The ability to unearth and employ astonishing and unexpected adjectives and otherwise to reduce the methods of the street fakir to cold type, was at that time equivalent to advertising ability. Fortunately the era of advertising insanity has passed, but the straining for wordy cleverness still continues to a greater or lesser degree. Even to-day the writer of advertising is looked upon by the staid, cold-blooded business man, as a vendor of "hot air," whose printed productions have been neatly characterized by one man high up in the lamp industry as "verbiage and phraseology."

Let the student of advertising at once dispossess his mind of the idea that such superficial cleverness plays any solid part in truly successful and permanent publicity. While it must be acknowledged that an occasional happy phrase has been known to win a wide approval, the proportion of clever advertisements which have proven effective is so small as to discourage the judicious writer from attempting them. Thus, several years ago, "Uneeda" biscuit, an altogether first-class product, packed in a new and extremely practical manner, appeared and was widely adveristised. The name was one of the cleverest conceits over devised and this, combined with a good product, has made it one of the great advertising triumphs. Following this success, there appeared by the thousand, similar suggestive trade names attached to an infinite variety of merchandise. Practically every one of them has been an advertising failure, regardless of the quality of the product. The reader can supply many instances of the same sort, all pointing to this truth, that cleverness is the most dangerous element in advertising.

The advertiser of electricity will immediately protest that his product is not one which lends itself to the sort of advertising suggested, but as he has only to glance over a good variety of printed publicity as put out by central stations to realize that the struggle for cleverness is not ended and that only in the most exceptional cases does such cleverness stand the acid test of disinterested reading.

PRINCIPLES OF ADVERTISEMENT WRITING.

The underlying principles of advertisement writing are not at all difficult of understanding, but the practice of these principles is a matter worthy of life-long effort. We may sum up the cardinal points thus:

Limitations: An advertisement should be written within certain well-defined limits; it should aim to make one or several points only; it should not evaporate in glittering generalities nor become ponderous with a superabundance of facts.

Simplicity: The best educated among readers will appreciate, and the most wholly ignorant will understand, a plain, simple statement of facts; no part of an advertisement should require a second reading, nor should there be a single word or phrase, the meaning of which is not instantly apparent to all.

Sincerity: The one virtue which must absolutely characterize every advertisement is that of honesty, and this honesty must be not alone basic, but it must be almost aggressively apparent. Superficiality in advertising, as in personal conversation, suggests insincerity, and any suggestion of insincerity is liable to immediately develop into actual misstatement in the eyes of the cursory reader.

Interest: It is obviously necessary to catch and hold the reader's interest with every statement. This does not mean that the advertisement must be "different," but that it must be written from the reader's viewpoint in such a manner as to appeal to him as something of particular and personal concern.

These are the principles: Each may be subdivided many times and each subdivision, to the very smallest, is worthy of the most minute attention. For example, under the heading "Interest," may be considered the question of illustration and embellishment, which itself is a matter so broad and so difficult to handle, that one New York specialist receives $15,000 per year for his knowledge and ability to properly "dress" advertisements.

THE WRITING OF CIRCULAR LETTERS.

The circular letter, as an effective medium of advertising, is without a peer. If a circular letter be prepared with sufficient skill, it will reach the man addressed—that is the secret of its power. But if it is not well prepared it will not only find the waste basket quicker than almost any other form of advertisement, but will engender a feeling of resentment in the addressee. Thus we pit the writer's and the printer's skill against the busy man's scrutiny and disinclination to read a business solicitation.

In preparing a circular letter the first and most difficult problem is that of gaining a hearing. We must frame our opening paragraph in such wise that the reader will not instinctively assume an unfavorable or defensive attitude. We must have plausible reasons for approaching the reader at all, and this reason must bear closely upon his personal interest. To say "We desire to interest you in an electric sign" is fatal, because, before one can hope to interest a man in an electric sign, the matter must be brought to his attention in such a manner that the interest will appear voluntary on his part. We must, so the saying is, "reach him on his blind side."

Having opened the subject, a paragraph or two is used to present the advantages of the proposition in hand, again not from your viewpoint, but from his. What will an electric sign actually net the man who uses it? Answer that question, not in glittering generalities, but in terse, crisp statements, the logic of which can not be disputed.

Having shown the advantages of the sign as a profitable investment, bring up the matter of price, appearing to offer an exceptional value either for the service or in the sign. Show your prospective customer that a sign is advertising, not store expense, without dodging issues. Keep away from the fact that the sign will increase his electric light bill—even show him that it will reduce his store lighting bill by increasing his hours of burning or kilowatt consumption, thus entitling him to lower rates or larger discounts for regular service. It must be

Digitized by Google

kept in mind always that nobody ever wants to spend money for anything. The prospect must be led to this matter of cost in the gentlest and most diplomatic way.

In enclosing a circular letter we must remember that the object of all advertising is to get results—inquiries—orders. Insist gently but firmly upon the reader giving this matter immediate thought and early action. Try; if possible, to make some sort of special offer, which he must accept at once or risk paying a higher price, as penalty for procrastination. Invariably there should be enclosed a postal card for reply. Be inflexible in urging the prospect to return it. Point out that a discussion with your solicitor costs him nothing. In writing the ad-man must picture himself as being in the prospective customer's presence, personally soliciting his signature to that card. Concentrate every fibre of your being upon this most important point—his signing that card to-day—now—this minute.

Where circular letters are used in series it is advisable to write the entire campaign in advance. In fact, it is almost impossible to secure maximum returns when the letters are prepared piecemeal and as necessity demands. Not alone is each succeeding letter likely to be written more hastily and therefore less forcefully than if all are prepared at one time, but the continuity of thought, the logical succession and sequence of argument is partially lost.

THE WRITING OF BOOKLETS.

The advertising booklet should be designed with several distinctive points in mind and these should limit both its size and literary form. The booklet is designed to present to presumably interested parties, information which they may desire in available form for reference or study.

With this idea in mind it must be apparent that the booklet may properly disregard some or all of the cardinal laws which govern other forms of advertising composition. It does not require the clever introduction, the hidden reference to price nor the insistence upon immediate action which must characterize the circular letter. Rather it should be an exposition of the subject treated, covering all necessary points and depending for results upon the fairness of the proposition offered as it appears to the reader after a careful consideration and mature reflection.

Obviously, advertising booklets should be clear cut, simple and as interesting as the subject and the ingenuity of the writer will permit. The chief struggle should be to avoid wordiness and to present the proposition always with the idea that the reader knows absolutely nothing about it and that every statement must be self-evident or supported by corroborative evidence.

At the same time it must be remembered that the reader has probably not the vital interest and undying enthusiasm of the writer, and effort should at all times be put forth to sustain attention by whatever sane device may be available. The most common of these is pictures, which it is well to use almost lavishly.

A practical plan to adopt in undertaking an advertising booklet is, first to secure from the printer a dummy (a booklet of blank pages) of the size and shape which it is intended the finished work shall be. Go over this carefully, laying out the various pages, allotting space to illustrations and preparing the booklet, in the mind's eye, exactly as it shall appear when finished. One is thus able to divide the subject under such headings and in such order as will make the finished work logically convincing and carry the reader from a cursory consideration of the subject to a determination to buy the product offered. Around such a schedule and dummy, and proceeding in such logical manner, one can not go far astray.

NEWSPAPER ADVERTISING.

Where local conditions make newspaper advertising seem, in the nature of things, to be advisable—and politics alone may make it advisable to use such space—too much care can not be given to the subject of copy. Newspapers are read hurriedly. Newspaper copy, therefore, must be built upon the "one idea" plan, embracing just enough elaboration to present the one idea fully and forcibly. If clear cut, attractive illustrations are available, they should be used, but the advertiser must bear constantly in mind the high speed of newspaper presses and the poor quality of paper used and make his designs fit these conditions. Advertising illustrations are intended solely to draw attention to, or shed light upon, the advertisement. Anything which is not self-explanatory at first glance is bad.

The catch-line of the newspaper advertisement is, naturally enough, its most salient feature. It is also its most dangerous feature. To acquire proficiency in handling catch-lines, it is not well to study advertisements, but to study the head-lines of the newspapers. Metropolitan newspapers employ specialists who do practically nothing else than write head-lines, and the demand for such men it is said always exceeds the supply. The principle involved in head-line writing apply with double force to the writing of advertisement catch-lines. What is the vital point of the story? What half-dozen or less words will best explain this point and lead the casual reader to stay his hurried glance? Let us analyze for a moment: If a head-line says "Murder," we are startled perhaps, but for a second only, because murders, after all are common enough. But if the head-line says "Murder on Broadway," we immediately picture in our mind an act of violence upon a crowded thoroughfare with which we are personally familiar. From an abstract news report, this item becomes one of personal concern and we pause for further information. We read on and the head-line writer's work is accomplished. Exactly these principles apply to the writing of advertisement catch-lines. First we must attract attention, and then make that attention a matter of personal interest to the reader.

For the rest, a newspaper advertisement should properly stick to one idea on one subject. Where a variety of subjects are treated as in department store advertising, it will be noted that they are treated practically as many small advertisements. For us, one idea, and let it be expressed in words of one syllable, in good sized type and in such style of display as will render it both distinctive and readable.

Finally, in the preparation of newspaper advertising it must be borne in mind by the central station ad-writer that although one portion of the public reads small-type department store and unattractive patent medicine advertisements with avidity, that is not the portion of the public which the central station is addressing.

BILL-BOARD AND CAR CARDS COPY.

Until recently it was not considered important to give any thought to the material used in bill-board advertising, and therefore such advertising, at least so far as concerns electric light companies seem to have consisted chiefly in certain inept catch phrases borrowed from gas companies, coupled with an wholly inordinate use of the Edison trade-mark. Since bill-boards are erected and painted for publicity purposes, it is as well to cover the space with something of advertising value. The writer recalls just one central station's sign boards which appeared to be worth the paint used to cover it, these being the boards erected by the Dayton Lighting Company and reading "Electric Light and Electric Power cheap anywhere in Dayton." A multiplicity

Digitized by Google

these boards strewn along the lines of the conduit excavation and at strategic points in the city served to spread in effective fashion the company's message that almost anybody anywhere in Dayton could get electric light and power cheap. This example will probably better serve as a guide for preparation of sign-board advertising than a column of "don'ts."

In connection with the car cards it is well for the advertiser to remember that most people are near-sighted and the cards so placed that when the light is good it is a little harder to see them than when the light is poor. Therefore, they should be simple, clean-cut—direct. Several colors should be employed, but if illustrations are used, they should be pretty broad wood-cuts, or line etchings done in poster style. The type should be plain and of good size. The cards should be changed often enough so that the traveling public does not turn in weariness from the old arguments.

IN GENERAL.

The gravest danger of the amateur writer of advertisements lies in his inability to rightly and rigidly judge of his own product. Contrary to popular belief, it is no easy job to write advertising, and the talent for it is no more common than is the talent for other serious literary composition. It is infinitely more easy to produce a short story worthy of publication in one of the standard monthlies than to produce a series of half-dozen circular letters. It takes no whit less of genius to create an effective campaign than is demanded to grind out a tolerable novel. An appreciation of this truth will lead the student of advertising to consider his work, not as something to be done in an idle moment, when he "has the time," but a labor worthy of his most serious, earnest and concentrated endeavors.

The writer of advertising is a salesman, talking, not to one prospective customer, but to thousands. A careless salesman may antagonize a single prospect without very serious consequences. The careless advertising man may antagonize the entire population of his city.

The privilege to speak to a multitude is one not to be trusted blindly to the clever word-monger; one not to be undertaken lightly by an unpracticed man whose duties already occupy him. The writing of advertising is a serious business, and is worthy of serious study.

The fifty-seventh convention of the American Association for the Advancement of Science opened in New York city at Earl Hall, Columbia University, on December 27, and will end on January 2. Dr. Nicholas Murray Butler, president of Columbia, delivered the address of welcome.

Arthur Vaughn Abbott.

Mr. Arthur Vaughn Abbott died of pneumonia at St. Luke's Hospital, New York city, December 1, 1906. His death marks the passing of an experienced engineer, an able writer and a widely esteemed man. To those who knew him through daily contact, as also to all who love a useful, earnest and well-ordered life, this simple account of his many broad activities is given. He came of a family that has contributed much to the world. His grandfather was Jacob Abbott, one time professor of mathematics at Amherst College, and author of "Young Christians," "Science for the Young" and the "Rollo Books." His father, Benjamin Vaughn Abbott, was no less noted for his legal writings, his court reports and his digest of state and national law. Among his

ARTHUR VAUGHN ABBOTT.

uncles were J. Cabot Abbott, author; Edward Abbott, rector of St. James Church, Cambridge, Mass.; Austin Abbott, lawyer and writer, and Lyman Abbott, pastor of Plymouth Church, Brooklyn, N. Y.

Arthur Vaughn Abbott, the son of Benjamin Vaughn Abbott and Elizabeth Titcomb, was born in Brooklyn, N. Y., in 1854. His early years were passed in his home city, where he also acquired his early education. He entered the Brooklyn Polytechnic Institute for his higher education and graduated from there with honors in 1875. His first work was with the Department of Works, New York city, where he remained one year. He next entered the engineering department of the Brooklyn Bridge, where he remained for seven years in charge of material inspection and as general superintendent of cable construction.

Upon the completion of the bridge he became associated for four years with E. T. Fairbanks & Company in the design and construction of testing machines and the manufacture of large railway and lock scales. From 1887 to 1890 he was consulting engineer of the Boston Heating Company, as such designing and superintending the installation and operation of a central plant for supplying heat to about two square miles of that city. He then became mechanical engineer of the Daft Electric Light Company and had charge of the shop construction of dynamos and motors. He later was associated in the design, construction or operation of many of the pioneer electric railways in the United States, among them the line at Meriden, Ct., Bloomfield, N. J., Atlantic City, N. J., and Bloomington, Ill.; the systems at Salt Lake City and Ogden, Utah, Augusta, Ga., and the Lake Roland Electric Railway, Baltimore, Md. He also equipped electrically the Interstate Road at Kansas City, Mo., and operated storage-battery cars on the Fourth Avenue road in New York city. During the same period he acted as consulting engineer for the Ogden City water works, the Bear river canal and the Waukesha water pipe line. In 1892 he became chief engineer of the Chicago Telephone Company, serving in that capacity until 1901. During this period twelve new offices and buildings were erected and relay switchboards aggregating nearly 40,000 lines were installed, together with the necessary conduits, underground cables and aerial lines, covering the city and adjacent territory, aggregating nearly 100,000 wire-miles; 35,000 subscribers' substations were also installed. He designed, installed and operated lighting plants on all the systems, aggregating 10,000 lamps. From 1901 to 1902 he was consulting engineer of the Consolidated Telephone Company of Buffalo, rendering services similar to those in Chicago.

From 1902 until his death he was associated with Westinghouse, Church, Kerr & Company, New York city, as chief statistician. Under his direction much data was collected on many subjects, especially those to which the activities of that organization were chiefly devoted. Of equal importance was his development of methods for interpreting and using this data in conjunction with information obtained through the various engineering departments.

His writings included the following books: "The Electrical Transmission of Energy," "A Treatise Upon Fuel," "Testing Machines," "The Evolution of a Switchboard," and a series of six volumes on "Telephony."

He was a member of the American Institute of Electrical Engineers, of which he was at one time vice-president, the American Society of Mechanical Engineers and the American Society of Civil Engineers.

Digitized by Google

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Western Electric Company's New Special Design Short Arc Lamp.

The accompanying illustration is a view of a new design short lamp, adapted for 110 or 220 volts, direct current, possessing many features of excellence in design and numerous points in material and workmanship which the makers assert can not fail to commend themselves to the thinking purchaser.

In the Western Electric Company's new lamp the overall length has been reduced to the lowest practical minimum, being but twenty inches from the top of the lamp to the lower end of the enclosing globe; this, too, without reducing the

WESTERN ELECTRIC COMPANY'S NEW SHORT ARC LAMP.

length of the carbons so greatly as to materially cut down the life under that given by an ordinary five-ampere lamp. A life of 100 hours with each trimming is guaranteed. Instead of the large bulky case which is ordinarily found in short lamps, this lamp, by reason of the use of indestructible windings and specially designed resistance units, is of small dimensions and quite as symmetrical in design as the regular well-known types of lamps manufactured by this company.

In the matter of ventilation special attention has been paid in the construction of this lamp to secure adequate ventilation while at the same time protecting the regulating mechanism from harmful accumulations of dust. These lamps are often placed in basements and low rooms where the heat accumulating is great, such as boiler rooms and engine rooms, and their design has been with special reference to such service. In the choice of material for the different parts only such as has been found best adapted for the purpose has been made use of, regardless of cost.

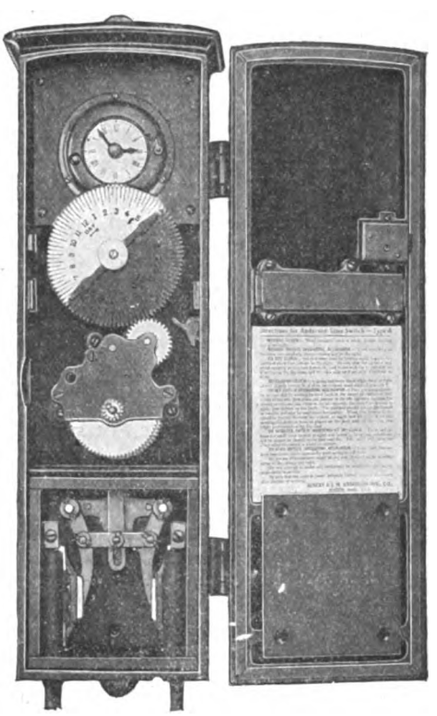
It is found quite difficult in practice to apply any effective safeguards against injury to lamps of this type, as ordinarily constructed, by the use of fuses and it not infrequently is found that lamps which were thought to be well protected have been practically destroyed by excess currents. In the new lamp provision is made to preserve the lamp absolutely from injury, even where fuses are entirely omitted, and the lamp may stand with the arc short circuited for hours without material injury and will be found ready for normal operation the moment proper conditions are restored.

The Anderson Electrical Time Switch.

The accompanying illustration shows a partial view of the electrical time switch recently placed on the market by the Albert and J. M. Anderson Manufacturing Company, Boston, Mass. This apparatus has been carefully designed and is guaranteed to open or close an electrical circuit at the precise time predetermined, is durable and weatherproof.

The switch-mechanism consists of two pivoted arms carrying laminated contacts and arcing contacts after the fashion of approved circuit-breaker construction. These arms are separated by a toggle motion, the central joint of which is thrust upward and downward by the propelling mechanism. When thrust downward the toggle motion is dead-centered and it is impossible to force the laminæ from their contact seats without exerting pressure sufficient to destroy the mechanism. There is no partial or imperfect contact possible.

The contact mechanism is housed in a slate enclosure in a separate compartment of the box and is fireproof. The lower or entering contacts are each separated from the jaws of the switch a distance of over an inch when the switch is open. The circuit is opened horizontally instead of vertically, thereby minimizing the chance of maintaining an arc. The propelling mechanism consists of a heavy spiral spring, equipped with two trains of gears. One of the spindles of one of these trains is equipped with a crank and connecting rod, the connecting rod being utilized to force the toggle of the switch up or down. A flyer on this train engages with an escapement that permits the crank to make a half revolution at a time. The connecting-rod of this crank has a slotted joint with the toggle so that the parts



THE ANDERSON ELECTRICAL TIME SWITCH.

can have some momentum before they are called upon to do any work, thus rendering the action more certain.

The second train of gears passes to the clock and is geared into the mechanism thereof. Should this train of gears be released, the mechanism would at once run down. This feature is of great value, because it will be seen that the duty of the clock, instead of driving anything, is rather to restrain something from being driven, and instead of contributing energy to the propelling mechanism it receives energy therefrom. Connected to the mechanism in this way, the clock is really

Digitized by Google

more certain of running than if propelled by its own unaided mainspring.

The shaft on the last gear on the train running to the clock is hollow, and both the hollow shaft and the solid shaft within are equipped with trip dogs which can be set by means of stout hands to any desired position in relation to the gear. To facilitate this setting the gear is marked with the twenty-four hours of the day divided into quarters, and in order that the daylight and darkness hours may be distinguished, the gear is enameled black on half of its face.

The two cams on the back of the propelling mechanism are set by the two hands on the front, and either cam when in action will cause the mechanism to make a half revolution. The first action of these cams as they revolve is to tilt the escapement and permit a small portion of this half revolution to be made. The clock itself, a moment later, tilts the escapement back, completing the half revolution. If, however, the flyer is interfered with, the crank will fail to act until the obstruction is removed. This fact is taken advantage of by gearing to the mechanism a second wheel carrying a suitable hand and cam. This second wheel revolves once in seven days, and on any one of these days can be set to interfere with the motion of the flyer, thereby preventing the switch from operating during that day. For convenience this wheel is naturally graduated to the days of the week. The escapement is also capable of being moved by a hand trigger so that the switch can be opened or closed independently of the clock.

An imported eight-day clock, of highest grade, is used with this time switch.

The whole switch is mounted in a three-compartment oblong cast-iron box. The bottom compartment, lined with slate, contains the switch. The middle compartment is divided so as to open from either the back or the front and contains the propelling mechanism. The upper compartment contains the clock. The whole is sealed with a heavy door, locked with a Yale lock, and rubber gasketed with a pressure lever, making the switch absolutely tight.

The action of the switch is as follows: The clock and mechanism are wound and the hands are set so as to cause an event at the desired hours of the day or night. The switch is then set by the hand trigger so that the next operation shall be that desired. For instance, if the next operation is to be closure, the switch should obviously be set in an open position. As the clock permits the dial wheel to drive slowly under the impetus of the mechanism spring, it carries with it its hands and cams. The first cam engages the escapement, permitting a partial revolution of the mechanism, and a few seconds later the clock trips the escapement back again, permitting the mechanism to make a full half revolution, closing the switch. The dial wheel then proceeds as before until the second cam is brought into play, when the cycle of operations is repeated, but with this difference, the switch opens. This is repeated every twenty-four hours, unless interfered with by the seven-day wheel, which may suspend the operations of the switch on any day of the week desired.

Electric Tower Control of Surface Track Switches.

The American Automatic Switch Company, New York city, has made an interesting installation for the Public Service Corporation of New Jersey at the Pennsylvania ferry terminal in Jersey City, N. J. All of the cars entering the terminal approach through York street and are switched on to the proper tracks by means of six electric track switches. These switches are controlled by an operator stationed in a tower back of the terminal. Fig. 1 shows the diagram of the tracks, the location of the tower and the various switches. The switch-throwing mechanism has already been described. An added feature is a rebound catch or lock which prevents the tongue from rebounding from the side of the switch bed when the switch is thrown. By holding the tongue firmly to the side of the switch bed the switch tongue can not be jarred to a dangerous position by the wheels of a car passing it or by the wheels of a wagon running in the car track.

A general view of the controlling mechanism in the tower is shown in Fig. 2. The number of levers corresponds to the number of switches to be operated. By the depression of one of these levers a double-break, single-pole switch is closed in oil. Current is taken from one of the trolley feeders contained in the cab through an oil switch and through the solenoid of one of the switch-throwing mechanisms to ground, thus throwing the switch. By removing the pressure of the hand from the lever the oil switch automatically opens the circuit. The blades and clips of the oil switch are protected by arcing pieces, which are readily replaceable. The amount of current required to operate the switch is fifteen amperes. The locking mechanism and the diagram of the circuits may be readily understood by reference to Fig. 3.

The switches are usually placed in one oil tank, the interior of which is porcelain lined, and any switch may be removed without interfering with the operation of the rest. When it is necessary to change the oil it is drawn off through a drain cock inserted in the bottom of the tank, fresh oil being introduced through the lip in front. Reference to Fig. 4 will show the accessibility of the oil tank.

As a precaution against splitting or throwing a switch beneath a passing car, each lever is automatically locked by the trolley wheel of the car about to take the switch. This is done through the medium of a contact-maker on the trolley pole, completing a circuit with a contact on the trolley wire at a considerable distance

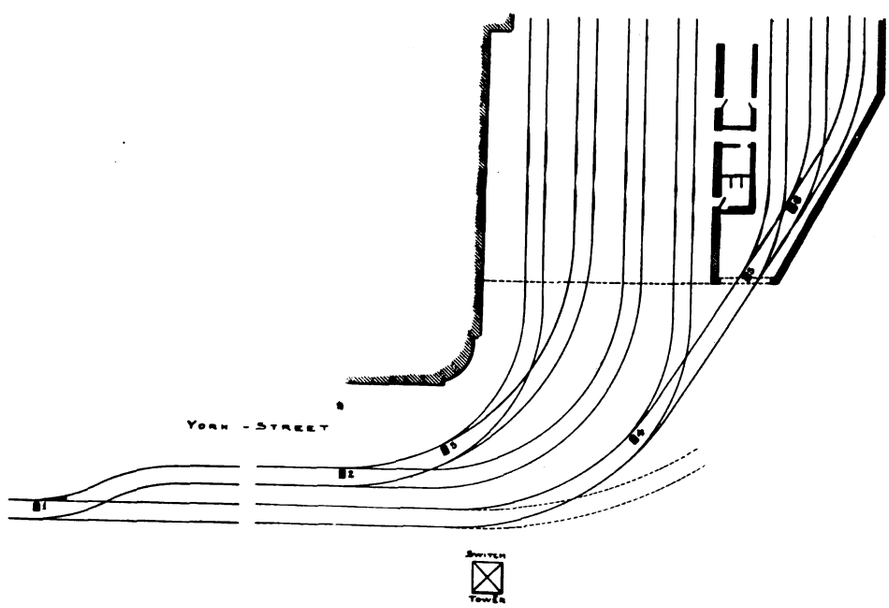


Fig. 1.—Layout of Tracks and Track Switches.

Digitized by Google

from the switch point. The operator has no control over this lever until it is locked in a similar manner.

In order that the operator may know at all times the position of each switch tongue, an indicator board is provided. This is well illustrated in Fig. 2. Upon this board there is a complete diagram of the yard, each track being represented by a strip of metal, and a miniature switch tongue moves coincidently with the tongue in the yard.

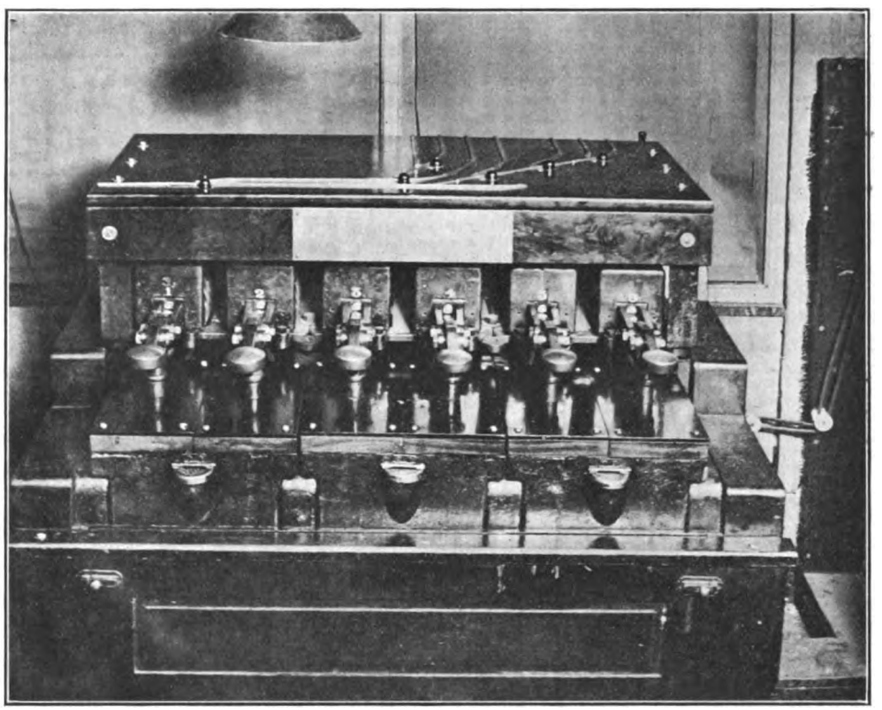


FIG. 2.—SWITCHBOARD AND OIL SWITCHES.

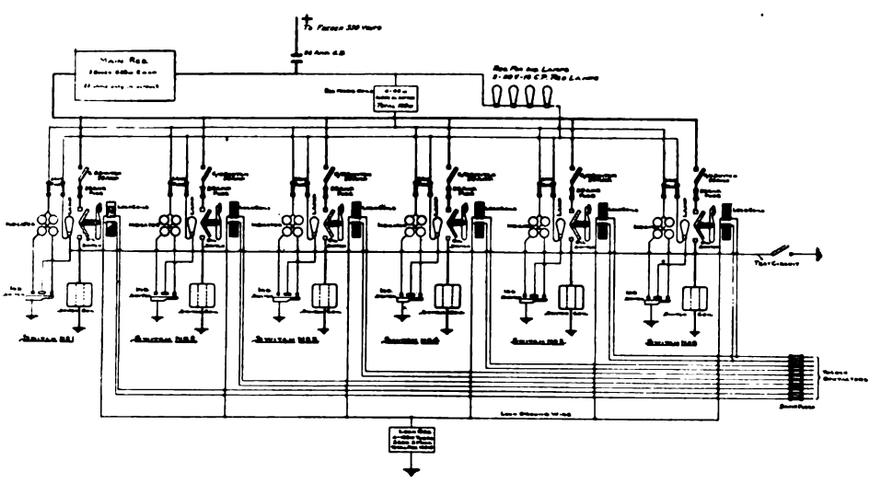


FIG. 3.—DIAGRAM OF CONNECTION OF SWITCH SYSTEM.

The indicating mechanism consists of four small magnet coils and an X-shaped armature, one opposite pair of coils being always in circuit, thus holding the miniature tongue in its proper position.

Within each box containing the switch-throwing mechanism there is a plate containing three contact strips, and upon the arm of the rod which moves the switch tongue there is a button which forms a ground connection. When the button is on either of the outside contact strips current is flowing through one of the two pairs of indicator coils. When the button rests upon the centre strip a ground connection is made through a small red lamp placed on the indicator board opposite each miniature tongue; therefore, if the switch tongue is split or unable to throw, owing to a stone or other obstruction being lodged between it and the side of the switch bed, this lamp indicates at danger. At the same time a stop signal notifies the motorman entering the yard, who proceeds with caution. Before his car can take the switch he will remove the cause of trouble and the danger signal will cease to show.

"Harvard" Outlet Boxes.

The accompanying illustrations show the new "Harvard" single and sectional gang switch boxes manufactured by the Harvard Electric Company, Chicago, Ill., and

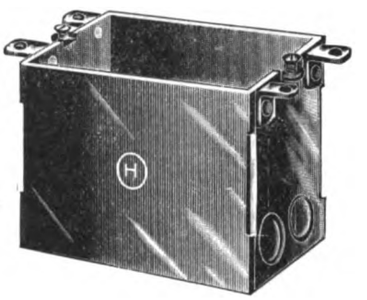


FIG. 1.—TYPE AA, SINGLE OUTLET BOX.

136 Liberty street, New York city. Fig. 1 shows the single combination switch box for flexible conduit. This box is made with two outlets in each end and four outlets in the bottom. The diameter of the

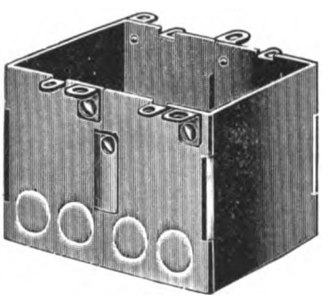


FIG. 2.—TYPE AA, TWO-GANG OUTLET BOX.

outlet holes is five-eighths of an inch. The box is designed for all standard push-button or rotary rectangular base switches.

The ears are made to operate on a screw pivot in a slot, whereby the box can be

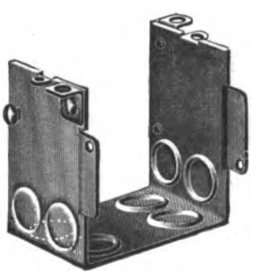


FIG. 3.—TYPE AA, SPACER.

adjusted to varying thicknesses of plaster in new work. These ears can also be reversed to work flush with the top of the box in finished work.

Fig. 2 shows the sectional two-gang switch box. Fig. 3 shows the spacer

Digitized by Google

which is used to enlarge the two-gang box to any required number.

The sectional switch box is designed so that the two-gang box may be converted

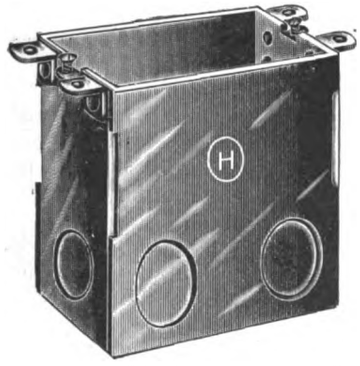


FIG. 4.—TYPE BB, SINGLE OUTLET BOX.

into a gang of any number by releasing the clamping screws and inserting the spacers. The gangs are easily assembled with the aid of a screw-driver, making a solid gang box for any required number of switches.

Fig. 4 shows the single switch box adapted for iron conduit work. This box is one-half inch deeper than the box de-

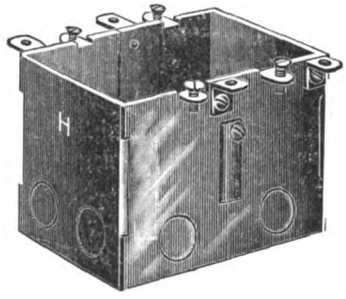


FIG. 5.—TYPE BB, TWO-GANG OUTLET BOX.

signed for flexible conduit work. It has one outlet in each end and two outlets in the side, and is made with the same special features as the AA single box.

Fig. 5 illustrates the sectional type BB two-gang box. Fig. 6 illustrates the spacer which is used to enlarge the two-

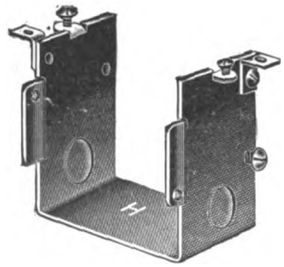


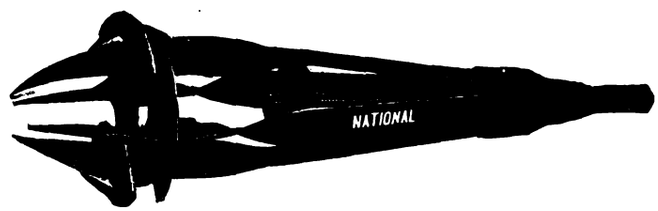
FIG. 6.—TYPE BB, SPACER

gang iron conduit box. These boxes are constructed entirely of No. 12 B. & S. cold-rolled steel. Each box is made up with a sufficient number of outlets to meet ordinary requirements, the holes being sealed with a steel disc, which may be removed by a sharp blow of the hammer. On removing the discs a clean, round hole is left, the exact size of the conduit, obviating the necessity of filing off ragged edges. The boxes are constructed in accordance with the underwriters' rules. They are thoroughly coated inside and out with a heavy baked insulating enamel.

These boxes are meeting with great favor among the dealers because, with a two-gang box and spacers in stock, a switch box of any required size may be quickly assembled.

The "National" Steel Tube Cleaner.

The accompanying illustration shows the "National" steel tube cleaner, which has been placed upon the market by the H. W. Johns-Manville Company, New York city. The salient feature of this



"NATIONAL" STEEL TUBE CLEANER.

cleaner is the independent action of each blade. The cleaner is so springlike in its nature that it conforms snugly to the surface which is to be cleaned. It may be forced through the tube with little effort, and each blade removes the particles of sediment or scale within the pipe. Another advantage of this cleaner is that it can be adjusted to fit various sizes of pipe, and if one or more of its blades become broken by rough usage or wear they may be readily repaired at a nominal expense.

Electric Service Supplies Company Announcement.

The Electric Service Supplies Company, Chicago, Ill., announces that it has secured, in addition to its former territory, the states of Michigan, Ohio and Indiana for the complete line of Locke insulators made by the Locke Insulator Manufacturing Company, of Victor, N. Y.

The high quality of Locke insulators is well known to the trade. This company has experimented with insulators under all conditions until now both the electrical and ceramic qualities of their product are as near perfection as possible.

Particular attention has been given to the effect of atmospheric moisture and temperature on the efficiency of insulation at high voltages; to the development of neutral colored glazes as the least conspicuous for insulators, presenting the least contrast with the background of sky and foliage, to the increased liberality of engineers in the matter of providing large factors of safety in designing supports and insulation for transmission lines.

The accurate knowledge of the engineers in the Locke factory concerning the qualities and characteristics of the constituents of their insulators, makes it possible for them to predetermine the exact electrical and mechanical strength of their product, even before the insulators are completed. Such results are the outcome of a great range of tests such as this company carries on.

Continued tests may at first seem an unnecessary item of expense; however, the Locke company has been convinced that only by means of such tests can they be absolutely assured of uniformity in their insulators. Such tests are made both mechanically and electrically.

Plant of the Dean Electric Company, Elyria, Ohio, Sold.

It is announced that the directors of the Dean Electric Company, Elyria, Ohio, have sold the plant to a new corporation. The old stockholders are secured by holdings in the new company. The authorized capital stock will be $1,000,000, of seven per cent preferred and $3,000,000 common stock. The increase in the capital stock was made on account of the increase in business, as the company has between $600,000 and $700,000 of orders ahead. The capacity of the plant will be doubled and new buildings will be erected. The working staff will be increased by 500 men, making a total of 1,000 employés.

Municipal Telephones for Manitoba.

The Manitoba cabinet has called for tenders to construct 1,000 miles of telephone lines in the province, following the mandate of the vote authorizing a publicly owned system. The contract involves many millions, which will be met through twenty-year debentures.

Digitized by Google

Current Electrical News

DOMESTIC AND EXPORT.

NEW LIGHTING COMPANY FOR SYRACUSE, N. Y.—The Municipal Gas Company, organized a few years ago, has applied for a franchise to light the city of Syracuse, N. Y., stating that it will change its name to the Niagara Distributing Company. The company proposes to secure power from the Niagara, Lockport & Ontario Power Company and distribute it for general purposes. The price for current for lighting is not to exceed eight cents a kilowatt-hour, the city to be given a reduction of ten per cent on this figure. The company offers to furnish electricity for power purposes at rates ranging from a maximum of three cents a kilowatt-hour for plants of five-horse-power capacity or less to not more than one cent a kilowatt-hour for plants of more than 150-horse-power capacity. A bond for $25,000 is offered to ensure the carrying out of the terms of the franchise, and the company agrees to turn over its entire establishment to the city, if desired, after twenty years' use, the city to pay for it as a going concern at a value to be determined by three appraisers appointed by the Appellate court. No information as to the capitalization of the company has been given.

MANHATTAN TRANSIT COMPANY TO OPERATE UNDER OLD GRANT—John C. Sheehan and those associated with him a short time ago secured control of the Manhattan Transit Company and the Long Acre Electric Light and Power Company. The former has a perpetual franchise for the running of electric and other vehicles in the streets of Greater New York and all other cities in this state, and also a franchise for the construction of a tunnel between the borough of Manhattan and Brooklyn. The Long Acre company is preparing actively to enter the electric lighting field. Mr. Sheehan now announces that the Manhattan Transit Company expects to build one or more of the proposed new subway lines recently approved by the rapid transit commission, as well as to construct a tunnel from a point about Broadway and Fulton street, Manhattan, to the Borough Hall building in Brooklyn. All the soundings of the bed of the East river have been completed, and other work toward bringing about as quickly as possible the perfection of the plans laid out has been accomplished. The plans for the big bore are those of the old New York & Brooklyn Railroad Company, which is controlled by the Manhattan Transit Company, but the latter proposes to do more than the old company planned. It is the intention to make this East river tunnel an important part of a great tunnel and subway system. The Manhattan Transit Company was incorporated in 1902 and is the successor of the General Carriage Company.

NEW HAVEN ROAD BUYS TROLLEY LINES—From the office of President Mellen, of the New Haven road, the statement has been given out that the New Haven road has purchased the Rhode Island Securities Company, paying in debentures of the Providence Securities Company bearing interest at four per cent and indorsed by the New Haven road. Mr. Mellen has been elected president of the Rhode Island company. At the same time a lease was taken, practically in perpetuity, of the properties of the Connecticut Railway and Lighting Company in Connecticut. The United Gas Improvement Company's interests in the Meriden, Southington and Compounce Tramway Company, in the New Milford Power Company and in the Housatonic Power Company, have also been bought by the New Haven company, which gives it a controlling interest. These purchases give the New Haven road control of all but ten of the forty trolley lines of Connecticut and Rhode Island. By the deal the New Haven road gets nearly 1,400 miles of trolley lines. The Connecticut Railway and Lighting Company controlled the trolley lines in Waterbury, Bridgeport, Norwalk, Derby, Westport, New Britain, Meriden and Milford, and has lighting plants in Greenwich, Norwalk and New Britain, Naugatuck and Waterbury. With the deal goes the New Milford Power Company and its rights on the Housatonic river. The gross earnings from the trolley lines in Connecticut and Rhode Island that have come to the New Haven road are figured at about $15,000,000 a year. It is estimated that the value of the companies acquired is more than $125,000,000.

MEXICAN ELECTRICAL NOTES—A concession has been granted by the state government of Guerrero to Max H. Lange for the use of the waters of the River Azul, which runs through the municipality of Quechultenango, in the district of Guerrero, to the extent of 9,000 litres per second of water, for the generation of electricity. The concession is to be for twenty years. The company, by the terms of the contract, is exempt for ten years from all state and municipal taxes on the capital invested in the business for the electric lighting and power systems which may be established in the towns of Chilpancingo, Tixtla and Chilapa. The company is also empowered to establish telephone lines and to erect poles for telephone lines, electric power circuits, etc., within the limit of the above towns as well as along the line of conduction. Negotiations by the Canada Electric Syndicate for the purchase of La Electra and La Compañia Industrial de Guadalajara are stated to have been discontinued, owing to a six-months' option secured on the latter company's property by Emilio Pinson, of Mexico City. The syndicate has declined the offer of Mr. Pinson to sell for $3,500,000 Mexican money. La Electra controls nearly all the tramways of Guadalajara and has an electric lighting and power plant, the properties being owned by the Bermejillos. La Compañia Industrial, which has a franchise for a short line of street railway and operates a lighting and power plant, is owned by a French company of Guadalajara. La Electra has a capitalization of $2,200,000, there being 22,000 shares of the par value of $100 each. It has outstanding bonds to the amount of $3,500,000 and it owes the state government $350,000. A further capitalization of $1,500,000, Mexican money, will be necessary to complete the works that have been started by the company, which will bring the liabilities to the sum of $7,550,000.

ENGINEERING SOCIETY NOTE.

CORNELL UNIVERSITY BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—G. A. Wardlaw addressed the Cornell University branch of the American Institute of Electrical Engineers on the evening of Thursday, December 6. Mr. Wardlaw's topic was "Engineering English." The address included an outline of engineering activity as expressed by technical literature, an analysis of the characteristic features of this expression, the misuse of ordinary words, and the paucity of engineering vocabulary resulting in vague and obscure expression. He marked the value of proper phrasing in English literature and laid down some rules for the construction of sentences. The lecture also considered the matter of paragraphing, the use of figures of speech, the effectiveness of good composition, and the tests which might be made to estimate the efficiency of the discourse.

EDUCATIONAL NOTE.

PURDUE UNIVERSITY—The November issue of the Bulletin of Purdue University contains the annual reports of the president and other officers for the college year 1905-1906. The reports show that there were in attendance 2,027 students, and that 383 degrees were granted at the close of the college year. There were 200 bachelors of engineering, seventy-four of them electrical, and eleven second degrees in engineering granted. Of the latter four were for electrical engineers. The report shows that the work of the university is considerably cramped for want of space, but the new civil engineering building recently completed will relieve this to some extent.

DATES AHEAD.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.

Northwestern Electrical Association. Chicago, Ill., January 16, 17 and 18, 1907.

Ohio Engineering Society. Columbus, Ohio, January 22-24, 1907.

Jamestown Ter-Centennial Exposition. Norfolk, Va., April 26 to November 30, 1907.

Digitized by Google

ELECTRIC LIGHTING.

REDLANDS, CAL.—The Home Gas and Electric Company has turned on electric lights throughout the city, only a few outside sections remaining unlighted.

CAMDEN, N. J.—The commissioners appointed by council to make enquiry into the movement to establish a municipal lighting plant, will at once ascertain the cost of installing the plant.

SHARON, N. Y.—The council has authorized the borough solicitor to prepare an ordinance for building an electric plant, at a cost of $40,000. It will be necessary to issue bonds, and a special election will be held.

SEA CLIFF, N. Y.—The Sea Cliff village board has entered into a three-year contract with the Nassau Light and Power Company for the lighting of the village. The terms of the contract are the same as those of that just expired.

HOUSTON, TEX.—Plans are now being drawn for an underground system for the Houston Lighting and Power Company, work to be commenced early in January. With the growth of the city the company finds it necessary to increase its facilities to keep pace with the demands of its business.

AMITE, LA.—The Central Light and Power Company, recently incorporated, has purchased rights and privileges of the Tangipahoa Light and Power Company. The board of directors has elected the following officers: H. P. McClendon, president; C. B. Pierce, vice-president, and W. B. Senter, secretary.

ALTOONA, PA.—An offer to furnish Altoona with electric current at one and one-half cents a kilowatt-hour for street-lighting purposes has been made by the Juniata Hydro-Electric Company, whose plant, operated by water power, is located near Huntingdon. The city must erect its lines and poles and maintain them.

BISHOPVILLE, S. C.—The town council of Bishopville has closed a deal with the Bishopville Light and Power Company, by which it purchases the entire plant of that company for $20,000. This purchase includes, besides the building, the engine, dynamos, wiring and all other material, and the good will of the company.

LAKE ARTHUR, LA.—V. A. Miller, secretary and treasurer of the Lake Arthur Ice, Light and Waterworks Company, Limited, recently incorporated with a capital stock of $15,000, states that the company will soon let contracts for the installation of ice and light plants. Efforts will be made to have the plants ready for operation by April 15 next.

CORPUS CHRISTI, TEX.—E. F. Gibbon, superintendent of the Corpus Christi Ice and Electric Company, recently incorporated with capital stock of $65,000, states that the company is a reorganization of the Corpus Christi Electric Light and Power Company with increased capital stock. Ice and electric plants will be installed at a cost of about $30,000.

JOLIET, ILL.—All private water power rights in and around Joliet have been consolidated. The Economy Light and Power Company, which controls the Jackson street dam, absorbed all the rights of the Munroe-Gaylord syndicate, which controlled valuable rights below Joliet. The deal involves millions. It is announced that $2,000,000 will be spent in developing 15,000 horse-power.

WILMINGTON, DEL.—The new Commercial Light, Heat and Power Company, which recently was granted a franchise, has asked the street and sewer directors for an extension of time in which to build its plant, and also to pay the balance of the $50,000 it agreed to pay the city for the franchise. It has paid $12,500 and was required to expend $50,000 upon its plant by February 5 next, but desires an extension of a year.

PITTSBURG, PA.—The Ohio Valley Light Company has entered into an agreement with the Avalon borough council to furnish twenty-five or more arc lights at $70 a year and fifty or more metallized-filament lights at $25 a year for five years from March 1 next. This is a reduction of $10 a year per arc light from the present contract, which would not have expired until March 1, 1909. The Central District and Printing Telegraph Company was granted the right to lay its wires under ground.

FREDONIA, N. Y.—The street lights of Fredonia village have been turned on in half the town for the first time in nearly four months, during which time the entire plant has been remodeled, a new building erected, new boilers, engines and dynamos, and an almost complete new equipment of cables and street lights installed, at an expense which will be partly met by the $12,000 bond issue authorized by the special election held July 6 last.

GADSDEN, ALA.—William L. Church, the consulting engineer of the Coosa River Power and Electric Light Company, the concern being promoted by R. H. Cobb, has made a report concerning the power plant at Lock 3. The company has succeeded in getting the consent of the government for the construction of a thirty-foot dam on the proposed site of the plant. He also states that he has made an accurate survey of the situation, a careful estimate of the volume of water in times of greatest drouth, assisted by government experts.

COLUMBUS, GA.—Boston capitalists have undertaken the harnessing of the falls of the Chattahoochee river, between Columbus and West Point. This project of developing over 200,000 horse-power, involving an outlay of millions of dollars, is now being pushed forward by the Columbus Power Company, a combination of all the power companies along the river for twenty miles above the city. Columbus is at the foot of the falls of the Chattahoochee river, the course of which for thirty-four miles above is marked by a series of the heaviest falls in the South. There are at present three dams between Columbus and West Point, all of which are within the city limits of Columbus and furnish power to many manufacturing enterprises there.

ST. JOHN, N. B.—The Grand Falls Power Company, Limited, has made a proposal to supply electrical power to St. John at prices which it is guaranteed shall not exceed certain maximum figures for thirty years, in return for an exclusive franchise for fifteen years subject only to the rights of the street railway. From estimates by its electrical engineer, the company expects to develop 60,000 horse-power at Grand Falls, and with storage to increase this twenty-five per cent. By its first installation, which in hydraulic development and electrical equipment is estimated to cost $2,500,000, only half the power will be developed. A portion will be reserved for works at Grand Falls and the surplus power will be available for transmission to St. John and other markets. The company estimates that to transmit 10,000 horse-power 165 miles to St. John will involve an outlay of $1,000,000.

READING, PA.—A meeting of the stockholders of the Reading Power Company and the West Reading Power Company was held at the office of the company recently to consider and vote on the adoption or rejection of a joint agreement entered into by the directors of the West Reading Power Company, for the merger and consolidation of the companies. The agreement was adopted and these officers were elected: president, John A. Rigg; first vice-president, Remi Remont; second vice-president, W. R. McIlvain; secretary and treasurer, T. W. Grookett, Jr.; assistant secretary and treasurer, Remi Remont; directors, John A. Rigg, Joseph L. Caven, William R. McIlvain, Richmond L. Jones, John H. Catherwood, John M. Frame, Frank L. Connard, Isaac Eckert, L. T. Custer, Ferdinand W. Roebling, Robert N. Carson, Remi Remont, William McIlvain, Preston Lea.

SPEARFISH, S. D.—George P. Baldwin, secretary and treasurer of the Eleventh Hour Mining Company, is promoting an electric company which will operate on Spearfish creek. This will be the first attempt made to utilize the immense water power there. Mr. Baldwin's company has bought the water rights of the Cascade Water Company and the Electric Transmission Company, extending below the falls for a distance of about five miles and a half. The river has a fall of about 100 feet to the mile and the volume of the water at the point of the intake is about fifty-six cubic feet per minute. The plant will generate something less than 3,000 horse-power, which will be for sale to mines and manufacturing companies throughout the Hills. The experience of the Homestake Mining, with its small electric water power plant at Englewood supplying power for three of its mills, shows that whereas the cost of the steam power generated by coal was about $115 per horse-power per year, the cost of the water plant is only $10 per horse-power per year. This new plant will cost between $350,000 and $400,000.

Digitized by Google

PERSONAL MENTION.

MR. W. H. HAYDEN, advertising agent of the Central Railroad of New Jersey, has resigned to accept the position of advertising manager of the Boston & Maine Railroad, with offices at Boston, Mass.

MR. EDWARD H. GRIER has resigned as assistant manager of the Bryant Electric Company, after fifteen years' association with that company, to open an office in New York as sales headquarters for a number of electrical manufacturing companies. Among the lines secured by Mr. Grier is that which will be known as the "Arrow P" snap and push-button switches.

MR. J. W. CREWS, assistant general manager of the Southern Bell Telephone and Telegraph Company, with headquarters in Atlanta, Ga., has been transferred to Richmond, Va., where he will continue the duties of assistant general manager of the entire company. This change is made necessary because of the very heavy growth in the telephone business in the state of Virginia and because of the company's desire to expedite as much as possible its business in this state and its northern territory. Mr. Fairfax G. Montague is relieved of the duties of superintendent of the first district, with headquarters at Richmond, Va., and will assume the duties of superintendent of exchange traffic, with headquarters in Atlanta, Ga. Mr. J. Reid A. Hobson is relieved of the duties of special agent, with headquarters in Atlanta, Ga., and is made superintendent of the first district of the Southern Bell Telephone and Telegraph Company with headquarters in Norfolk, Va.

OBITUARY NOTE.

GEN. JOHN M. HOOD, president of the United Railways and Electric Company, of Baltimore, Md., and for many years president of the Western Maryland railroad prior to its sale to the Gould interests, died on December 17, after a short illness following nervous breakdown due, it is said, to overwork. He was born in Howard county, Md., in 1843. General Hood served in the Confederate army during the Civil War and was several times wounded.

NEW PUBLICATIONS.

HISTORY OF AUTOMATIC ELECTRIC AND ELECTRICALLY CONTROLLED FLUID-PRESSURE SIGNAL SYSTEMS FOR RAILROADS—Under the title "History of Automatic Electric and Electrically Controlled Fluid-Pressure Signal Systems for Railroads," William Robinson, of Brooklyn, N. Y., has published considerable data bearing on his claims as the original inventor and patentee of the Robinson automatic electric and electropneumatic signal systems. There is also an announcement concerning the new Robinson electric railway system for safe third-rail operation of electric trains.

THE POWER OF NIAGARA—The Niagara Falls Power Company, Niagara Falls, N. Y., and the Canadian Niagara Power Company, Niagara Falls, Ontario, have published a pamphlet descriptive of the power plants and facilities for service at Niagara Falls. This work has been prepared in very handsome style and includes a comprehensive map showing the location of the power stations and the transmission lines. In addition to the literature descriptive of the power plants there are many illustrations and considerable data concerning the industries and possibilities of this section of the country.

ELECTRICAL SECURITIES.

Contrary to expectations, there was a severe break in the stock market last week, resulting in more or less demoralization with regard to prices. The apparent cause for the unsettlement was the announcement of some $253,000,000 of new stock issues to be floated by Northwestern railroad systems. Stock dealings were very active, the railroad specialties leading in the amount of sales. While the break of last week was unlooked for, and with this fresh in the minds of every one in the financial community, it is the very general opinion that until after the end of the year there will be comparatively quiet speculation in the stock market. The Department of Agriculture's final estimates as to the year's harvests were made public last week, and were fully as favorable as expected. It appears that, contrary to expectations, the Western banks have plenty of money and there will be no shortage of funds to carry out the plans of extension and betterment which so many industrial organizations have in mind for early in the new year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 22.

New York:	*Closing.*
Allis-Chalmers common	17
Allis-Chalmers preferred	44
Brooklyn Rapid Transit	79⅝
Consolidated Gas	138
General Electric	156
Interborough-Metropolitan common	35
Interborough-Metropolitan preferred	73
Kings County Electric	150
Mackay Companies (Postal Telegraph and Cables) common	70¼
Mackay Companies (Postal Telegraph and Cables) preferred	67½
Manhattan Elevated	140¼
Metropolitan Street Railway	104¼
New York & New Jersey Telephone	126
Western Union	85
Westinghouse Manufacturing Company	150

A quarterly dividend of 2½ per cent upon the preferred, assenting and non-assenting stocks of the Westinghouse Electric and Manufacturing Company has been declared, payable January 10, 1907, to stockholders of record December 27, 1906. Transfer books closed December 27, 1906, and will reopen January 11, 1907.

Representatives of the General Electric Company state that the gross business of the corporation for the fiscal year ending January 31, 1907, will not fall short of $58,000,000, an increase of about $13,500,000 over the preceding year. Assuming that these figures will prove correct, the net earnings of the corporation, based on the percentage of net earnings to gross in the two preceding years, will not fall short of $9,600,000. In the fiscal year ending January 31, 1906, the General Electric Company revealed net earnings of $7,319,161, which figure was equal to 16.5 per cent of the gross business of $44,419,613. Net earnings in the fiscal year ended January 31, 1905, were $6,719,546, or 16.6 per cent of the gross business of $40,323,354. If the General Electric Company does a gross business of $58,000,000 this year, and its net represents 16.5 per cent of the gross, it will have earned $9,570,000.

Boston:	*Closing.*
American Telephone and Telegraph	135
Edison Electric Illuminating	225
Massachusetts Electric	67
New England Telephone	125
Western Telephone and Telegraph preferred	80

The adjourned special meeting of the Edison Company, of Boston, which was to have been held to act upon the decision of the gas commission relative to a new stock issue, has been adjourned until January 9.

Directors of the American Telephone and Telegraph Company have declared a regular quarterly dividend of 2 per cent. The dividend is payable January 15 to stock of record December 31. Books close January 1 and reopen January 14. The instrument statement of the company for the month ended November 30 is as follows: gross output, 151,208; returned, 57,711, leaving a net output of 93,497, as compared with a net output of 134,395 for the same month of 1905.

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	68
Electric Storage Battery preferred	68
Philadelphia Electric	7⅞
Philadelphia Rapid Transit	22⅞
United Gas Improvement	92½

Directors of the Electric Storage Battery Company have declared the regular quarterly dividends of 1¼ per cent on the common stock and 1¼ per cent on the preferred, payable January 2 to stock of record December 26.

Chicago:	*Closing.*
Chicago Telephone	117
Chicago Edison Light	144
Metropolitan Elevated preferred	71
National Carbon common	86½
National Carbon preferred	115½
Union Traction common	—
Union Traction preferred	—

Directors of the South Side Elevated have declared the regular quarterly dividend of 1 per cent, payable December 31.

Directors of the National Carbon Company have declared the regular quarterly dividend of 1 per cent on the common stock, payable January 15. Books close January 5 and reopen January 16.

Digitized by Google

NEW INCORPORATIONS.

ALBANY, N. Y.—Oakland Electric Light and Gas Company. $50,000.

MONTREAL, QUEBEC.—The Canadian Electrical Exhibition Company, Limited. $20,000.

ST. PAUL, MINN.—Cannon Valley Telephone Company. Increased from $60,000 to $100,000.

COLUMBUS, OHIO—Citizens' Telephone Company, Delaware. Increased from $125,000 to $200,000.

AUGUSTA, ME.—Lewiston, Greene & Monmouth Telephone Company. Increased from $10,000 to $50,000.

PORTLAND, ORE.—Western Electric Company. $50,000. Incorporators: Charles H. Carey, Omar C. Spencer and Roger B Sinnott.

CHICAGO, ILL.—Mason City Telephone and Telegraph Company, of Mason City. $2,500. Incorporators: W. A. Grandy, J. F. Culp, H. F. Reason.

GUTHRIE, OKLA.—The Deep Fork Telephone Company, of Oklahoma City. $5,000. Incorporators: J. T. Pierce, C. F. Woodward and N. W. Clark.

CINCINNATI, OHIO—Millcreek Valley Electric Company. $10,000. Incorporators: George Feltes, D. H. Hauss, A. Smith, William Kling and Wilson Halin.

PEORIA, ILL.—Peoria & Canton Railway. $5,000. Incorporators: George M. Mattis, R. H. Watson, C. R. Littler, Charles Zilly and John C. Emerson.

SENECA FALLS, N. Y.—The Geneva-Seneca Electric Company. To supply electricity for lighting, heating and power purposes in Ontario and Seneca counties. $10,000.

EATON, PA.—Eaton Electric Light Company. $10,000. Incorporators: C. B. Cokefair, C. C. Foos, Elam Fisher, Homan Royer, E. E. Bailey, L. L. Brown and O. A. Gale.

LEADVILLE, COL.—The Leadville Light and Power Company. $800,000. Incorporators: Leonard E. Curtis, Orlando B. Willcox and W. T. Waterton, all of Colorado Springs.

CAMDEN, N. J.—Northampton Light, Heat and Power Company. $275,000. Incorporators: Horace Evans, Martin L. Finkle, Hugh B. Eastburn, Edward H. Stokes and John McQuillen.

AUSTIN, TEX.—The Electric Light Company, of Hamilton. $10,000. Incorporators: John L. Spurlin, George F. Perry, J. T. James, F. C. Williams, J. E. Secrest and A. R. Edison.

LOS ANGELES, CAL.—Porterville Gas and Electric Company, of Los Angeles. $150,000. Directors: G. I. Weinberg, Moses Greenwald, Adolph Genslein and S. Magnus, all of Los Angeles.

GUTHRIE, OKLA.—The Ringwood Telegraph and Telephone Company, Ringwood, Okla. $500. Directors: E. A. Wales, E. Frasier, P. H. File, F. W. Walson and W. W. Shadden, all of Ringwood.

CRIPPLE CREEK, COL.—Catamount Creek Water and Power Company. $200,000. Directors: Theophilus Harrison, E. W. Giddings, Frank G. Peck, Charles T. Fertig and F. B. Dow, of Colorado Springs.

JERSEY CITY, N. J.—The Minneapolis, Rochester & Dubuque Traction Company. To operate trolley lines in Minnesota and Iowa. $1,000,000. Incorporators: H. O. Coughlan, B. S. Mantz and John R. Turner.

LOS ANGELES, CAL.—Sirch Electrical and Testing Laboratories, of Los Angeles. $75,000. Directors: James M. White, E. J. Borgmeyer, R. B. Sumner, H. F. Anderson and A. P. Thomson, all of Los Angeles.

AUGUSTA, ME.—Marquette County Gas and Electric Company. To manufacture, generate and supply gas and electricity for light, heat and power. $750,000. President, E. J. Pike; treasurer, Fred Bogue, both of Augusta.

HARRISBURG, PA.—Wilkesbarre & Plains Street Railway Company, Wilkesbarre; $24,000; president, John A. Rigg, Reading.

Pittston & Avoca Street Railway Company, Wilkesbarre; $13,500; president, John A. Rigg.

ALBANY, N. Y.—The Buffalo Transit Company. $150,000. Directors: H. L. Brown, Fred W. Ely, John B. Richards, James McAlpine, Jacob C. Obersheimer and Joseph B. Rodgers. The office to be located at Grand Island.

ALBANY, N. Y.—Fulton Chain Electric Company, Webb, Herkimer county. To furnish light, heat and power. $5,000. Directors: Spencer Kellogg and F. S. Kellogg, of Utica, and Frederick Cleveland, of Fulton Chain.

DETROIT, MICH.—The Clark Wireless Telegraph Company, successor to the Clark Electrical Engineering Company. $300,000. Officers: R. R. Sterling, president; James H. Livesy, vice-president; E. Collins, treasurer; W. P. Rands, secretary.

BANGOR, ME.—Canaan Power Company. Organized at Augusta for the purpose of developing water power and timber lands. $50,000, fully paid in. Officers: president, Stephen A. Nye, of Fairfield; treasurer, Frank B. Purinton, of Fairfield.

AUGUSTA, ME.—Kanakee Light, Heat and Power Company. Organized at Portland for the purpose of owning and operating plants for generating light, heat and power. $100,000. President, Millard W. Baldwin, of Portland; treasurer, Clarence E. Eaton, of Portland.

TRENTON, N. J.—Delaware & Belvidere Telephone and Improvement Company, Delaware, N. J. $2,000. Incorporators: Charles J. Quigg, F. Brisbane, Michael C. Allen, George T. Peall, Jacob E. Albertson John H. Albertson, Joseph B. Kimenour, Delaware, N. J.

GUTHRIE, OKLA.—Tecumseh & Norman Traction Company, of Tecumseh. For the purpose of building an electric line from Tecumseh across Pottawatomie and Cleveland counties to Norman, at an estimated cost of $650,000. $1,000,000. Incorporators: George Weed, of New York; Samuel B. Mitchell, Charles G. Stanford, Martin H. Tennison and James T. Butler, of Tecumseh.

LOS ANGELES, CAL.—San Bernardino Interurban Company. To construct an electric line west from Los Angeles through the Rialto district to North Ontario; another one southerly through Colton to Riverside, and a line from the most convenient point on the Riverside route easterly to High Grove. $1,000,000.

DOVER, DEL.—The American Public Uses Corporation. The company is authorized to construct, maintain and operate plants for the generation and production of water, light, heat and power for public uses. $1,000,000. Incorporators: W. H. Spensler and M. P. Reed, of Philadelphia, and Christopher L. Ward, of Wilmington.

SPRINGFIELD, ILL.—Springfield Belt Railway Company. To construct a belt line around the city of Springfield. $5,000. Incorporators and first board of directors: J. E. Johnson, of Danville; George M. Mattis, B. E. Bramble, Charley Zilley and W. H. Birke, of Champaign; all officers in the McKinley company, of whose system the new road will be a part.

RALEIGH, N. C.—Clinton Light and Power Company, of Clinton. To manufacture and sell electric light, heat and power in the town of Clinton and to transmit the same to other points in Sampson and Duplin counties. $200,000. Stockholders: Henry A. Grady, Archibald McG. Graham and Walter F. Peterson, of Clinton, and Stephen S. Grady, of Cambridge, Mass.

ST. JOSEPH, MO.—St. Joseph, Savannah & Northern Railway Company. To construct and operate an interurban traction line fifteen miles in length from St. Joseph to and through Savannah, Mo. $300,000. Incorporators: W. P. Fulkerson, Milton Tootle, Jr., L. C. Burnes, R. A. Brown, F. J. Wheeler, T. B. Campbell, Louis T. Golding, C. F. Enright and Charles Pasche.

INDIANAPOLIS, IND.—White River Light and Power Company, Indianapolis, To manufacture electric current for light and power purposes, and to engage in the manufacture of ice. $675,000. Incorporators: August M. Kuhn, J. T. Dickson, William E. Kurtz, Aaron D. Booth, Thomas Griffin, Robert H. Sharp, Charles F. Ruschaupt, Horace E. Smid and Roscoe O. Hawkins.

Digitized by Google

ELECTRIC RAILWAYS.

CHICAGO, ILL.—The Chicago & Milwaukee Electric Company has contracted to carry packages for the United States Express Company.

HATTIESBURG, MISS.—Work has been commenced on the first street railway in Hattiesburg. There will be about nine miles of track laid at once.

MARSHALLTOWN, IOWA—Hamilton Browne is negotiating for the purchase of the local street railway line and proposes extending it to Ferguson and eventually to Newton.

LOUISVILLE, KY.—The directors of the Louisville Railway Company have decided to purchase fifty new cars. The cars will cost $5,000 each, making the total outlay $250,000.

PHILADELPHIA, PA.—Improvements costing nearly $500,000 are to be made to the electric line of the West Jersey & Seashore Railroad before the next summer schedule goes into effect. The directors have authorized the purchase of thirty-two cars.

PLAINFIELD, N. J.—F. H. Alleman, superintendent of the Morris County Traction Company, says the company will have completed the construction of its trolley line between Elizabeth and Summit by next summer. Traffic between the two cities will be opened in the early spring.

HUSTIFORD, WIS.—At a mass meeting the project of building an electric line through this town from Milwaukee to Beaver Dam, promoted by the Milwaukee Western Electric Railway Company, was endorsed and a committee was appointed to raise funds with which to purchase the company's bonds.

TROY, N. Y.—The capitalists who have secured control of the Troy, Rensselaer & Pittsfield Railroad will, it is said, at once begin the construction of a trolley line from Rensselaer to Troy, and another from some point along the Albany & Hudson Railroad to connect with the Pittsfield trolley system.

NEW YORK CITY—The Sixth and Ninth avenue elevated lines of the Interborough company are to be extended across the Harlem river to Highbridge and there connect with the station of the New York Central. When this is done a forty-minute schedule from Highbridge to Wall street for a five-cent fare will obtain.

FREDERICKTON, NEW BRUNSWICK—James Burgess, J. F. Tweedie and John E. Stewart, all of Victoria county, have given notice that they will at the next session of the legislature apply for a charter to construct an electric railway from St. John to Grand Falls. The distance between the two points is 125 miles.

HOUSTON, TEX.—The Central Texas Traction Company, of Dallas, has been granted a franchise to build, maintain and operate an interurban railway system over the streets of Waxahachie. The company has ninety days from the passage of the ordinance to accept it. A forfeiture clause requires the road to be completed within two years after the acceptance of the ordinance.

FINDLAY, OHIO—It is learned that the right of way of the Marion-Findlay electric line will be resurveyed at once. Construction work will begin immediately after the survey is complete. The object of the new survey is to lessen the length of the line by two miles. G. W. Meeker, treasurer of the company, has sent out a map showing the towns through which the road will pass.

POTOMAC, ILL.—The Illinois Traction Company will have its electric line completed between Danville and East St. Louis by March 1 next, according to a statement by L. E. Fisher, vice-president and general manager. The company will put in operation between Danville and Springfield the "Capital City Express," and between Danville and East St. Louis the "Corn Belt Limited."

BALTIMORE, MD.—The Maryland Electric Railway Company has let the contract to the J. G. Brill Company, of Philadelphia, for the building of forty high-speed cars of the semi-convertible type, which will be used by the United Railways and Electric Company on the Sparrows Point line. All of the high-speed cars will be used on the Sparrows Point line. The cars will cost about $6,000 each.

ALTOONA, PA.—The syndicate of business men at Huntingdon which is now building a trolley line there, has arranged to make extensions both east and west of the town. Westward the line will connect with Tyrone, and thus reach Altoona over the Logan Valley line. Eastward a line will be built to Mount Union. Some fifty miles of track will be laid, according to the present plans of the promoters.

BOSTON, MASS.—The Western Massachusetts Street Railway Company and the Woronoco Street Railway Company have petitioned the railroad commissioners to approve the sale of the latter to the former. The Western Massachusetts also petitions to issue $250,000 additional capital stock to consummate the sale, the new shares to be exchanged share for share for the stock of the Woronoco Company.

MARTINEZ, CAL.—After several months' delay in securing franchises and completing surveys, the first electric road to tap the fruit belt of Contra Costa county is being constructed. Rights of way have been secured through the principal streets of Martinez and along the county roads between Concord and Walnut Creek and positive assurance has been given that the line will be rushed to completion.

BANGOR, ME.—John R. Graham, of Bangor, has completed a deal for the purchase of the Augusta, Winthrop & Gardiner Street Railway. This road is between thirteen and fourteen miles long, with $120,000 capital stock, owns about twenty-five cars, is operated by a steam plant and handles about 2,500,000 passengers annually. Mr. Graham's interests now include the Bangor Railway and Electric Company, Lewiston, Brunswick & Bath Railway, the Union River power project and others.

NEW YORK, N. Y.—The common council of New Rochelle has granted a franchise to the New York, Westchester & Boston Railway Company, known as the Westchester road, to pass over various streets and public places in this city on either overhead or underground construction. The company agrees to have not less than three stations in New Rochelle, and to charge not more than five cents in that city and ten cents to any station in New York, and to operate the road within three years.

SPOKANE, WASH.—A six-mile electric railroad will be built from Chewelah to the properties of the United Copper Mining Company, northeast of the town. The cost of the road is estimated at between $30,000 and $50,000. The railroad will be built and owned by the mining company, and will be used for hauling ore from the United Copper mine and adjoining properties to the Spokane Falls & Northern road at Chewelah, from which there is direct transportation to the smelters. The right of way for the line has been secured.

PENN YAN, N. Y.—Formal application to the state railroad commissioners has been made by James F. Turk for a certificate of convenience to construct a trolley road from Hornellsville, Steuben county, to Branchport, Yates county. The construction of the road depends upon the raising of $50,000 which must be on hand. Of the amount necessary $20,000 has been raised in Howard and $22,000 in Hornellsville, and the balance of the $8,000 will be raised in other towns. It is said that work will be commenced on the proposed line early next spring.

SHARON, PA.—The Cleveland & Sharon Traction Company, which was recently incorporated with a capital of $2,500,000, has organized by the election of the following officers: president, Francis B. Morgan, Cleveland, Ohio; vice-president and secretary, John Blake, Brooklyn, N. Y.; treasurer, C. F. Clendenning, New York, N. Y.; assistant secretary and treasurer, P. F. Morgan, Cleveland, Ohio. The company will build a line from Middlefield, Ohio, to Sharon. At the former place it will connect with the Cleveland & Eastern, giving a direct line from Sharon to Cleveland, and within a short time Cleveland and Pittsburg will be connected by trolley.

ALBANY, N. Y.—The state board of railroad commissioners has consented to the issuance by the Paul Smith Electric Light, Power and Railroad Company of a first mortgage for $500,000 on condition that only $400,000 bonds shall be issued under this consent, and that before the remaining $100,000 or any part thereof shall be issued the company must receive consent of the board. The board has also approved of an increase of the capital stock

Digitized by Google

of the company from $100,000 to $500,000 on condition that only $100,000 of the increase be issued under this approval; the remaining $400,000 or any part thereof may not be issued without further approval.

SEDRO-WOOLLEY, WASH.—The details are being completed for a corporation which is being organized for the purpose of constructing an electric interurban road from this city to La Conner by way of Burlington, Avon and West Mount Vernon. A. W. Lynn, of San Francisco, has been attending to the details of promotion; Those prominent in the organization are: Herbert Conner and W. E. Schricker, of La Conner; Thomas Smith, Mount Vernon; Robert Moody, of Burlington, and C. E. Bingham, A. E. Holland and J. B. Alexander, of Sedro-Woolley. The enterprise has had a very substantial backing from business men in this city, as it will place Sedro-Woolley in close touch with water transportation. La Conner is also interested in the project on account of its lack of transportation facilities.

SPRINGFIELD, MO.—The proposed electric line known as the Kansas City, Springfield & Southern Railway will probably be built. The promoters of the project asked for a bonus of $30,000. The Commercial Club passed a resolution pledging help in securing the right of way and promising to secure the bonus when the road was finished and in operation, provided that work should begin within the next eight months and be completed in two years. The line is to run from Springfield to Richards, a point twelve miles from Nevada, and there intersect the Kansas City Southern, with a branch line from Stockton to Sylvania. The entire length of the line will be 135 miles. The road is to have a two-hour service, the schedule being not less than twenty-five miles per hour. It will be equipped with overhead trolley, and will handle both passenger and freight business.

KANSAS CITY, MO.—The Kansas City & Northern Traction Railway Company, which was chartered by the secretary of state at Jefferson City recently, will cost, completed, more than $500,000. Two lines of railroad are to be built. They will be together twenty miles in length and will cost $10,000 a mile. A bridge is to be built across the Missouri river at or near Quindaro. It is estimated that the bridge alone will cost $300,000. The approaches, which must be long and high in order to clear the Missouri Pacific tracks, which run along the Kansas side of the river near Quindaro, will cost about $50,000. Already fourteen miles of the right of way have been obtained. The road is to be built in Platte and Clay counties, just northeast of Kansas City. One line goes northwest in Platte county four and one-half miles, then northeast to Smithville, in Clay county. The other starts in township fifty in Clay county and goes northwest until it joins the first-mentioned line.

DETROIT, MICH.—Four new electric lines to form a chain eastward from Grand Rapids to Pontiac and Detroit are to be built during the next eighteen months, according to E. M. Hopkins, president of the four companies, who says negotiations for the construction and equipment of the lines were recently completed. The lines are to be known as the Grand Rapids & Ionia, the Grand Rapids, Belding & Greenville, the Ionia & Owosso and the Owosso & Pontiac railways. President Hopkins states that the lines are to be built by the W. A. Cullen Construction Company, of 25 Broad street, New York, and a surety bond of $100,000 is given to assure the completion of the roads within eighteen months from March 1 next. The construction work is to be under the personal direction of Charles E. Van Bibber, of New York. The principal towns and places through which the lines are projected to run are: Pontiac, Drayton Plains, Waterford, Windiate, Clarkston, Davisburgh, Holly, Fenton, Linden, Gaines, Durand, Vernon, Corunna, Owosso, Burton, Ovid, Shepardsville, St. Johns, Fowler, Pewamo, Muir, Ionia, Saranac, Lowell, Cascade, Grand Rapids, Belding and Greenville. Mr. Hopkins says no arrangements have been completed for connections between Pontiac and Detroit, but if a traffic arrangement is not made with the Detroit United Railways an independent line will be built. The capital stock of the four companies is $4,900,000, and bonds are to be issued for $4,250,000. The officers and directors are: president, E. M. Hopkins; vice-president, J. L. Hudson; treasurer, John T. Rich; secretary, Frank Westcott. These gentlemen and J. Boyd Pantlind, Robert D. Graham, Charles H. Pomeroy, John P. Hopkins and Edward Holmes form the board of directors.

INDUSTRIAL ITEMS.

THE AUTOCOIL COMPANY, Jersey City, N. J., has published a new catalogue and several circulars devoted to its "O7" autocoil.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, has ready its handsome catalogue and price list devoted to type G brakes and spare parts.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1510 describes and illustrates the Allis-Chalmers heavy-duty, direct-connected Reynolds-Corliss engines.

THE BRISTOL COMPANY, Waterbury, Ct., in catalogue No. 44 describes and illustrates the Bristol recording gauges. This catalogue will be sent to any one interested upon request.

THE ROCHESTER MACHINE TOOL WORKS, Rochester, N. Y., has ready for distribution some interesting literature concerning "Acme" engines of stationary, marine and automobile types.

THE HENRY D'OLIER, JR., ENGINEERING COMPANY, 119 South Fourth street, Philadelphia, Pa., in bulletin No. 26 gives many illustrations of universal sockets and shades, together with price lists and dimensions.

THE AMERICAN CIRCULAR LOOM COMPANY, Chelsea, Mass., is sending to its friends a unique card bearing a "Happy New Year" expression. This is one of the neatest and most artistic cards which has been received in a long while.

THE STEAM APPLIANCE COMPANY, Milwaukee, Wis., will be pleased to send to any one interested upon request some new literature descriptive of its steam-engine appliances. A catalogue descriptive of the "Root" reducing valve has just been published.

THE NARRAGANSETT MACHINE COMPANY, Providence, R. I., reports its orders far ahead of its productive capacity, in spite of the fact that it has increased its factory space to the point of producing 1,000 lockers per week, and will probably increase it further.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, Chicago, Ill., has ready for distribution some new literature descriptive and illustrative of "Union" enclosed fuses, blocks and fittings. This literature will be sent to any one interested upon request.

THE WELLMAN-SEAVER-MORGAN COMPANY, Cleveland, Ohio, has published a handsome booklet entitled "What We Do." This is devoted to suggestions and illustrations concerning equipments of iron and steel works machinery, ore and coal-handling machinery, cranes, etc.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has ready for distribution three new bulletins. No. 3,205 describes and illustrates bipolar ventilated motors, one-sixteenth to one-eighth horse-power, for direct current; No. 3,206, bipolar enclosed motors, one-twentieth to one-fifth horse-power, for direct current; No. 3,303, direct-current volume blowers for direct and alternating currents.

THE WESTINGHOUSE MACHINE COMPANY, East Pittsburg, Pa., has an order for three turbine-generator units each of 6,000 kilowatts capacity for the Philadelphia Rapid Transit Company's Wyoming avenue power station. These, with the one now in course of erection, will make four units of the same capacity in this station. Six 1,500-kilowatt Westinghouse turbine-generator units have been operating in this station for the past year.

EDWARDS & COMPANY, manufacturing electricians, New York, are now located in their new building at One Hundred and Fortieth and Exterior streets, Borough of Bronx, New York city. This company now occupies a large, well-made four-story brick factory, having outgrown its earlier quarters, which it had occupied since 1872.

THE REED ELECTRICAL CORDAGE COMPANY, Syracuse, N. Y., has recently installed a large equipment of modern machinery, supplementing the already extensive outfit of its large plant. The present equipment gives the company a capacity five times as large as heretofore. The company will shortly begin the manufacture of

Digitized by Google

lamp cord. The products now include rubber-covered wire, annunciator wire and wire specialties.

THE CHASE-SHAWMUT COMPANY, Newburyport, Mass., has recently disposed of its patented switchboard interests to James S. Pennefather, of New York city.

THE PHOENIX GLASS COMPANY, New York city, will open a new and larger office and salesroom at 507 Heyworth Building, No. 42 East Madison street, Chicago, Ill.

EMIL CALMAN & COMPANY, New York, N. Y., manufacturers of insulating varnishes and varnishes for special work, is distributing an illustrated calendar for 1907.

THE BAY STATE LAMP COMPANY, Danvers, Mass., announces an advance in price for "Bay State" renewed lamps, January 1, 1907. New price lists will be mailed upon application.

THE AMERICAN INSTRUMENT COMPANY, 1112 Chestnut street, Philadelphia, Pa., will be pleased to send some new literature descriptive of the American voltmeters and ammeters.

THE SAFETY-ARMORITE CONDUIT COMPANY, Bailey-Farrell Building, Pittsburg, Pa., is distributing a desk-pad blotter enriched with a celluloid mat beautifully lithographed with holly and lavender ribbon.

THE NEW PROCESS RAWHIDE COMPANY, Syracuse, N. Y., has published a handsome little booklet devoted to "New Process" noiseless pinions and accurately cut metal gears. This little book contains a great deal of very useful information, and will be sent to any one interested upon request.

THE THORDARSON ELECTRIC MANUFACTURING COMPANY, 153 South Jefferson street, Chicago, Ill., has been incorporated under the laws of the state of Illinois with a capital of $100,000, to take over the business of C. H. Thordarson. The officers are: C. H. Thordarson, president and director; Joseph W. Watkins, vice-president and director; John A. Brennan, secretary-treasurer and director.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 17 Park place, New York city, will be pleased to send some attractive literature devoted to "Red Seal" dry batteries, Manhattan separable attachment plugs, the Manhattan dry battery, the Manhattan flush receptacle and the "Mesco" time-switch. The company announces that owing to increased facilities it is in position to make prompt shipments of all orders.

THE UNION SWITCH AND SIGNAL COMPANY, Swissvale, Pa., has been awarded the entire contract for the interlocking and signaling of the terminal station now being constructed in Washington, D. C., by the Pennsylvania Railroad and the Baltimore & Ohio Railroad. The installation will be electropneumatic, similar in its general characteristics to that in the railway yards of the Pennsylvania Railroad at the Union Station, Pittsburg, Pa.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a new series of literature, including the following: bulletin No. 4,466, remote-control field rheostats; bulletin No. 4,470, the electric motor in saw-mill work; bulletin No. 4,473, the GE-81 railway motor. There is also a handsome catalogue issued from the power and mining department, describing and illustrating the General Electric electric mine locomotives. This is a particularly interesting and valuable publication.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., announces that George V. W. Ingham has been transferred from the main office to Chicago as Western sales agent, in charge of the territory controlled from Chicago. Mr. Ingham has been connected with the factory for some time, and is well posted in the line and in a position to handle all conditions very satisfactorily. A. S. Merrill remains in charge as assistant Western sales agent. This change has been made necessary owing to the increasing volume of business handled from the Chicago territory.

THE WESCO SUPPLY COMPANY, St. Louis, Mo., has purchased the plant of the Davis Electric Manufacturing Company, Springfield, Mass., including all machinery and the finished and unfinished product, which is being removed to St. Louis, where the company will continue the manufacture of the Davis switches as well as all of its other specialties. The five-story factory building at the corner of Eighth street and Clark avenue, St. Louis, has been leased for a term of years, and is being equipped with the most modern machinery for the manufacture of these specialties, as well as tablet boards, cutout cabinets, switchboards, telephones and telephone accessories. The factory will be in complete operation by January 15, 1907.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has published a handsome pamphlet devoted to its Hawthorne works for the manufacture of power apparatus. The Hawthorne plant occupies a very large tract of land at the extreme west of the city of Chicago. Two railroad trunk lines—the Chicago, Burlington & Quincy and the Illinois Central—cross the plant and are provided with switch connections; while the West Indiana Belt Line, the Manufacturers' Junction Railroad and the Chicago Terminal Transfer Railroad, give connection with all of the trunk lines entering Chicago. The works consist of office, pattern shop, pattern storage, foundry, forge shops and machine shops, cable and rubber plants. In publishing this pamphlet concerning the Hawthorne works the company desires to give wide publicity to its facilities for the manufacture of large power apparatus and switchboards of extreme dimensions.

Record of Electrical Patents.

Week of December 18.

838,525. TESTING SYSTEM FOR TELEPHONE LINES. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed June 29, 1903. A common testing conductor is connected with the cords.

838,545. MULTIPLE TELEGRAPHY AND TELEPHONY. Maurice Hutin and Maurice Leblanc, Paris, France, assignors, by mesne assignments, to Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. Filed May 9, 1894. The various circuits have reactances equal to zero for their respective frequencies.

838,547. ELECTRIC MOTOR AND METHOD OF CONTROLLING THE SAME. Austin Kimble, Chicago, Ill., assignor of one-half to Perkins B. Bass, Chicago, Ill. Filed May 21, 1906. A compound-wound motor arranged so that the series winding is short-circuited at starting.

838,583. SYSTEM FOR CHARGING STORAGE CELLS. Ira S. Raymer, Beaver, Pa. Filed August 23, 1905. An arrangement for charging block-signal batteries.

838,586. ELECTRIC-CAR SIGN AND SIGNAL. Charles W. Ryder and Franklin Orth, Burlington, Vt. Filed April 8, 1905. A rotatable illuminated sign.

838,605. DYNAMOELECTRIC MACHINE. Bernard A. Behrend, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed March 26, 1906. The laminæ of the core are spaced in groups leaving ventilating ducts. The coil-retaining wedges are reduced so as not to obstruct these ducts.

838,617. MEANS FOR EFFECTING AND CONTROLLING THE STORAGE OF WATER IN HYDRAULIC-POWER SYSTEMS. Fritz Golwig, Vienna, Austria-Hungary. Filed May 5, 1906. An electric regulator controlled by a float which maintains equal the overflow from two reservoirs.

838,727. DIE FOR FORMING INSULATORS. Fred M. Locke, Victor, N. Y. Filed November 24, 1905. A two-part die, the parts being connected by ribs.

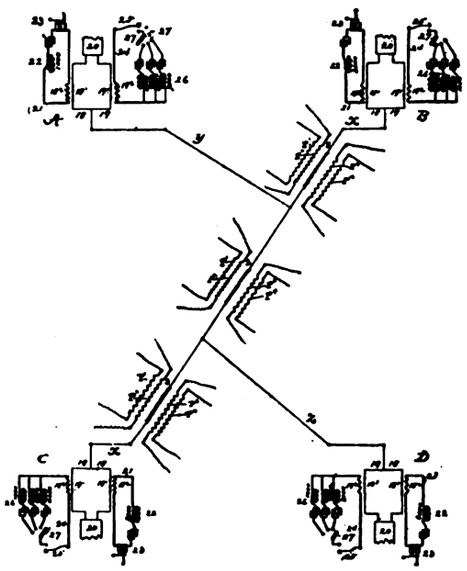
838,749. TELEPHONE SYSTEM. Henry L. Reber, St. Louis, Mo. Filed March 29, 1905. A modified transfer system.

838,764. MEANS FOR INSULATING ELECTRIC CONDUCTORS. Stanislaus Berger, Trier, Germany. Filed May 9, 1905. A duct filled with insulating material.

Digitized by Google

838,787. TELEPHONY. Isidor Kitsee, Philadelphia, Pa. Filed June 8, 1901. The switchboard is provided with soft-iron connectors adapted to act as armatures of a stationary electromagnet.

838,788. ELECTRIC TRANSMISSION OF INTELLIGENCE. Isidor Kitsee, Philadelphia, Pa. Filed August 11, 1906. Interference by a power circuit is prevented by surrounding the signal wires by a coil connected to a second coil surrounding the power wire.

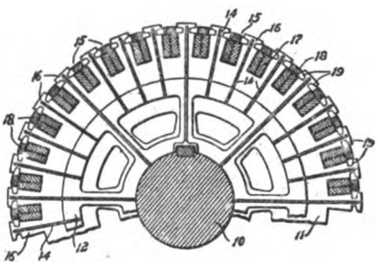


838,545.—Multiple Telegraphy and Telephony.

838,789. REFLECTOR. Charles J. Klein, New York, N. Y., assignor to Ralph A. Schoenberg, New York, N. Y. Filed August 11, 1905. A reflector fitting over the lower half of the lamp.

838,800. AUTOMATIC VOLTAGE REGULATOR FOR DYNAMOS. George S. Neeley, St. Louis, Mo. Filed July 31, 1905. The regulating resistance is controlled by a compound electromagnet.

838,801. METHOD OF REGULATING THE FIELD DENSITY OF ELECTRIC GENERATORS. George S. Neeley, St. Louis, Mo. Filed August 21, 1905. A differential electromagnet controls the field rheostat.



838,605.—Dynamo-Electric Machine.

838,802. AUTOMATIC REGULATOR FOR DIRECT-CURRENT DYNAMOS. George S. Neeley, St. Louis, Mo. Filed September 29, 1905. A compound electromagnet with its shunt winding in series with the field controls the regulating resistance.

838,811. ELECTRICAL RECEPTACLE. Bert E. Salisbury, Syracuse, N. Y., assignor to Pass & Seymour, Incorporated, Solvay, N. Y. Filed July 20, 1904. A circular receptacle for incandescent lamps.

838,822. BATTERY-CHARGING SYSTEM. William I. Thomson, Newark, N. J., assignor to the Safety Car Heating and Lighting Company, New York, N. Y. Filed August 17, 1904. The resistance controlling the charge is regulated by a double-wound electromagnet.

838,848. SIGNAL DEVICE. James S. Cunningham, Allegheny, Pa. Filed October 26, 1905. Telephone contact rails are carried parallel with the track.

838,850. AUTOMATIC CALL INDICATOR FOR TELEPHONES. Earl P. Denton and Arthur W. Nazor, Frankfort, Ky. Filed January 13, 1906. A telephone call-bell indicator automatically reset by the removal of the receiver.

838,854. ELECTRIC BLOCK-SIGNAL SYSTEM FOR RAILWAYS. George P. Finnigan, Greene, N. Y. Filed August 19, 1905. The signals of successive blocks are controlled by those of preceding blocks.

838,860. INCANDESCENT-LAMP GUARD. Harvey Hubbell, Bridgeport, Ct. Filed August 18, 1906. A wire cage guard.

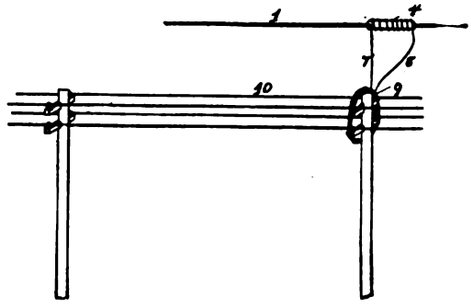
838,884. PLURAL-COIL ELECTRIC HEATER. James F. McElroy, Albany, N. Y., assignor to Consolidated Car-Heating Company, Albany, N. Y. Filed April 9, 1906. Several resistance elements are wound on the same support.

838,885. ALTERNATING-CURRENT HEATER. James F. McElroy, Albany, N. Y., assignor to Consolidated Car-Heating Company, Albany, N. Y. Filed September 6, 1906. A balanced electric heater for multiphase circuits.

838,916. INDUCTIVE BOND. Louis H. Thullen, Edgewood, Pa. Filed February 27, 1906. A bond wound on a core with a conductor leading from the middle point.

838,918. ELECTRIC ALARM CLOCK. Louis Trede, Durant, Iowa. Filed June 15, 1906. The alarm circuit is closed by the clock hands.

838,949. VAPOR RECTIFIER. Alexander Churchward, New York, N. Y., assignor to General Electric Company. Filed April 19, 1905. An automatically started electrifier.



838,788.—Electric Transmission of Intelligence.

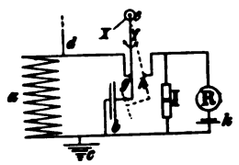
838,950. THERAPEUTIC LAMP. Harley E. Coger, Minneapolis, Minn., and John B. Marshall, Chicago, Ill., assignors to Spear-Marshall Company, Chicago, Ill. Filed August 31, 1905. The lamp is surrounded by a protecting reflector so as to throw but a single beam.

839,023. INCANDESCENT ELECTRIC LAMP. George A. Nellis, Allegheny, Pa. Filed September 25, 1905. The leading-in wires are helically wound.

839,027. ELECTRIC CONTACT DEVICE. Peder O. Pedersen, Copenhagen, Denmark. Filed April 15, 1904. Vibrations of a definite period are produced by an electromagnet.

839,029. RECEIVING SYSTEM FOR WIRELESS TRANSMISSION OF SIGNALS. Valdemar Poulsen, Copenhagen, Denmark. Filed October 2, 1905. A condenser charged by a wireless signal has its capacity changed by a local circuit.

839,048. AUTOMATIC CUT-OUT DEVICE FOR ELECTRIC CIRCUITS. William O. Taylor, Limerick Square, Pa. Filed January 3, 1905. A spark coil, the vibrating member of which is retarded by a dash pot.



839,029.—Receiving System for Wireless Transmission of Signals.

839,049. SPARK-PRODUCING DEVICE. Fredus A. Thurston, Chicago, Ill. Filed February 7, 1905. An electromagnet with a loose armature.

839,050. ATTACHMENT FOR ACOUSTICONS PERMITTING USE OF ORDINARY TELEPHONES. Kelly M. Turner, New York, N. Y. Filed April 9, 1906. The acousticon transmitter may be attached to an ordinary telephone receiver.

839,060. MACHINE FOR BENDING METAL STRIPS EDGEWISE. Gano S. Dunn, East Orange, N. J., assignor to Crocker-Wheeler Company, Ampere, N. J. Filed November 16, 1905. The strip is wound on a rotary mandrel by a reciprocating motion.

839,072. RAIL BOND. Frank D. Masterson, Boston, Mass., assignor to Chase-Shawmut Company, Boston, Mass. Filed October 2, 1905. A laminated bond.

839,079. TIME-LIMIT CIRCUIT-BREAKER. William M. Scott, Philadelphia, Pa., assignor to Cutter Electrical and Manufacturing Company. Filed February 17, 1903. The bridging member is released by the motion of a pivoted liquid-containing chamber which strikes the latch.

Digitized by Google

ELECTRICAL REVIEW

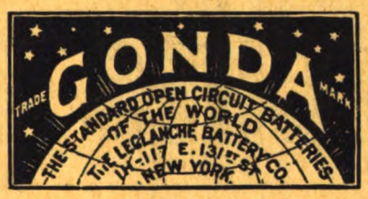
VOL. XLIX—No. 26. NEW YORK, SATURDAY, DECEMBER 29, 1906. THREE DOLLARS A YEAR.
Registered in United States Patent Office. SINGLE COPIES TEN CENTS.

The Phoenix Glass Co.
Pittsburg-New York-Chicago
MANUFACTURERS OF
Electric Globes and Shades *both ARC and INCANDESCENT*
Inner and Outer Globes *for all ENCLOSED ARC SYSTEMS*
CATALOGUES SENT ON REQUEST

"PHONO-ELECTRIC" TROLLEY WIRE
is used extensively by the leading railroads in this Country, Canada and Europe, and the companies using it claim that it gives a security and permanence to their lines that can be derived by the use of no other trolley wire.
BRIDGEPORT BRASS COMPANY
Postal Telegraph Bldg., Broadway and Murray St.
NEW YORK

"It's Tough" (3)

Easophones
The WIRE and TELEPHONE COMPANY of AMERICA
ROME, N.Y.
LONG DISTANCE HAND TELEPHONE
Long Horseshoe Magnet Receiver Solid Back Transmitter. No Exposed Connections. Exposed Bell Adjustment. Single Coil Ringer. Reversible Hook. Indestructibility.
Write for Bulletin No. 101



WILLARD L. CANDEE, H. DURANT CHEEVER } Mgrs.
GEO. T. MANSON, Gen. Supt. W. H. HODGINS, Secy.
1889 Paris Exposition Medal For Rubber Insulation
OKONITE
TRADE MARK
REG. U.S. PATENT OFFICE.
1893 World's Fair Medal For Rubber Insulation
THE OKONITE CO., Ltd. 253 Broadway, New York
The Standard for Rubber Insulation. Sole Manufacturers of Okonite Wires, Okonite Tape, Manson Tape, Candee Weatherproof Wires. Write for Prices.

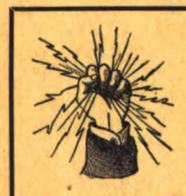
All progressive Central Stations and dealers buy
AMERICAN ELECTRIC HEATING APPLIANCES
AMERICAN ELEC. HEATER CO.
Main Office and Factory: DETROIT, MICH.
Branch: 7 & 9 Warren Street, NEW YORK

The National Conduit and Cable Company
EXECUTIVE OFFICES
41 PARK ROW NEW YORK, N. Y.
Manufacturers of
Bare Copper Wire and Cable
Weatherproof Wires and Cables
Paper Insulated Cables
For Power, Telephone and Telegraph
BOSTON PHILADELPHIA CHICAGO
SAN FRANCISCO

If the SUPPLY HOUSE you trade with does not keep our GOODS in stock, WRITE US. We will attend to your wants.

SHIPMENTS QUICK
NEW YORK INSULATED WIRE COMPANY
Main Office: 114 LIBERTY STREET, NEW YORK
Branches: CHICAGO, 192 Desplaines St. BOSTON, 7 Otis St.
SAN FRANCISCO, 766 Folsom St.

HYLO
THE ONLY SUCCESSFUL TURN-DOWN ELECTRIC LAMP. IT SAVES 5/6 OF YOUR LIGHT BILL. WRITE FOR OUR CATALOGUE AND PRICE LIST.
THE PHELPS COMPANY, 20 STATE ST. DETROIT, MICH.


American Electrical Works
Bare and Insulated Electric WIRE
Main Office and Factories
PHILLIPSDALE, - R. I.

Bristol Recording
Voltmeters : Ammeters
Wattmeters : Pressure
Gauges Thermometers
PAY FOR THEMSELVES
SEND FOR CATALOGUE J
THE BRISTOL CO.
WATERBURY, CONN.
N. Y. Office, 114 Liberty St.
Ch'go, 753 Monadnock Blg.

BISHOP WIRES AND CABLES
Meeting the most trying conditions a specialty

All kinds of FLEXIBLE CABLE. For Controlling, for Electric Lights, and for Annunciators in ELEVATORS
Also for Theatre and other trying work
BISHOP GUTTA-PERCHA COMPANY
420-430 EAST 25TH ST., NEW YORK 324 DEARBORN ST., CHICAGO

STANDARD UNDERGROUND CABLE CO.
FIBER PAPER RUBBER **ELECTRIC CABLES** FOR ALL CLASSES OF SERVICE
HIGH-GRADE BARE, RUBBER COVERED AND WEATHERPROOF **WIRES** TELEPHONE, TELEGRAPH, ELECTRIC LIGHT AND POWER
Westinghouse Bldg., Pittsburgh, Pa.; 56 Liberty St., New York; 1225 Betz Bldg., Philadelphia, Pa.; Security Bldg., St. Louis; 322 The Rookery, Chicago, Ill.; Bacon Block, Oakland, Cal.; 10 Post Office Square, Boston, Mass.

LAMP CORDS AND **ELECTRICAL WIRES**
LOWELL INSULATED WIRE CO.
LOWELL, MASS.

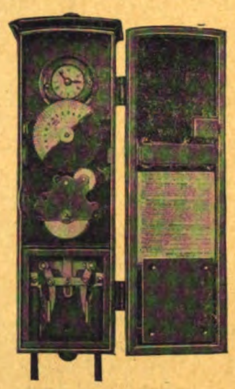
INDIANA RUBBER AND INSULATED WIRE CO.
MANUFACTURERS OF
PARANITE RUBBER COVERED WIRES AND CABLES
Underground, Aerial, Submarine and Inside Use
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES
All Wires Are Tested at Factory JONESBORO, IND.

SIMPLEX
RUBBER INSULATED
WIRES AND **CABLES**
Aerial Submarine Flameproof
Lead Covered Steel Taped
Prompt Attention to Special Requirements
THE SIMPLEX ELECTRICAL CO.
1140 MONADNOCK BLK. CHICAGO
110 STATE STREET, BOSTON.

MOORE WIRE CORDS CABLES
ALFRED F. MOORE, Philadelphia, Pa.

Digitized by Google

AN INTERESTING PROPOSITION



For The ELECTRIC LIGHT COMPANY
The RETAIL MERCHANT
The THEATRICAL MANAGER
The HOTEL MAN

Or any live business man using electrical illumination for advertising purposes.
A small initial expenditure will procure years of faithful service.
This silent but industrious little boxful of mechanism will turn your lights on and off intelligently and surely, without superintendence, without need of reminder, and without further payment.

MAY WE SEND YOU A DESCRIPTIVE CIRCULAR OF THE **ANDERSON TIME SWITCH?**

Albert & J. M. Anderson Mfg. Company

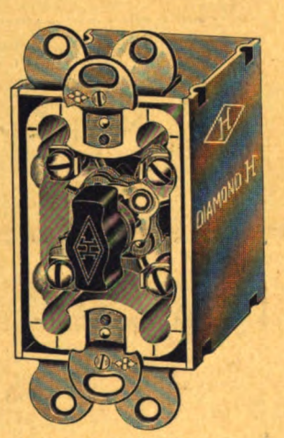
Main Office and Factory, 289-293 A STREET, BOSTON, MASS.

E - J E P C O BOSTON

"DIAMOND H" SWITCHES

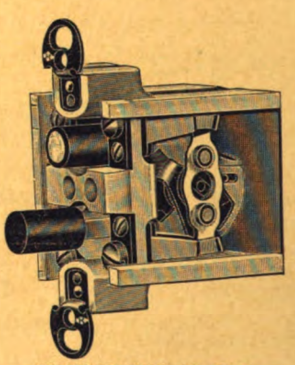
AND

FLUSH RECEPTACLES



ROTARY FLUSH SWITCH
In No. 81 Galvanized Wall Case

are unequalled in durability and efficiency. They are made of the best material only and assembled with care and absolute accuracy, making them the best on the market.



PUSH-BUTTON SWITCH
With side cut away to show construction

Buy them the next time you want a good switch and get complete satisfaction, and bear in mind the fact that

IF YOU WANT SWITCHES OF OUR MANUFACTURE ALWAYS SPECIFY

"DIAMOND H"

Made by

Hart Mfg. Company, Hartford, Conn.

NEW YORK BOSTON CHICAGO TORONTO, ONT. DENVER SAN FRANCISCO LONDON, ENG.

ACCURATE EFFICIENT RELIABLE INDICATING

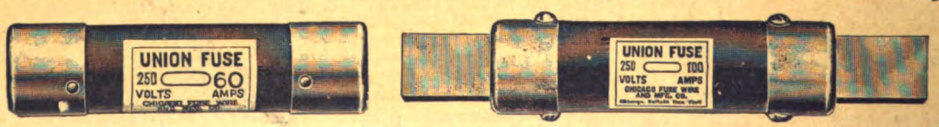
DO NOT HESITATE

SPECIFY "UNION" ON YOUR NEXT ORDER

FOR ENCLOSED FUSES

Approved by Underwriters' Laboratory

Write for Catalogue No. 18



CHICAGO FUSE WIRE & MFG. CO. NEW YORK CHICAGO

Digitized by Google

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

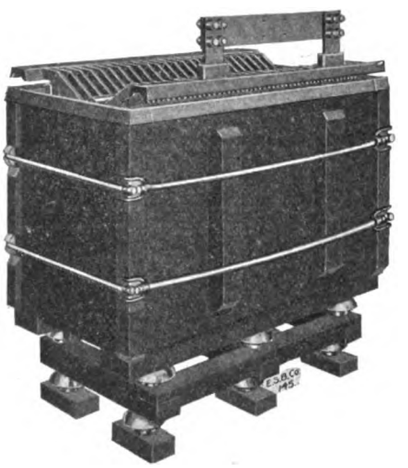
MANUFACTURER OF THE "Chloride Accumulator"

FOR

Central Lighting and Power Stations

Electric Railway Power Houses

Isolated Lighting and Power



Descriptive Bulletins Forwarded Upon Request

SALES OFFICES

PHILADELPHIA: Allegheny Ave. & 19th St. NEW YORK: 100 Broadway BOSTON: 60 State St. CHICAGO: Marquette Bldg. PITTSBURG: Frick Bldg. Annex ST. LOUIS: Wainwright Bldg. CLEVELAND: Citizens' Bldg. OAKLAND, CAL.: 525 Thirteenth St.

CANADA: Canadian General Electric Co., Ltd., Toronto CUBA: G. F. Greenwood, Mgr., 84 Empedrado Street, Havana

(4)

THERE ARE REASONS WHY

PEERLESS LAMPS

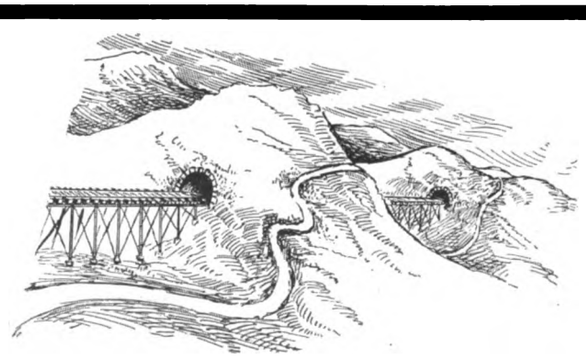
ARE MORE UNIFORMLY SATISFACTORY THAN OTHERS

The chief reason is that they are more carefully made than others. Every PEERLESS is just as good as every other PEERLESS, that is to say, each and every one is without a flaw or defect.

THE WESCO SUPPLY CO.

"EVERYTHING ELECTRICAL"

FORT WORTH ST. LOUIS (7)



WHICH ROAD WILL YOU TAKE?

Will you take the road that leads over the hills in a roundabout way or will you take the straight and safe course through the mountain of detail? Every step the old way is dangerous. Old-style instruments may endanger your profits.

KEYSTONE INSTRUMENTS will lead you to new economies. They have a world-wide reputation for quality, accuracy and reliability. They are not cheap instruments, but they are less costly than any that cost less, and as good as any that cost more—we couldn't make them any better if we wanted to.

KEYSTONE INSTRUMENTS are the short cut to profits.

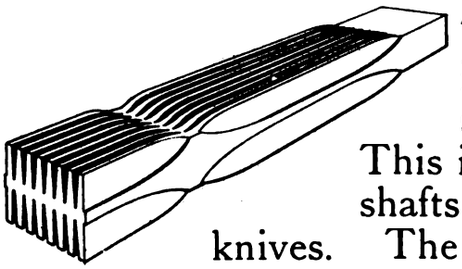
Send for Catalogues 12 and 13 describing A. C. and D. C. Switchboard and portable instruments.

KEYSTONE ELECTRICAL INSTRUMENT COMPANY, NINTH STREET AND MONTGOMERY AVENUE PHILADELPHIA, PA.

New York, 114 Liberty Street Boston, 170 Summer Street Chicago, 165 S. Canal Street (3)

Digitized by Google

Gould Battery Plate Formation.



The Gould Storage Battery Plate is absolutely integral. A "blank" plate is first cut from a sheet of densely rolled, chemically-pure lead. This is then passed between two rapidly revolving shafts on which are mounted sets of circular steel knives. The knives penetrate into the lead further and further as the process advances, spinning the displaced metal into the narrow ribs between the knives. The total area thus developed as a contact surface for active material is enormous.

It is of especial note that no lead is removed or added in the process—the blank is merely changed in form.

No other Battery plate so completely fulfills the accepted requirements of an ideal storage battery plate. The results of practical experience bear out this assertion. Every detail of the Gould Battery highly recommends its selection for large and important service. Write for our Bulletins. 82

SALES OFFICES
Chicago, Rookery Bldg.
Boston, 89 State Street
San Francisco,
Room 705 Monadnock Bldg.

Gould Storage Battery Co.

MAIN OFFICE
1 West 34th Street
New York City

Works, Depew, N. Y.

Toronto, Ont., 62-64 Wellington Street, West

SHAWMUT

National Electrical Code Standard

Enclosed Indicating Fuses

**WELL DESIGNED
WELL BUILT
WELL TESTED**

Do you need a GOOD FUSE?

**WHY NOT GET NEW PRICES
NEW DISCOUNTS
IN BULLETIN No. 32?**

CHASE-SHAWMUT COMPANY

NEWBURYPORT, MASS.

FOR IMMEDIATE SHIPMENT

OKONITE
TRADE MARK

Okonite Wires **Okonite Tape**

Manson Tape

Candee Weather-Proof Wires

"Flexduct," Noark Fuse and Blocks, made by H. W. Johns-Manville Co. Femco and Columbia Incandescent Lamps, G. I. Arc Lamps, Columbia Dry Batteries, made by the National Carbon Co. Samson Batteries, made by the Electric Gas Light Co. Bossert Boxes and Supplies. Hart & Hegeman and Perkin's Switches.

THE F. D. LAWRENCE ELECTRIC CO.

219 W. Fourth Street, Cincinnati, Ohio 5

Digitized by Google

VICTOR INSULATORS

No. 407—Porcelain Insulators.
Diameter 6½ inches.
Height 5⅛ inches.
For lines of 16,500 volts.
This Insulator is made of two pieces cemented together.

(6)

THE LOCKE INSULATOR MFG. CO.
VICTOR, N.Y.

SEE THE

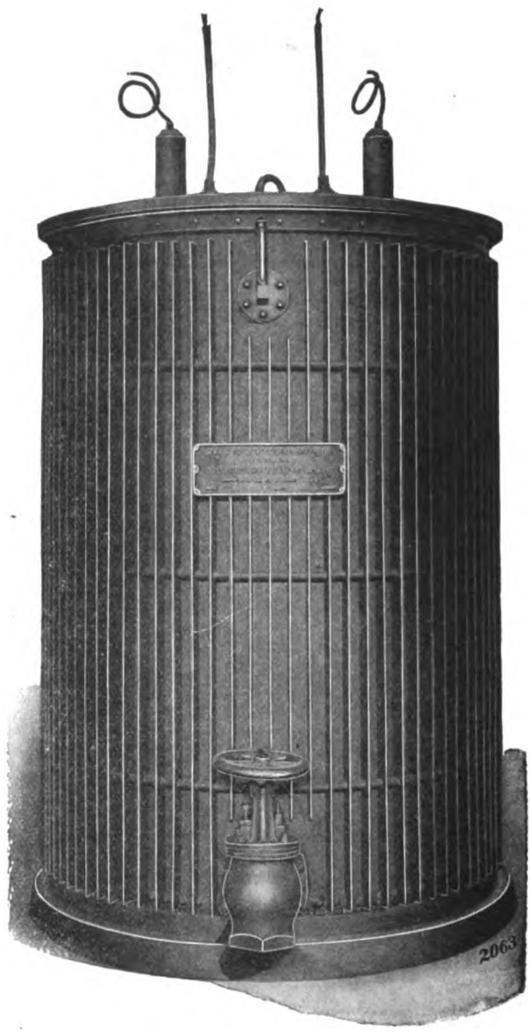
Teats on the Petticoat

They take all the moisture from the inner and outer surface of the insulator and keep the pin dry.

Hemingray Glass Company

ESTABLISHED 1848
INCORPORATED 1870 } COVINGTON, KY

Factories, - MUNCIE, INDIANA



100 K. W., 2,200 to 24,000 volt, Oil Filled, Self Cooled "Heavy Duty" Transformer.

LARGE Transformer Units manufactured by this company eight and nine years ago are still operating without any signs of deterioration or stress. We manufacture Transformer Units in any capacity and for any voltage.

¶ Repetition orders are a pretty good indication of good value. We are handling the entire Transformer requirements of a great many central stations. We have held this Transformer business in spite of the fact that our customers have been offered Transformers of other makes at less money.

¶ We would be pleased to correspond with Central Station managers in reference to their Transformer needs. We have many testimonials from central station men who have used our apparatus. Our form of coil winding permits of good regulation with good insulation. Write for bulletin S.

Wagner Electric Manufacturing Co.

Saint Louis, Mo.

Digitized by Google

The Leeds & Northrup Co.

4901 Stenton Avenue, Philadelphia
Monadnock Block, Chicago

The L. & N. Portable Testing Sets are accurate instruments for the convenient measurement of resistance and location of faults.
We make a complete line of Cable Testing Apparatus, Standardizing Apparatus for Calibrating Ammeters and Voltmeters, Galvanometers, Resistance Boxes and Standards, Condensers and other electrical measuring apparatus. Our complete illustrated catalogues sent on request.

Electrical Measuring Instruments

In the HEART of the
NEW ELECTRICAL CENTER
OF NEW YORK

THE BEST EQUIPPED ELECTRICAL SUPPLY STORE

STANLEY AND PATTERSON
23 MURRAY STREET 27 WARREN STREET
(FROM BLOCK TO BLOCK)

GENERAL STORAGE BATTERY CO. BIJUR HIGH DUTY NEW YORK

BIJUR BATTERIES BUILT FOR BUSINESS

GENERAL STORAGE BATTERY CO
42 BROADWAY, NEW YORK

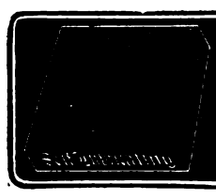
SMALL but ACCURATE

OUR NEW
Switchboard Voltmeters and Ammeters
Are Just the Thing Where Space Is Limited.

PRICE IS LOW

Send for Catalog of Portable and Switchboard Instruments.

L. M. PIGNOLET
78 Cortlandt Street :: New York



COMMUTATOR INSURANCE

That's what we offer, for there's no friction or wear with these brushes.
Being 90% pure graphite insures low resistance, no sparking under varying load, longer wear and no greasing.

HOLMES BRE-GRAPHITE MFG.

KELLOGG CEDAR
SWITCHBOARD & SUPPLY COMPANY **POLES**

CHICAGO, ILL. Write us for Cedar-Pole "Booklet No. 3-E"

VOLT AND AMMETERS
DIRECT OR ALTERNATING
High-Grade Instruments at Reasonable Prices
Send for Catalogue and Discounts

DONGAN INSTRUMENT COMPANY
ALBANY, N. Y.

THE ROESSLER & HASSLACHER CHEMICAL COMPANY CHEMISTS NEW YORK TRADE MARK

Battery Brand
SAL AMMONIAC
BLUESTONE
CHLORIDE OF ZINC
Fused and Granular

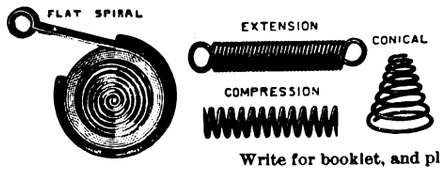
The Roessler & Hasslacher Chemical Company
100 William Street, New York

HOW ARE YOUR BATTERIES?

The "Connecticut" pocket meters will tell you.
TWO METERS IN ONE
0-6 volts—0-30 amperes - - $6.00
Ammeter only—0-30 amperes - $4.00
The ampere side is used for testing dry and wet batteries, the voltage side for storage batteries.
ACCURATE, DURABLE, LOW IN PRICE
CONNECTICUT TELEPHONE & ELECTRIC CO.
MERIDEN, CONN., U. S. A.
Send for circular No. 40

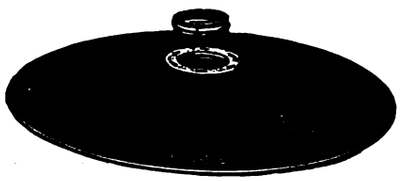
CARY SPRING WORKS

240 and 242 West 29th Street, New York City



Manufacturers of
Wire and Springs
For Machinery, Motors, Clocks, Music Boxes and all kinds of Electrical Purposes

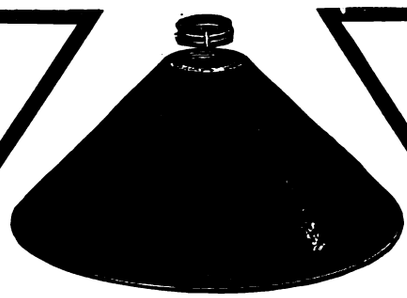
Write for booklet, and please mention this paper.



No. 5432—10-inch, Flat

THE SHADE THAT
CANNOT BECOME LOOSE

When you see a room full of shades standing at all angles, you can depend upon it that they are not Hubbell's.

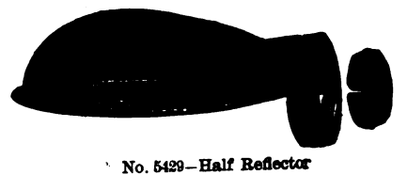


No. 5441—10-inch Cone

HUBBELL'S

The Shade that doesn't require any shade holder, screws or tools to attach.

HARVEY HUBBELL,
Incorporated
Main Office and Factory:
BRIDGEPORT, CONN.



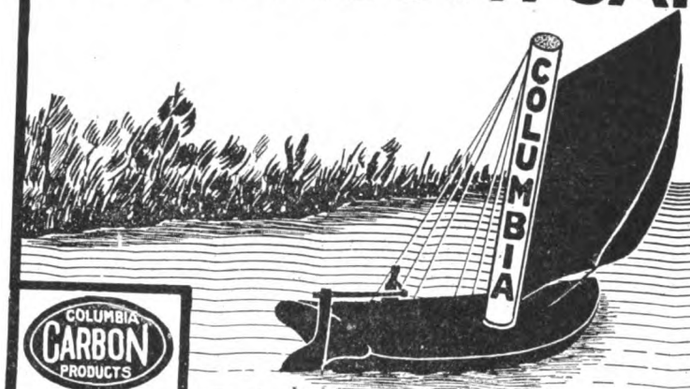
No. 5429—Half Reflector

THE SHADE THAT
CAN BE ATTACHED ONLY ONE WAY—VIZ: "STRAIGHT."
AND WILL STAY SO IN SPITE OF ALL ABUSE
Fit all sockets and cost only a few cents more than the other kind with a [illegible] shade holder.

CANADIAN AGENTS:
R. E. T. PRINGLE CO., Ltd., Montreal

Digitized by Google

IT'S SMOOTH SAILING FOR USERS OF COLUMBIA CARBONS



COLUMBIA CARBON PRODUCTS

NATIONAL CARBON CO.,
CLEVELAND, OHIO, U.S.A.

Okonite Tape—Manson Tape

The Standard For RUBBER TAPE

The Standard For FRICTION TAPE

To make a perfect insulation all wire joints should be taped, first with OKONITE rubber tape, and second with MANSON friction Tape.

OKONITE tape is thoroughly waterproof and a perfect insulating medium. It is not injured by exposure to weather, does not deteriorate.

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

GENERAL WESTERN AGENTS:
264-266-268-270 Fifth Avenue, Chicago

OKONITE

TRADE MARK
REG. U.S. PATENT OFFICE.

The Standard For Rubber Insulation

IT TAKES A LIVE FISH TO SWIM UP STREAM

ANY DEAD ONE CAN FLOAT DOWN

WE ARE SURE ENOUGH "LIVE ONES"

ROCK ISLAND DRY CELLS

THE BEST IN EVERY TEST

Write for Samples and Prices

ROCK ISLAND BATTERY CO.

CINCINNATI - - - OHIO

ELECTRIC WAGONS

TRUCKS AND CARS.

FOR LIGHT AND HEAVY HAULING

THE ELWELL-PARKER ELECTRIC CO. OF AMERICA

CLEVELAND, OHIO, U.S.A.

Wire Machinery

Insulating, Cabling and Stranding Machines

Rubber Mill Machinery
Hydraulic Machines

Aiton Machine Company

ARTHUR B. SEVES, PRESIDENT THOS. A. AITON, VICE-PRESIDENT
JOHN B. SHOWELL, SECRETARY

126 Liberty St., New York Works: Harrison, N. J.

Digitized by Google

OH, DO WAKE UP!

Here is a meter that you can erect, connect and then let alone except for taking your readings. It has no commutator to roughen, blacken or short-circuit; it has no heavy moving system grinding away on an expensive jewel, in fact there is no weight at all on its lower bearing; it contains no wooden blocks to shrink and warp and no porcelain pieces to crack; your lineman can put it up without having first to qualify as a meter expert; it is small, neat, absolutely dust and vibration-proof, and defies short-circuits; its mechanical design and the workmanship and the materials employed are without equal in the meter field; it has higher initial and higher sustained accuracy than any other meter; in short, it is far and away the best. Get one or two or a hundred or two and try them out. We can guarantee the result.

Made for Direct Current and for Alternating Current

FULL PRINTED MATTER SENT ON REQUEST

Sangamo Electric Co.

Springfield, Ill.

SALES AGENTS:

Electric Appliance Co., Chicago and San Francisco
Wesco Supply Co., St. Louis and Fort Worth
Machado & Roller, New York and Chicago
John Forman, Montreal

Digitized by Google

Results Count—and that is why

"AMERICAN"

Voltmeters and Ammeters

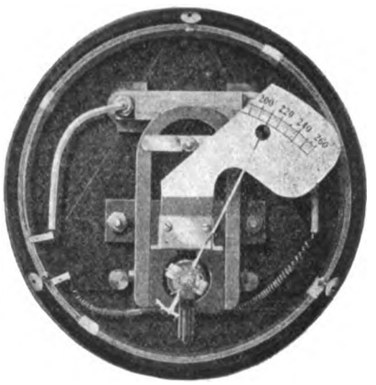
are being specified and used by the most prominent electrical men throughout the country.

Have you noticed the large scale opening on Switchboard types? It lets in plenty of light and makes them easy to read.

Cylindrical pivots, really dust-proof cases, strong controlling springs, interchangeable shunts, etc., are a few other unique features which make "AMERICAN" instruments superior to others.

If you have not tried "AMERICAN" instruments do so now.

WRITE FOR CATALOG 60



AMERICAN INSTRUMENT Co

James G. Biddle, General Sales Agent, 1114 Chestnut St., PHILADELPHIA

T. G. SEIXAS, SINGER BLDG., NEW YORK A. B. WEEKS, 5628 JACKSON AVE., CHICAGO HOLABIRD-REYNOLDS ELECTRIC CO., 116 EAST 5TH ST., LOS ANGELES

Established 1875

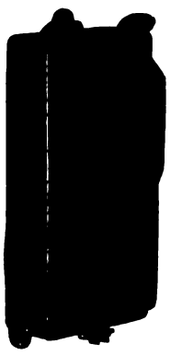
We make these and dozens of other composition devices

Bushings, Rings, Collars, Coil Plugs, Battery Covers, Switch Bases, Switch Keys, Socket Keys, Handles, Mouth Pieces, Etc. (1)

And we do our work RIGHT

DICKINSON MANUFACTURING CO.

SPRINGFIELD, MASS. U.S.A.



Service Boxes

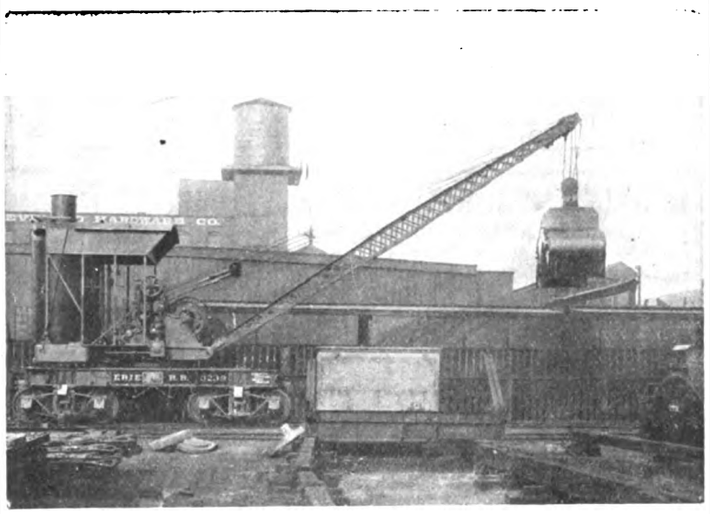
We couldn't improve the switches, so we improved the Boxes. You are going to hear a lot about them, but just a word in advance. The neatest Service Boxes you ever saw. A complete line of Weatherproof, Self-Closing Service Boxes, equipped for gasket, drilled for conduit, or with bushings.

The Trumbull Electric Mfg. Co.

PLAINVILLE, CONN.

BROWN HOIST
LOCOMOTIVE CRANES

are found to be exceedingly economical Tools about power and lighting stations



The Brown Hoisting Machinery Company

ENGINEERS AND MANUFACTURERS HOISTING MACHINERY FOR ALL PURPOSES

Office and Works: CLEVELAND, OHIO

Branch Offices, New York and Pittsburg

DUNCAN METERS

FOR

DIRECT CURRENTS

ALTERNATING CURRENTS

READ IN

WATT HOURS

KILOWATT HOURS

OR

DOLLARS AND CENTS

SEND FOR BULLETINS

DUNCAN ELECTRIC MFG. CO.

LA FAYETTE, IND.

Digitized by Google

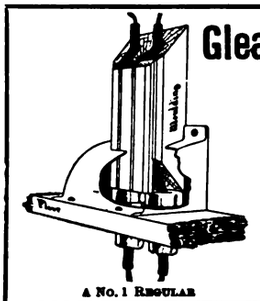
"GRIPTITE"
GROUND CONNECTING CLAMP
For Grounding Metal Conduit and Lead Cables
Patent Pending

MADE FOR
½, ¾, 1, 1¼, 1½, 2, 2½ and 3-inch
IRON PIPE
TAKES
GROUND WIRE
To No. 4, B. & S.

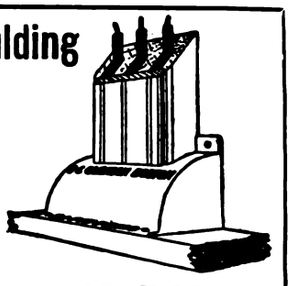
NATIONAL ELECTRICAL CODE STANDARD
MANUFACTURED BY
NOVELTY ELECTRIC CO.
PHILADELPHIA, PA.
Ask for Prices and Discounts . . .

Successful for over 14 years

ALLEN SOLDERING SALTS
are not new, but have been making solder flow and stick in all kinds of electrical work for over 14 years
THAT'S THE BEST INDORSEMENT WE KNOW OF
L. B. ALLEN CO., Inc., 1335 Columbia Ave. CHICAGO, ILL.



Gleason's Moulding Boxes
Send postal for Pamphlet and Price List to
JOHN L. GLEASON
290 South St.,
JAMAICA PLAIN,
MASSACHUSETTS



A No. 1 REGULAR B No. 1 REGULAR

RUBBER COVERED WIRES AND CABLES
NATIONAL INDIA RUBBER CO.
Factories and General Offices
BRISTOL, R. I.
New York Office, 42 Broadway

HABIRSHAW WIRES AND CABLES
The India Rubber and Gutta-Percha Insulating Co.
SALES OFFICE, 253 BROADWAY, NEW YORK
OFFICE AND FACTORY, GLENWOOD WORKS, YONKERS, N. Y.

Chicago Insulated Wire & Mfg Co.
National Electrical Code Standard Bare and Insulated Electrical Wires
CHICAGO, ILL.

RUBBER COVERED WIRES & CABLES
For Every Service

SEAMLESS RUBBER SAFETY INSULATIONS

For Underground, Aerial and Submarine use, "SAFETY" wires and cables have the endorsement of some of the largest users in the United States.

The Safety Insulated Wire & Cable Co.
114-116 LIBERTY ST., NEW YORK

HY AND DE
INSULATED
WIRES & CABLES
UNDERGROUND TRANSMISSION
UNDER ANY VOLTAGE
DIELECTRIC CO. OF AMERICA
BELLEVILLE, N. J.

WINDING MACHINERY
FOR INSULATING WIRE
American Insulating Machinery Co.
N. W. Cor. Hancock and Oxford Streets
PHILADELPHIA, PA.

AMERICAN SEWER PIPE CO. CONDUITS
The largest manufacturers of glazed earthenware in the world.
General Offices, PITTSBURG, PA.

H. N. FENNER, President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer
NEW ENGLAND BUTT COMPANY
Manufacturers of
MACHINERY FOR INSULATING ELECTRICAL WIRES
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders
FINE CASTINGS A SPECIALTY
304 PEARL STREET, - - - - PROVIDENCE, R. I., U. S. A.

Digitized by Google

OKONITE
TRADE MARK
REG. U.S. PATENT OFFICE.

The Standard for Rubber Insulation

Okonite Insulated Wires and Cables
Candee Patented Potheads
Okonite Tape
Manson Tape

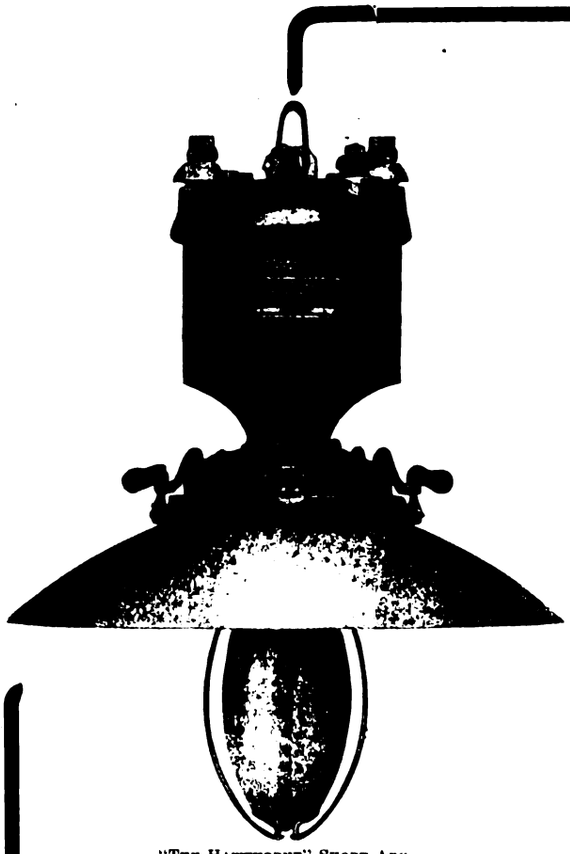
For years the recognized Standard in their respective fields

SOLE MANUFACTURERS

THE OKONITE COMPANY, Ltd.

253 BROADWAY
NEW YORK

Digitized by Google



"The Hawthorne" Short Arc
110 or 220 Volts D. C.

DON'T WORRY ABOUT THE CEILING HEIGHT

Our New *Special* Design *Short Arc* is *only 20 inches over all*

We guarantee a burn of 100 hours each trimming. Maximum carbon length.

Special attention has been given to the construction of this lamp to secure adequate ventilation, while at the same time protecting the regulating mechanism from harmful accumulations of dust.

The perfect Lamp for basements and low boiler and engine rooms, where the heat accumulating is often very great.

Provision is made to preserve the Lamp absolutely from injury, even where fuses are entirely omitted, and our Lamp may stand with the arc absolutely short-circuited for hours without material injury and will be found ready for normal operation the moment proper conditions are restored.

WESTERN ELECTRIC COMPANY

CHICAGO NEW YORK PHILADELPHIA ST. LOUIS SAN FRANCISCO
DENVER KANSAS CITY ST. PAUL SEATTLE PITTSBURG
LOS ANGELES CINCINNATI

Get Prices on Incandescent Lamps

from us—Learn about the quality of the product from our factory.

LOOK FOR THE PATENT PROTECTION LABEL IN THE STEM

WE ARE INDEPENDENT.

SAINT MARYS Incandescent Lamp Co.
SAINT MARYS, PENN.

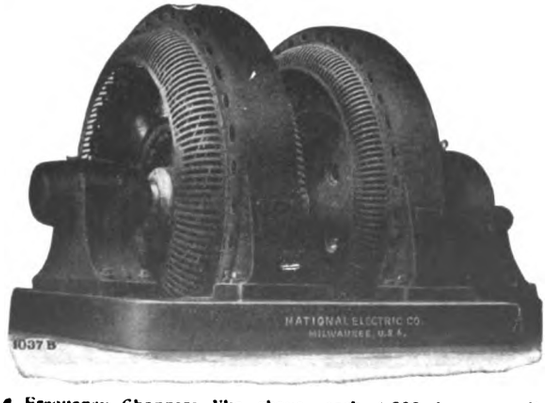
Franklin Double Refracting Electrics

ALL STYLES GLASS FOR ELECTRIC LIGHTING

Gillinder & Sons, Inc.
135 Oxford Street
Philadelphia

SALESROOMS
Phila. .. 839 Market St.
New York, 42 W. Broadway
Chicago .. 160 State St.
Boston . 67 Chauncey St.

Bulletin Shows Twenty-one Varieties



4 Frequency Changers like above, each 1,000 kw. capacity, installed by us on a recent order

Electrical Machinery

for Lighting, Power and Railway Service

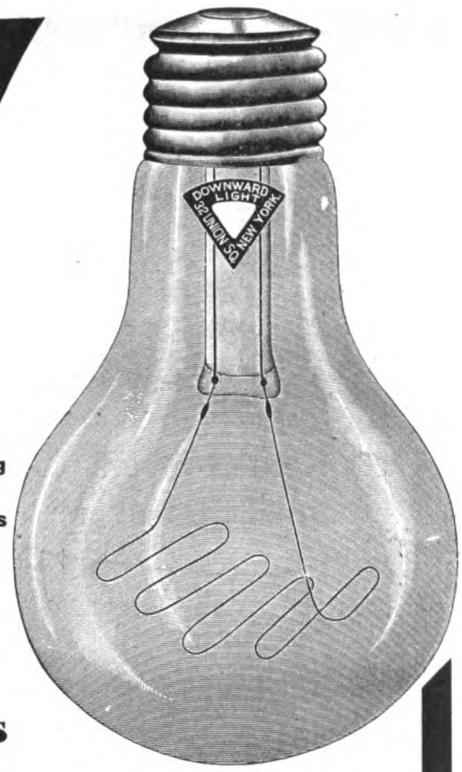
Built in All Types and Capacities

National Brake & Electric Co.
Milwaukee, U. S. A.

General Sales Office, 519 First National Bank Building, Chicago

Digitized by Google

GREATER ILLUMINATION AT LESS COST



Why do you persist in buying lamps that produce useless light?

Why don't you figure on the light you use?

The New 40-Watt DOWNWARD (TRADE MARK) LAMP is highest in illuminating efficiency.

Compared with the best ordinary 3.1-Watt 16 C. P. Lamp, it shows

20% LESS CURRENT
71% MORE DOWNWARD LIGHT
145% LONGER LIFE

Tipless DOWNWARD (TRADE MARK) Lamps, 18 cents

AGENTS WANTED

Downward Electric Light Company

UNION SQUARE, NEW YORK

Lamp with Porcelain Reflector

ALL THE OBJECTIONS TO THE ORDINARY ARC LAMP HAVE BEEN ELIMINATED IN THE NEW

A=B Arc Lamp

IT IS NOISELESS

No slipping nor jarring of carbons

Less breaking of inner globes

Candle power efficiency

THIS LAMP WILL BURN FROM 60 TO 70 HOURS with one set of carbons, much depending upon the quality of the carbons used, current consumed and care taken in trimming.
Has no complicated mechanism, and no more parts than are absolutely necessary for reliable operation.

Send for new Bulletins showing different types

Adams-Bagnall Electric Co.

CLEVELAND, O., U. S. A.

Canadian Agents: The R. E. T. Pringle Co., Ltd., Montreal, P. Q.

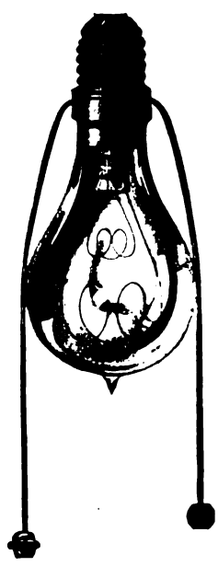
BRANCHES IN ALL THE PRINCIPAL CITIES

3

3 DEGREES OF LIGHT

"3-STEP"

HYLO



In halls and vestibules a dim light all night, a moderate light during the evening, and a brilliant light for company, is desirable. The three-step **HYLO** gives 4 candle power for early evenings, 1 candle power all night after ten o'clock, and 16 candle power for company. Also made in five other combinations.

Please Your Customers

Get the things they want. Make them comfortable and happy. All our **HYLO** lamps make happy homes, but the particular style and candle power combination which exactly fits the need makes the most happy home.

NOTE—Write for bill posting particulars, The **HYLO** Magazine, The Complete Price List. Send 50c. for sample 3-Step.

THE PHELPS CO.

20 State Street, Detroit, Mich.

Digitized by Google

ADVANCED CONSTRUCTION

is embodied in the N. Y. Automatic Motor Starter. Its accomplishments in operation and its excellence of construction are such that every engineer should know about it. Send for a bulletin and price information of the N. Y. MOTOR CONTROLLER.

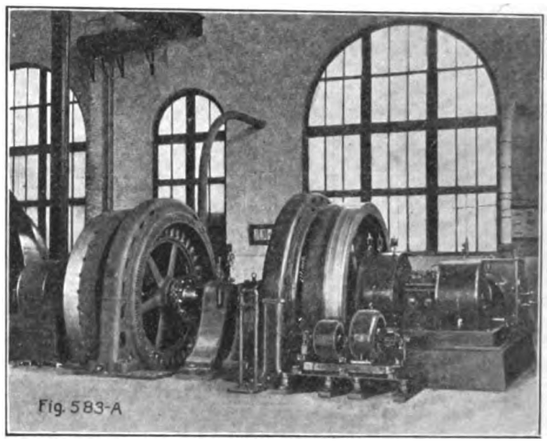
Note that it Eliminates

Solenoids,
Rubbing Contacts,
Dash Pots,
Suction Air Pots,
Cams, Gears,
Belts,
Compression Cylinders,
Retarding Springs

New York Electric Controller Co.

21-27 New Chambers Street NEW YORK

C-W ALTERNATORS FOR ISOLATED PLANTS



The C-W Alternators at Armour & Co.'s Plant, Chicago, Ill.

We are not alone in believing that we are ahead of the market in A. C. design. Send for Bulletins Nos. 74 K and 77 K, "Alternating Current Generators."

CROCKER-WHEELER COMPANY

ALTERNATING AND DIRECT CURRENT MACHINERY

AMPERE, N. J.

MOTORS AND DYNAMOS

FOR

DIRECT AND

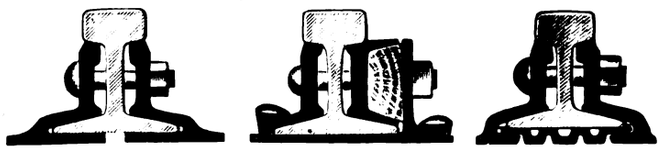
ALTERNATING CURRENT

BURKE ELECTRIC COMPANY

Main Office and Works, Erie, Pa.

NEW YORK 26 Cortlandt Street
PITTSBURG Park Building
PHILADELPHIA Real Estate Trust Building
CHICAGO: Maural & Co., Fisher Building

OVER 25,000 MILES IN USE



THE RAIL JOINT COMPANY

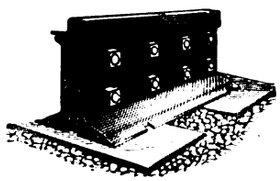
GENERAL OFFICES: 29 WEST 34TH ST., NEW YORK CITY

Makers of

Continuous, Weber and Wolhaupter Rail Joints

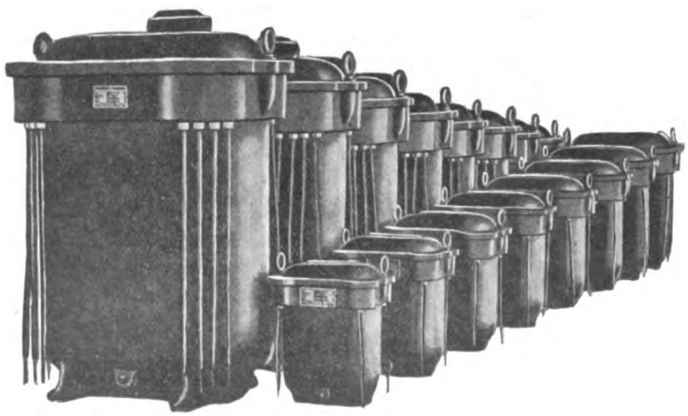
Compromise and Insulating Joints

Protected by United States Patents



Branch Selling Agencies
Atlanta, Ga.
Baltimore, Md.
Boston, Mass.
Chicago, Ill.
Cincinnati, O.
Denver, Colo.
New York, N. Y.
New Orleans, La.
Pittsburg, Pa.
Portland, Ore.
Seattle, Wash.
St. Louis, Mo.
St. Paul, Minn.
Troy, N. Y.

Catalogues at all Selling Agencies



HORNBERGER TRANSFORMERS

1891 - 1906

The superiority of these Transformers is not a matter of discussion but an unassailable fact. A trial will convince. Our prices are right. Ask for Bulletin E.

Lafayette Electrical Mfg. Co.

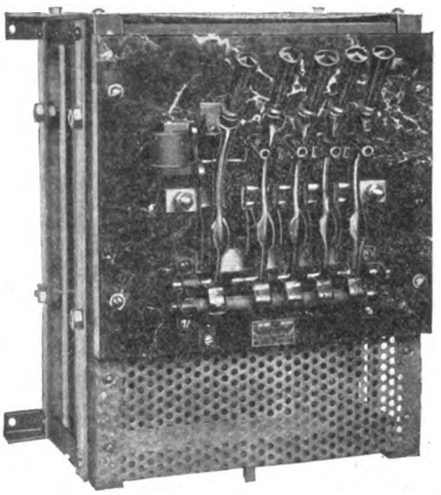
LAFAYETTE, IND., U. S. A.

Digitized by Google

REGULATORS FOR FAN MOTORS

MULTIPLE SWITCH TYPE FOR LARGE MOTORS

SLIDING CONTACT TYPE FOR SMALL MOTORS



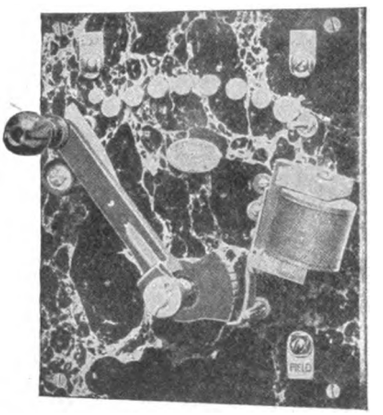
MULTIPLE SWITCH REGULATOR

All Fitted with Automatic Release, Which Fully Protects the Motor from Injury Due to Failure of Current Supply

A peculiar set of conditions is created in the operation of a Fan Motor, owing to the widely varying power required at various speeds.

C. & H. Regulators will operate satisfactorily under these conditions, without undue heating, provided the motor is properly fitted to the size of the fan.

BULLETIN No. 40 GIVES SOME USEFUL INFORMATION CONCERNING FAN INSTALLATIONS



SLIDING CONTACT TYPE REGULATOR

THE CUTLER-HAMMER MFG. CO.

NEW YORK BOSTON MILWAUKEE CHICAGO PITTSBURG

Diehl Motors For All Purposes

Motors for Individual Drive for Sewing Machines

Four Sizes Direct Current

Two Sizes Alternating Current

Catalogue No. 210, 1-7 H. P.

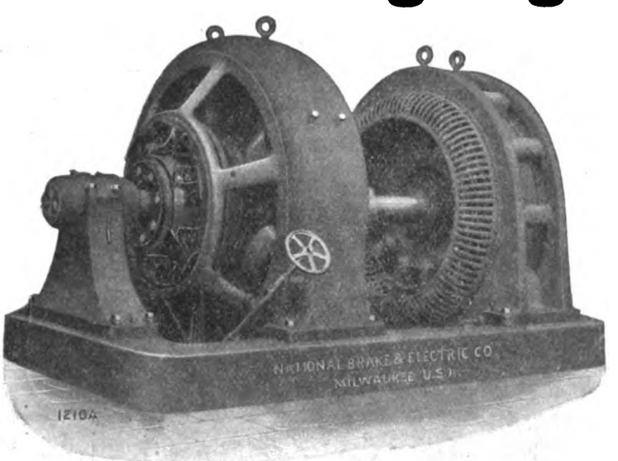
SEND FOR BULLETINS

Diehl Manufacturing Co.

ELIZABETHPORT, New Jersey

Branches: New York Philadelphia Boston Chicago

Motor Generator Sets For Powor AND Lighting



500 K. W. MOTOR GENERATOR SET

NATIONAL BRAKE & ELECTRIC CO.

MILWAUKEE

GENERAL SALES OFFICE

519 First National Bank Building, CHICAGO

Digitized by Google

NEW YEAR

Reaching every department of the vast

January Twelfth

Twelve days after the mass of holiday literature and
will be essential to all those who desire
and development of the electric

REVIEW OF ELECT

Technical and Literary Value

The reading pages of this New Year's Number will present a series of intelligent and comprehensive reviews of the progress made in the several branches of electrical development. These articles will be written by men who either by reason of their close study of, or intimate connection with, these departments of electrical activity, are accepted as authorities upon the subjects which they discuss. Among other contributors to this important number the following will write especially for the ELECTRICAL REVIEW:

NEWER FORMS OF ILLUMINANTS AND ELECTRIC LIGHTING, by Dr. Clayton H. Sharp, *Test Officer, Electrical Testing Laboratories.*

ELECTRIC TRUNK RAILWAYS, Dr. Louis Bell, *Consulting Engineer, author of "Electric Power Transmission," "Power Distribution for Electric Railways," etc., etc.*

TELEGRAPHY AND RADIOTELEGRAPHY, by William Maver, Jr., *Consulting Engineer, author of "American Telegraphy and Encyclopedia of the Telegraph," "Wireless Telegraphy," etc.*

GENERAL TENDENCIES IN CENTRAL STATION PRACTICE, by Frank Koester, *Consulting Engineer, author of "Modern Power-Plant Design and Economics," etc.*

ELECTROCHEMISTRY AND ELECTROMETALLURGY, by C. F. Burgess, *Professor of Electrochemistry, University of Wisconsin.*

ILLUMINATING ENGINEERING, by Louis B. Marks, *Consulting Engineer, President Illuminating Engineering Society.*

HYDROELECTRIC DEVELOPMENT, by Lamar Lyndon, *Consulting Engineer.*

MODERN THEORIES AND ELECTRICAL RESEARCH, by Dr. John C. Trowbridge, *Professor of Physics, Jefferson Physical Laboratory, Harvard University.*

ELECTRIC RAILWAY DEVELOPMENT, by Sydney W. Ashe, *Instructor in Electrical Engineering, Brooklyn Polytechnic, author of "Electric Railways," etc.*

TELEPHONE DEVELOPMENT, by E. E. Clement, *Patent Expert and Telephone Engineer.*

PATENTS, by E. G. Siggers, *Patent Attorney, Editor and Publisher, "Inventive Age."*

REVIEW OF ELECTRICAL DEVELOPMENTS ON THE CONTINENT, by C. L. Durand, *European Correspondent of the* ELECTRICAL REVIEW.

REVIEW OF ELECTRICAL DEVELOPMENT IN GREAT BRITAIN, by A. H. Bridge, *British Correspondent of the* ELECTRICAL REVIEW.

In addition to these articles there will be illustrated descriptions of power plants, transmission systems, high-tension insulator development, telephone exchanges, street-railway equipments, new forms of apparatus, a comprehensive news section, an illustrated record of electrical patents, directory of electrical and allied engineering and professional societies and an exceptionally valuable contribution to the subject of central station publicity, in the department "Methods of Getting New Business," by Charles A. Parker.

ELECTRICA

13 Park Row, New York City

Digitized by Google

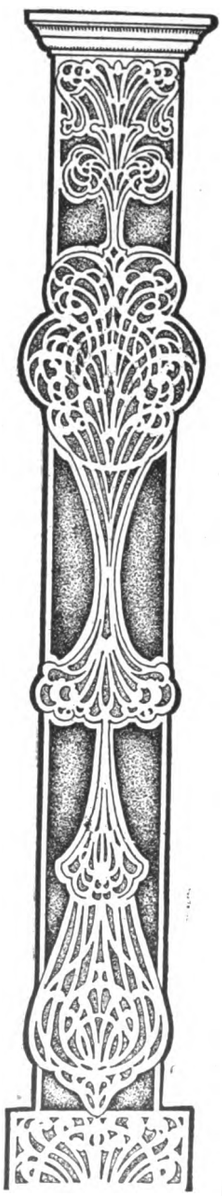
'S NUMBER

artmen/ast Electrical Industry, will appear

el Nineteen=Seven

iday and after the season's distractions. This number
hose sire to be informed on the progress
t of ctrical arts. It will be a

LTRICAL PROGRESS



Exceptional Value to Advertisers

The success of the annual New Year's Numbers of the ELECTRICAL REVIEW has been so great that for several years the original edition has been exhausted, although extra efforts were made by the publishers to meet the demand. For the forthcoming New Year's Number extraordinary facilities in every department will be arranged, so that we believe its circulation will exceed that of any previous New Year's Number which we have published.

As the issue will be the regular "Export and Domestic Number," advertisers will receive the benefit of the extra domestic and foreign circulation, and no advance in rates for space will be charged.

The advertising pages will constitute in themselves a comprehensive index of the American electrical manufacturing industry. These pages will be more than ordinarily elaborate, inasmuch as our Advertisers' Art Department is concentrating every effort on the preparation of advertising to be published in this number. The display will be such as will attract and hold the attention, and because of their volume and completeness the advertisements will be carefully studied by subscribers.

In our art and engraving departments, advertisers may have the advantage of a force of skilled artists and intelligent ad.-writers, as this department is organized to assist and advise in the preparation of copy, free of charge.

Copy instructions may be sent to any of our offices. Early reservation of space and the advanced preparation of advertising matter mean good service.

L REVIEW

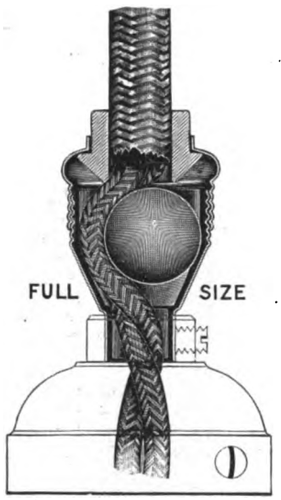
Branch Offices CHICAGO: 1513 Manhattan Bldg. BOSTON: 95 Milk St.
LONDON: 42 Old Broad Street

Digitized by Google

Stronger, Neater, Better Work

and Money Saved, by using

The Keough Cord Grip



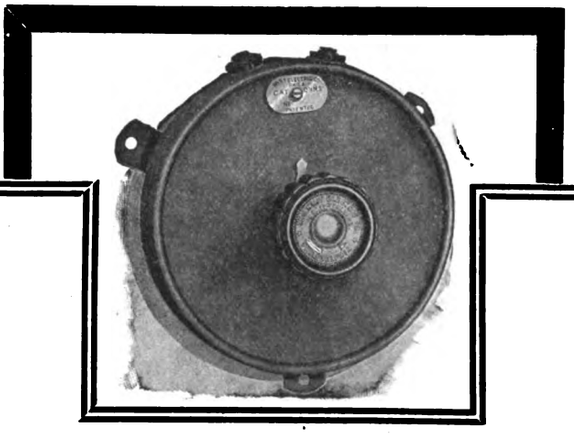
Attached to a Receptacle Plug, Pendant Switch, etc., it acts as a reducer for the cord.

Its use permits the employment of the largest size, reinforced cord, with a 1/8-inch in place of a 3/8-inch socket.

Manufactured by

Keough Electric Co., Boston, Mass.

Gilpin, V. C. Sales Agent 120 LIBERTY STREET NEW YORK



A New Type of Rheostat

D. R. TYPE

ADAPTED FOR

Small Generator Field Rheostats — Motor Field Rheostats
Small Speed Controllers — Use in Laboratories, for Calibrating, etc

HIGH RESISTANCE :: MODERATE CAPACITY

Made in two sizes, 7½ inches and 10 inches in diameter. Wound for any resistance up to 2000 ohms. Resistance coil, commutator and switches entirely enclosed. Not less than several hundred steps.

ASK FOR BULLETINS AND CATALOG

The Wirt Electric Co., Inc.

New York **Philadelphia** Chicago 2

Bossert Boxes

EXPERIENCED CONTRACTORS SPECIFY

BOSSERT BOXES

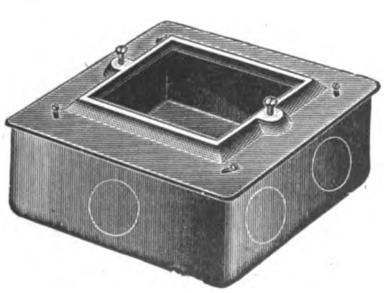
DO YOU KNOW WHY ?

BECAUSE—they have hermetically sealed outlets that can be removed with one blow of the hammer and not break the box

BECAUSE—they save time.

BECAUSE—they save money.

BECAUSE—they need no filing or reaming and the hole is as round and clean as a die can make it. Use them and you will be in a position to meet all competition.



Write for Information

Bossert Electric Construction Co.

OFFICE AND WORKS. UTICA, N. Y. (4)

NEW YORK CENTRAL LINES

"America's Greatest Railroad"

Operating more than 12,000 miles of Railway east of Chicago, St. Louis and Cincinnati

COMPRISING THE

New York Central & Hudson River
Lake Shore & Michigan Southern
Big Four Route
Michigan Central
Boston & Albany
Pittsburg & Lake Erie
Lake Erie & Western
Chicago, Indiana & Southern
Lake Erie, Alliance & Wheeling
New York & Ottawa
and Rutland Railroads

For a copy of "America's Winter Resorts," send a two-cent stamp to George H. Daniels, Manager General Advertising Department, Grand Central Station, New York.

C. F. DALY
Passenger Traffic Manager,
NEW YORK

Digitized by Google

Here's a Live One

524

Digitized by Google

INTER-POLE VARIABLE SPEED MOTORS

PATENTED NOVEMBER, 1904

ELECTRO-DYNAMIC CO., BAYONNE, N.J.

INDEX TO ADVERTISERS

A

Adams-Bagnall Electric Co..... 13
Ahlm, C. E. F..... 52
Aiton Machine Co..... 7
Ajax Line Material Co..... 47
Allen & Co., L. B..... 10
Allis-Chalmers Co.....
American Battery Co.....
American Bell Telephone Co..... 54
American Bridge Co..... 29
American Circular Loom Co..... 21
American Conduit Co..... 22
American Diesel Engine Co..... 49
American District Steam Co..... 50
American Electrical Heater Co... 1
American Electric Telephone Co. 55
American Electrical Works..... 1
American Engine Co..... 24
American Insulating Machinery Co..... 10
American Instrument Co..... 9
American Sewer Pipe Co..... 10
American Vitrified Conduit Co.... 28
American Vulcanized Fibre Co.. 52
Anderson Mfg. Co., A. & J. M... 2
Arnold Company..... 52
Atlantic Insulated Wire & Cable Co 47
Atlantic Mfg. Co..... 26
Atwater Kent Mfg. Works..... 47
Automatic Electric Co 55

B

Babcock & Wilcox Co 50
Baker & Co., Inc..... 30
Ball Engine Co..... 49
Banner Electric Co.....
Barron & Co., James S.....
Barstow, W. S..... 52
Bates, Putnam A..... 52
Bay State Lamp Co..... .....
Biddle, James G..... 9
Bishop Gutta-Percha Co..... 1

B

Blake Signal & Mfg. Co..... 58
Bossert Electric Construction Co.. 18
Boston Incandescent Lamp Co....
Brady, T. H..... 25
Bridgeport Brass Co..... 1
Brilliant Electric Co.....
Bristol Co..... 1
Brown Hoisting Machinery Co.... 9
Buckeye Electric Co.....
Buckeye Engine Co..... 51
Bunnell & Co., J. H..... 58
Burke Electric Co..... 14
Burnley Battery & Mfg. Co..... 55
Byllesby & Co., H. M..... 52

C

C. & C. Electric Co.....
Camp Co., H. B. 7
Carichoff, E. R..... 52
Cary Spring Works..... 6
Central Electric Co..... 7
Century Electric Co..... 24
Chase-Shawmut Co..... 4
Chicago & Alton Railroad..... 21
Chicago Edison Co..... 50
Chicago Fuse Wire & Mfg. Co.. 2
Chicago Insulated Wire Mfg. Co. 10
Chicago & Northwestern Ry..... 47
Clement, Edward E..... 52
Collyer Insulated Wire & Cable Co. 58
Columbia Incandescent Lamp Co.....
Connecticut Tel. & Elec. Co..... 6
Copley Square Hotel.....
Corson, Wm. R. C..... 52
Couch Co., S. H..... 26
Crescent Company.....
Crescent Insulated Wire & Cable Co..... 58

C

Crocker-Wheeler Co..... 14
Crouse-Hinds Co.....
Cutler-Hammer Mfg. Co..... 15
Cutter Co..... 1

D

Dale Company.....
Darlington, F. W..... 52
Dayton Fan & Motor Co.....
Devine Co., J. P..... 22
Dickinson Mfg. Co..... 9
Diehl Mfg. Co..... 15
Dielectric Co. of America..... 10
Dixon, Jos., Crucible Co..... 47
Dodge & Day..... 52
Dongan Instrument Co..... 6
Doubleday-Hill Electric Co.....
Downward Light Electric Co..... 13
Duncan Electric Mfg. Co..... 9
Dunton & Co., M. W..... 21
Duvall, E. S., Jr..... 47
D. & W. Fuse Co .....
Dwyer Machine Co..... 30

E

Eastern Carbon Works.....
Eck Dynamo & Motor Works..... 25
Edison Decorative & Miniature Lamp Department..... 30
Edison Mfg. Co..... 25
Eldredge Electric Mfg. Co..... 26
Electric Controller & Supply Co.
Electric Motor & Equipment Co.. 26
Electric Service Supplies Co....
Electric Storage Battery Co..... 3
Electrical Testing Laboratories... 26
Electrical Trades Exposition Co...
Electro-Dynamic Co..... 20
Elm City Engineering Co..... 54
Elwell-Parker Electric Co..... 7
Emerson Electric Mfg. Co..... 50

F

Federal Electric Co.....
Fergus & Co., W. L..... 52
For Sale..... 47
Fort Wayne Electric Works..... 19
Foster, Horatio A..... 52
Freeman Electric Co., E. H..... 21
Frink, I. P..... 58

G

General Electric Co..... 28,30
General Storage Battery Co..... 6
Germania Electric Lamp Co..... 22
Gest, G. M..... 22,24
Gillette, Vibber & Co.....
Gillinder & Sons, Inc..... 12
Gilpin V. C..... 18
Gleason, John L..... 10
Gould Storage Battery Co..... 4
Green Fuel Economizer Co..... 24

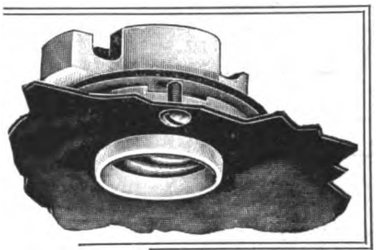
H

Hallberg, J. H..... 52
Hamilton, James..... 47
Hanchett, Geo. T..... 52
Hart & Hegeman Mfg. Co..... 27
Hart Mfg. Co..... 2
Hemingray Glass Co..... 5
Holmes Fibre-Graphite Mfg. Co... 6
Holophane Glass Co.....
Holtzer-Cabot Electric Co., The..
Homer Commutator Co..... 6
Hubbell, Harvey..... 52
Humphrey, Henry H.....

(*Continued on page 24.*)

Digitized by Google

PORCELAIN SIGN RECEPTACLE



FOR METAL FACED SIGNS

This receptacle is held in place by the metal clamping ring. Receptacle may be removed by loosing the screws a few turns. No screw lugs to break off.

Send for list of our twenty new specialties.

E. H. Freeman Elec. Co.

Trenton - - New Jersey

TIN SHADES

The season is approaching for tin shades and we have a big stock on hand ready for your orders

Goods Right *Deliveries Prompt*
Prices Satisfactory *What more do you want*

WHEELER REFLECTOR CO.

156 Pearl Street, Boston

CHICAGO & ALTON RAILROAD

"THE ONLY WAY"
CHICAGO - ST. LOUIS
KANSAS CITY
AND POINTS BEYOND
GEO. J CHARLTON, *General Passenger Agent*
CHICAGO, ILLINOIS.

WHEN ADDRESSING ADVERTISERS PLEASE MENTION THIS PAPER

TRADE MARK REGISTERED

A CONTRACTOR WILL HAVE NO TROUBLE WHEN HE USES

"CIRCULAR LOOM"

THE IDEAL FLEXIBLE CONDUIT
MADE BY THE OLDEST FIRM IN THE WORLD MAKING CONDUIT
SEND FOR SAMPLE

American Circular Loom Co.

CHELSEA, MASS., U. S. A.

NEW YORK, R. B. Corey, 39 Cortlandt Street
SAN FRANCISCO, John R. Cole Co., 766 Folsom Street
CHICAGO, Thos. G. Grier, 128 W. Jackson Boulevard

TRAY PLATE STORAGE BATTERY

The Simplest, most Durable and best Storage Battery made for Central Stations, Lighting and Power Plants, Isolated Plants, etc.

Send for Details

TRAY PLATE BATTERY COMPANY

5 FREDERICK ST., BINGHAMTON, N. Y. NEW YORK, 39 CORTLANDT ST.

Every electrical book is either published or for sale by us.
ELECTRICAL REVIEW, 13-21 Park Row, New York.

GOOD INSULATION IS GOOD POLICY

FOR FINISHING PURPOSES USE

Sterling Extra Black Finishing Varnish

THE STERLING VARNISH COMPANY, MANCHESTER, ENG. PITTSBURG, PA. (4)

BEWARE OF IMITATIONS

For the protection of our customers we advise that Klein's Pliers are being imitated to LOOK LIKE KLEIN'S. This however, does not make them Klein's.

CAUTION. Look for this stamp M. KLEIN & SONS, on the inside of handles—NONE are genuine without this stamp.

Use only genuine Klein's. They are the product of years of experience and have stood the test of time.

Mathias Klein & Sons, Chicago, Ill.

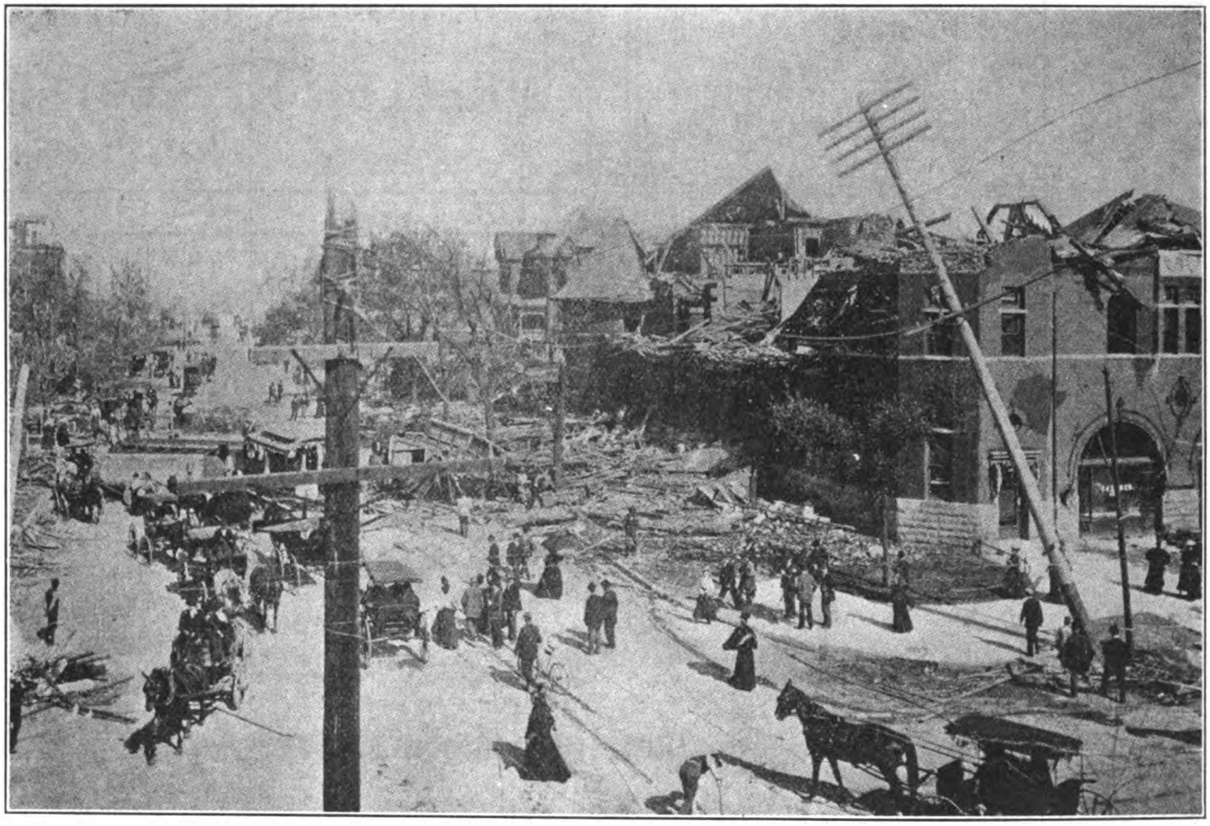
"The Best Thing I Could Find"

M. W. DUNTON & CO.
PROVIDENCE, R. I.

Digitized by Google

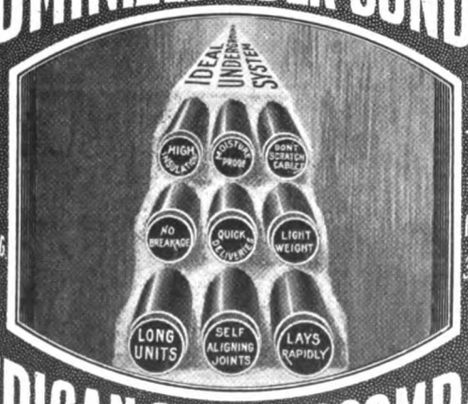
"IT'S AN ILL WIND THAT BLOWS NOBODY GOOD"

PUT YOUR WIRES UNDERGROUND



C. M. CEST EXPERT ELECTRICAL SUBWAY CONTRACTOR
Union Trust Building, Cincinnati 277 Broadway, New York

BITUMINIZED FIBER CONDUIT



MAIN OFFICE: 501 MARQUETTE BLDG. CHICAGO.

OTHER OFFICES 170 BROADWAY, N.Y. 336 MACY STREET, LOS ANGELES.

AMERICAN CONDUIT COMPANY

VACUUM DRYING AND IMPREGNATING APPARATUS

Electric Cables Armatures
Emil Passburg System — Passburg Patents
Field Transformers Magnet Coils

J. P. DEVINE CO.
314 Mooney-Brisbane Bldg. Buffalo, N. Y.
Over 700 apparatuses in use.

GERMANIA LAMPS
are sold on their merits.
GERMANIA LAMPS
are made by an independent company.
GERMANIA PRICES
are below those quoted by members of the combination

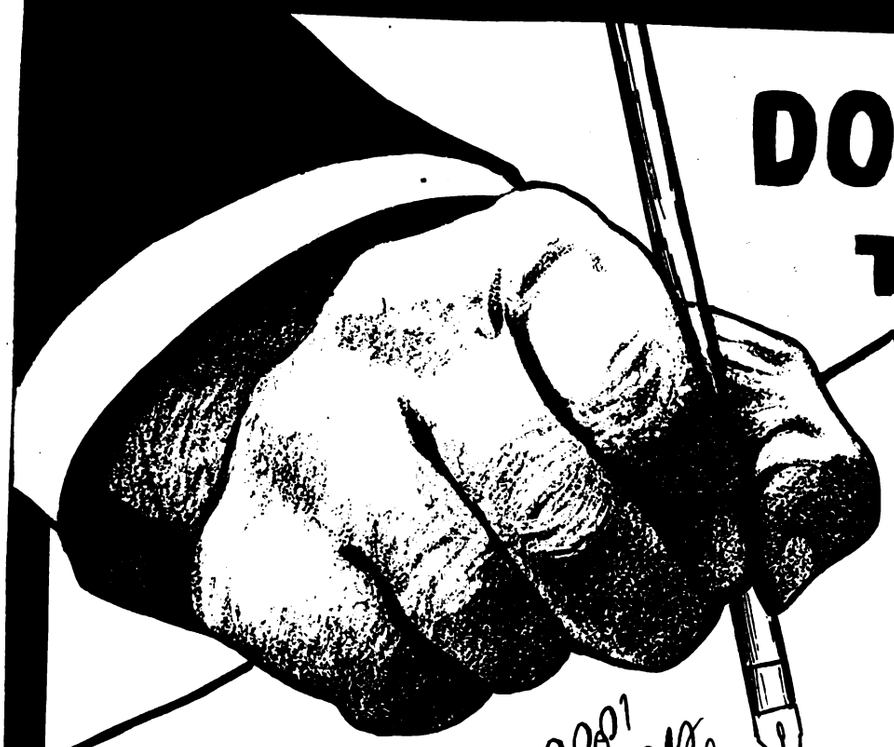
WRITE FOR THEM

Germania Electric Lamp Co., 120 Liberty St., New York 420 Ogden St., NEWARK, N. J.

WHEN ADDRESSING ADVERTISERS PLEASE MENTION THIS PAPER.

Digitized by Google

DONT FAIL TO READ THIS



LOOK FOR THE LICENSE LABEL IN THE STEM

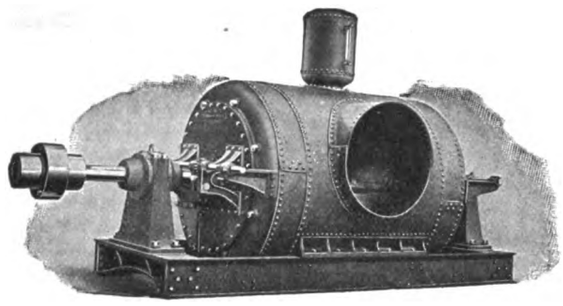
The Shelby Electric Co

Nos. 6 to 30 High Street

SHELBY, OHIO

BRANCHES IN ALL THE PRINCIPAL CITIES

Digitized by Google



PAIR
McCORMICK
TURBINES

1400 H.-P., 400 R. P. M., 160 feet head, driving generator in power plant of the Cascade Water, Power and Light Company, British Columbia.

Write for Catalogue if Interested

WE DESIGN AND BUILD TURBINES TO MEET REQUIREMENTS

S. MORGAN SMITH CO., YORK, PA., U. S. A.

Branch Office: 176 Federal Street, BOSTON, MASS.

INCANDESCENT LAMP REPLACER and CLEANER
HANDLES THEM AT ANY HEIGHT OR ANGLE
FRANK W. MORSE
ROOM 301, 116 BEDFORD STREET
BOSTON, MASS.

WHEN ADDRESSING ADVERTISERS PLEASE MENTION THIS PAPER

ALTERNATING CURRENT MOTORS AND CEILING FANS
M'F'D BY
CENTURY ELECTRIC CO.
ST. LOUIS, MO.

ALPHABETICAL INDEX.—(*Continued from page 20.*)

I

Illinois Central R. R..... 47
India Rubber & Gutta Percha Insulating Co..... 10
Indiana Rubber & Insulated Wire Co..... 1
Inventive Age Publishing Co..... 47
Iron City Engineering Co..... 52

J

Jeffrey Mfg. Co..... 55
Jessop & Sons, Wm.. .....

K

Kellogg Switchboard & Supply Co..... 6
Kelly, John F., Engineering Co .. 52
Keough Electric Co..... 18
Keystone Electrical Instrument Co. 8
Kitfield, Edward H..... 52
Klein & Sons, Mathias 21
Knowles, Edward R..... 53

L

La Fayette Electrical Mfg. Co.... 14
Lansingh, Van Rensselaer..... 53
Lawrence Electric Co., F. D.... 4
Leclanche Battery Co..... 1
Leeds & Northrup Co..... 6
Leffel & Co., James..... 25
Locke Insulator Mfg. Co..... 5
Lombard Governor Co..... .....
Lowell Insulated Wire Co..... 1
Lundin Electric & Machine Co.... 26
Lyndon, Lamar 53

M

Machado & Roller..... .....
Manhattan Electrical Supply Co.. 26
Marine Engine & Machine Co.... 49
Marquette Elec. Mfg. Co 26
Marshall, Wm 26
Massachusetts Chemical Co..... 25
McMeen, Samuel G..... 53
Mershon, Ralph D..... 53
Miller, Kempster B..... 53
Mitchell W. E. G. 47
Monarch Electric Mfg. Co..... .....
Moore, Alfred F..... 1
Morris Co., Elmer P..... 26
Morse, Frank W..... 24

N

National Battery Co..... 28
National Carbon Co..... 7
National Brake & Electric Co....12,15
National Conduit & Cable Co 1
National India Rubber Co..... 10
National Metal Moulding Co..... 58
New England Butt Co 10
New England Engineering Co.... 53
New Jersey Central R. R..... 8
New Process Raw Hide Co..... .....
New York & Ohio Co..... .....
New York Cen. & Hud. Riv. R.R.. 18
New York Electric Controller Co. 14
New York Insulated Wire Co.... 1
New York Telephone Co 55
Novelty Electric Co..... 10
Novelty Incandescent Lamp Co... 28

O

Okonite Co..... .. 1,11
Olds Gas Power Co..... .....
Oneida Community, Ltd..... .....
Ostrander, W. R. & Co. 26
Otto Gas Engine Works..... 49

P

Paiste Co., H. T..... 30
Partrick, Carter & Wilkins Co.... .....
Pass & Seymour ....
Phœnix Glass Co 1
Phelps Co..... 1,13
Phillips, Eugene F..... 1

(*Continued on page 25*)

GREEN FUEL ECONOMIZER COMPANY

Sole builders of the Green Fuel Economizer in the United States. Also Fans, Blowers and Exhausters, Steam Heating Coils and the Green Air Heater. Heating and Ventilating Apparatus. Send for Book "ER" on Fuel Economy and Fan Catalog.

GREEN FUEL ECONOMIZER CO. MATTEAWAN, N. Y.

With your New Year's Resolutions, add one that you will place your wires in a secure place—

UNDERGROUND

G. M. GEST, EXPERT ELECTRICAL SUBWAY CONTRACTOR

277 BROADWAY, NEW YORK - - - CINCINNATI, OHIO

Same as a Ball Joint
The Universal Adjustment of
Fullman Floor Outlets

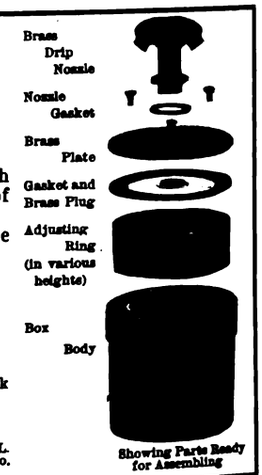
makes the floor plate line up perfectly with the floor surface, no matter how much out of level the box body is.

The catalogue tells all about it. May we send it?

Manufactured by
STEEL CITY ELECTRIC CO.
PITTSBURGH, PA.

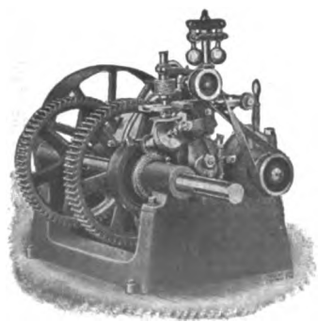
Gilpin, V. C. Sales Agent 120 Liberty St., New York

BOSTON T. C. Bliss 44 Federal St.
CHICAGO I. A. Bennett 127 S. Clinton St.
CLEVELAND W. P. Ambos Citizens' Bldg.
ATLANTA Newcomer-Manry Co. 106 S. Forsyth St.
BUFFALO G. E. Bennett 257 Vermont St.
SAN FRANCISCO, CAL. Brown-Spear-Sloane Co. Union Trust Bldg.



Showing Parts Ready for Assembling

How did you learn the addresses on this page?
Tell the advertiser WHEN YOU WRITE to him.

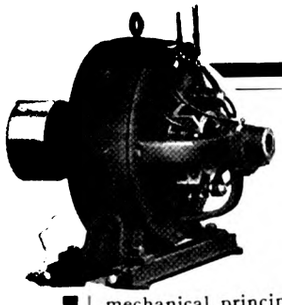


A WATER WHEEL
GOVERNOR

must govern or it is worse than useless. Hundreds of our Compensating Governors are in successful use on power and lighting plants. They must be good.

Let us send you our catalogue

WOODWARD GOVERNOR CO.
656 Race St., ROCKFORD, ILL.



UNCOMPLAINING WORKERS.

American Ball dynamos and motors are built to run day in and day out without "lying down" when a little overload comes or when they have to run overtime. Common sense, reliable machines, these, embodying only tried and approved mechanical principles and free from all "freak" features. Full information on request.

AMERICAN ENGINE CO.,
48 Raritan Avenue, BOUND BROOK, N. J.

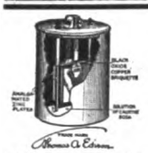
(2)

Digitized by Google

MASSACHUSETTS CHEMICAL CO.
WALPOLE MASS. U.S.A.
Pioneers of LIQUID and RUBBER INSULATION
—OPERATES—
WALPOLE RUBBER WORKS WALPOLE VARNISH WORKS
ARMALAC and No. 50 are the BEST in LIQUID INSULATORS
Cable and Transformer Compounds
ALL GRADES FRICTION TAPES AND SPLICING COMPOUNDS

THE STAR EXPANSION SCREW ANCHOR
Makes all kinds of fastenings to Brick, Slate, etc.

and saves labor, time, expense
Send for samples and catalog
STAR EXPANSION BOLT CO.
147-9 Cedar St., New York


The first thing to know of a battery is what to expect of it. With a dry cell there is no knowing. With the Edison Primary Battery you know exactly. The Edison is not only the most trustworthy of all batteries but it delivers the greatest amount of energy for the least cost.
Tell us for what use you wish electrical energy and we will tell you which Edison Battery you need, how many and the cost.
Edison Manufacturing Company
3 Lakeside Ave., Orange, N. J.
31 Union Sq., New York 304 Wabash Ave., Chicago
25 Clerkenwell Road, London, E. C.

The SARCO PENDANT SWITCH

CUT HALF SIZE
LIST PRICE 80 CENTS
Costs You No More Than Others
YOUR CUSTOMER
WILL PAY YOU MORE
because it
LOOKS more for the money
IS mere for the money
THE SARCO CO.
906-6TH AVE., N. Y. CITY

THE BRADY MAST ARMS
T. H. BRADY, New Britain Conn., U. S. A.
Manufacturer of Mast Arms, Pole and Swinging Hoods, House Brackets and other specialties for construction work
Catalogue and Prices Furnished on Application

ECK DYNAMO AND MOTOR WORKS
TRADE MARK Belleville, N. J.

THE SCHWERDTLE STAMP CO.
STENCILS-BURNING BRANDS
STEEL STAMPS & DIES
SEALS-MACH PLATES-CHECKS
BRIDGEPORT, CONN.

ALPHABETICAL INDEX.—(*Continued from page 24.*)

P
Phillips Insulated Wire Co. 58
Phosphor-Bronze Smelting Co. 52
Pignolet, Louis M. 6
Platt Iron Works Co. 49
Prentiss Clock Improvement Co. 55
Prometheus Electric Co.

Q
Queen & Co., Inc. 30

R
Rail Joint Company 14
Reed Electrical Cordage Co.
Reed, Warren B. 53
Reisinger, Hugo.
Robbins & Myers Co 30
Robertson & Sons, James L.
Rochester Machine Tool Wks., Ltd. 50
Rock Island Battery Co. 7
Roebling's Sons Co., John A. 58
Roessler Hasslacher Chemical Co. 6

S
Safety Insulated Wire & Cable Co. 10
St. Marys Incandescent Lamp Co. 12,47
Samson Cordage Works. 58
Sangamo Electric Co. 8
Sarco Co. 25
Sawyer-Man Electric Co.
Schneider & Co., C. O.
Schott, W. H. 53
Schwerdtle Stamp Co. 25
Sears, Henry D.
Shelby Electric Co 23
Shepherd Engineering Co. 49
Siggers & Siggers. 47
Simplex Electrical Co. 1
Simplex Electric Heating Co. 26
Smith Company, S. Morgan. 24
Southern Mills. 47
Sprague Electric Co. 30
Standard Electrical Mfg. Co.
Standard Paint Co.
Standard Underground Cable Co. 1
Standard Varnish Works. 30
Stanley & Patterson. 6
Stanton, Le Roy W. 53
Star Expansion Bolt Co 25
Steel City Electric Co. 24
Steel Gain Mfg. Co.
Sterling Electrical Mfg. Co.
Sterling Varnish Co. 21
Stevens & Co., Milo B. 47
Stirling Consolidated Boiler Co. 52
Stow Manufacturing Co.
Stromberg-Carlson Telephone Mfg. Co 55
Stuart-Howland Co.
Sunbeam Incandescent Lamp Co.

T
Technical Press Association. 47
Townsend, Fitzhugh 53
Tray Plate Battery Co 21
Triumph Electric Co. 26
Trumbull Electric Mfg. Co. 9

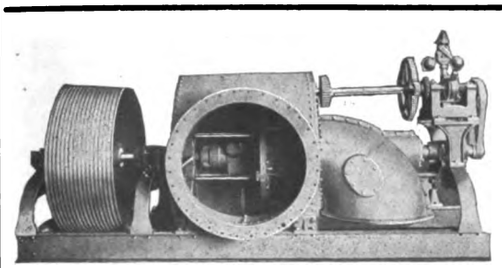
V
Van Nostrand Company, D.

W
Wagner Electric Mfg. Co. 5
Wanted 47
War Department.
Waterbury & Company 58
Watertown Engine Co.
Wesco Supply Co. 3
Western Electric Co. 12
Westinghouse Electric & Manufacturing Co. 56,57
Westinghouse Machine Co. 57
Weston Electrical Instrument Co. 30
Wheeler Reflector Co 21
White & Co., J. G. 53
Whitney Electrical Inst. Co.
Willard Storage Battery Co. 26
Wire & Telephone Co. of America. 1
Wirt Electric Co. 18,49
Woodward Governor Co. 24
Woodworth, George K. 47

Y
Yost Electric Mfg. Co. 26

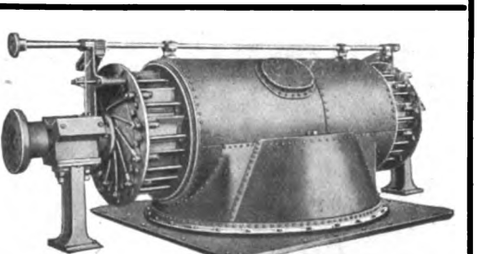
(*Continued on page 26.*)

SAMSON TURBINE



If the SPEED of the turbine is to be controlled by a GOVERNOR, the turbine should be of such capacity that it will develop the MAXIMUM POWER required, when operating at ¾ to ⅞ gate, then when an overload is thrown on, the governor can open the gates wider, and allow an increase in power. The EFFICIENCY of the SAMSON between ¾ and ⅞ gate is over 84%.

James Leffel & Co., No. 309 Lagonda Street Springfield, O., U.S.A.



Digitized by Google

ELECTRIC HEATING APPARATUS
OF EVERY DESCRIPTION
"UNIT" ENAMEL RHEOSTATS
SIMPLEX QUALITY
The Simplex Electric Heating Company
CAMBRIDGEPORT, MASS.

LUNDIN
HIGH GRADE ELECTRICAL SPECIALTIES
SEND FOR CATALOG
THE LUNDIN ELECTRIC AND MACHINE CO.
Boston, Mass.

The Marquette Arc Lamp
The perfect Arc. Price, $10 wholesale
See our display adv. next week's issue
MAIN OFFICE AND FACTORY
N. W. Cor. Clinton & Van Buren Sts.
CHICAGO

W. R. Ostrander & Co.

22 Dey Street, NEW YORK
Manufacturers of
Speaking Tubes, Whistles, Bells, Annunciators
Electric Light Supplies
Factory 80 Kalb Ave. Brooklyn
Send for Catalogue

MANHATTAN
ELECTRICAL SUPPLY CO.
Something Electrical for Everybody
NEW YORK, 17 Park Pl. and 14 Murray St.
CHICAGO, 188 5th Ave.
Factories, JERSEY CITY, N. J., RAVENNA, O.

ELECTRIC SIGNS
AND
SIGN FLASHERS
Electric Motor and Equipment Co.
Newark, N. J.

Electrical Testing Laboratories
We are now prepared to undertake Electrical Testing of all kinds. Electrical and Photometrical Standardizations. Tests of Lamps, Instruments, Materials and Supplies. Secondary Standards of Candle-Power furnished.
"The TRUE Label of Quality"
80th St. and East End Ave., New York City

ELECTRIC CONDENSERS
WM. MARSHALL, Manufacturer
Standards a Specialty
709 Lexington Ave., New York

Couch TELEPHONES
SEND FOR CATALOGUE
S. H. COUCH CO., Inc.
160 Pearl St., Boston, Mass.

WILLARD STORAGE BATTERIES
THE WILLARD STORAGE BATTERY CO.

ARMORED
"Hiko" Soldering Stick
CLEAN, EFFECTIVE, LAST LONGEST
ALL GOOD DEALERS CARRY IT
Atlantic Mfg. Co., Allenhurst, N. J.

For Testing Primary or Storage Batteries Use the
ELDREDGE BATTERY VOLTMETER
0 to 8, 0 to 6, 0 to 10 volts. Dead Beat.
Eldredge Electric Mfg. Co.
2 P. O. Sq., Springfield, Mass.

"EUREKA" ELECTRIC IRONS
all equipped with the patent
"SPRING CORD PROTECTOR"
Write for descriptive matter
The W. J. Barr Electric Mfg. Co.
CLEVELAND, OHIO

WHEN ADDRESSING ADVERTISERS PLEASE MENTION THIS PAPER

YOST SPECIALTIES
Sockets, Rosettes, Receptacles
Cord Adjusters
Write for Catalogue
The Yost Electric Mfg. Co.
TOLEDO, OHIO

TRIUMPH MOTORS
FOR SPEED CONTROL
C-14

WOOD PINS—100,000 IN STOCK
These pins are the best ever produced. Prices are satisfactory.
ELMER P. MORRIS CO.
51 Dey St., New York

CLASSIFIED INDEX—(*Continued from page 25*)

ADJUSTERS
Morse, Frank W.

AIR-COMPRESSORS
Allis-Chalmers Co.
Emerson Electric Mfg. Co
National Electric Co.
Platt Iron Works Co.

ALARMS, BURGLAR
Partrick, Carter & Wilkins Co.

ALARMS, HIGH AND LOW
Partrick, Carter & Wilkins Co.

ALARMS, FIRE
Partrick, Carter & Wilkins Co.

ALTERNATORS
Allis-Chalmers Co.
Crocker-Wheeler Co.
Fort Wayne Electric Works
General Electric Co.
National Electric Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

ANCHORS, GUY
Doubleday-Hill Electric Co.

ANNUNCIATORS
Doubleday-Hill Electric Co.
Partrick, Carter & Wilkins
Stanley & Patterson
W. R. Ostrander & Co.
Wesco Supply Co.
Western Electric Co.

ARCHITECTURAL ENGINEERS
Dodge & Day

ATTACHMENT PLUGS
Hubbell, Harvey

BATTERIES, PRIMARY
Bunnell & Co., J. H.
Burnley Battery & Mfg. Co.
Doubleday-Hill Electric Co.
Eastern Carbon Works
Edison Mfg. Co.
Electric Motor & Equipment Co.
French Battery Co.
Gordon Battery Co.
Lawrence Electric Co., F. D.
Leclanche Battery Co.
Manhattan Electrical Supply Co.
Rock Island Battery Co.
Wesco Supply Co.

BATTERIES, STORAGE
American Battery Co.
Doubleday-Hill Electric Co.
Electric Storage Battery Co.
General Storage Battery Co.
Gould Storage Battery Co.
National Battery Co.
Tray Plate Battery Co.
Willard Storage Battery Co.

BELLS
Manhattan Electrical Supply Co.
Ostrander & Co., W. R.
Partrick, Carter & Wilkins Co.
Wesco Supply Co.

BELT DRESSING
Dixon Crucible Co., Joseph

BLOWERS
Emerson Electric Mfg. Co.
Green Fuel Economizer Co.

BOILERS
Babcock & Wilcox Co., The
Morgan Smith Co., S.
Platt Iron Works Co.
Stirling Consolidated Boiler Co.
Westinghouse, Church, Kerr & Co.

BOLTS, EXPANSION AND TOGGLE
Star Expansion Bolt Co.

BOOKS, TECHNICAL
Electrical Review Pub. Co.
Van Nostrand Co., D.

BOOSTERS
Allis-Chalmers Co.
Crocker-Wheeler Co.
National Electric Co.
Western Electric Co.

BRIDGES
American Bridge Co.

BRIDLE RINGS
Barron & Co., Jas. S.

BRUSHES, DYNAMO
Eastern Carbon Works

BRUSHES, DYNAMO
Holmes Fibre Graphite Co.
Wirt Electric Co.

BUSHINGS
Bossert Electric Construction Co.
Federal Electric Co.
Steel City Electric Co.

CABLE COMPOUNDS
Massachusetts Chemical Co

CABLE HANGERS
Barron & Co., Jas. S.
Standard Underground Cable Co
Steel City Electric Co.

CABLE MACHINERY
Aiton Machine Co.

CABLING MACHINES
New England Butt Co.

CAPS FOR PIPES
Gillette, Vibber & Co.

CAR HEATERS, ELECTRIC
Simplex Electric Heating Co.

CARBONS
Eastern Carbon Works
National Carbon Co.
Reisinger, Hugo

CASTINGS
National Electric Co.
New England Butt Co.
Phosphor-Bronze Smelting Co., Ltd

CATALOGUES
W. F. Leggett

CHAINS, FOR SUSPENDING ARC LAMPS
Oneida Community, Ltd.

CIRCUIT-BREAKERS
Cutler-Hammer Mfg. Co.
Cutter Electrical Mfg. Co.
Doubleday-Hill Electric Co.
Fort Wayne Electric Works
General Electric Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

CLEANERS, INCANDESCENT LAMPS
Morse, Frank W.

CLEATS
Blake Signal & Mfg. Co.

CLIMBERS
Klein & Sons, Mathias

CLUSTERS
Hubbell, Harvey
I. P. Frink

COAL-HANDLING MACHINERY
Jeffrey Mfg. Co., The

COAL MINING MACHINERY
Allis-Chalmers Co.
General Electric Co.
Jeffrey Mfg. Co., The
Westinghouse Electric & Mfg. Co.

COILS, INDUCTION
W. R. Ostrander & Co.

COMMUTATORS
Homer Commutator Co.

COMMUTATOR LUBRICANT
Allen & Co., L. B.
Atlantic Mfg. Co.
Dixon Crucible Co., Jos.

CONDENSERS, ELECTRIC
Marshall, William

CONDENSERS, STEAM
Allis-Chalmers Co.
Platt Iron Works Co.

CONDUITS
American Circular Loom Co.
American Conduit Co.
American Sewer Pipe Co.
American Vitrified Conduit Co.
Camp Co., H. B.
Doubleday-Hill Electric Co.
Gest, G. M.
National Conduit & Cable Co.
Osburn Flexible Conduit Co.
Sprague Electric Co.

CONDUIT RODS
Barron & Co., Jas. S.
Doubleday-Hill Electric Co.

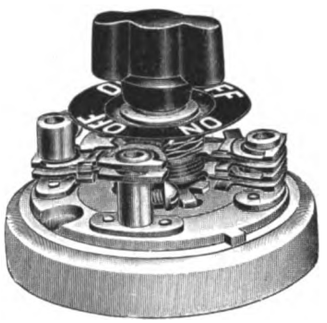
CONDUIT TOOLS
Steel City Electric Co.

CONDUIT REAMERS
Steel City Electric Co

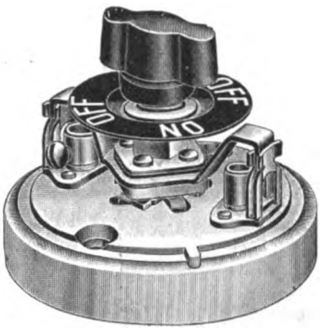
(*Continued on page 27*)

Digitized by Google

NEW PRICE LIST DISCOUNTS



WRITE FOR LATEST LIST AND DISCOUNTS



92 CAPITOL AVE. THE HART AND HEGEMAN MFG. CO. HARTFORD, CONN.

CLASSIFIED INDEX—(*Continued from page 26*)

CONSTRUCTION
New England Engineering Co.
White & Co., J. G.

CONSTRUCTION SUPPLIES
Barron & Co., Jas. S.
Brady, T. H.

CONTROLLERS
Allis-Chalmers Co.
Bullock Electric Mfg. Co.
Crocker-Wheeler Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Supply Co.
New York Electric Controller Co.
Simplex Electric Heating Co.
Wirt Electric Co.

CORD ADJUSTERS
Crescent Co

CORD GRIPS
Gilpin, V. C.
Keough Electric Co.

CORD AND ROPE
Ajax Line Material Co.
Reed Electrical Cordage Co.
Samson Cordage Works

CRANE MOTORS
Western Electric Co.

CROSS-ARMS, BRACKETS, PINS, TIES, CLIMBERS ETC.
Central Electric Co.
Doubleday-Hill Electric Co.
Klein & Son, Mathias
Northern Electric & Machine Co.

CURRENT TAPS
Hubbell, Harvey

DIMMERS
Cutler-Hammer Mfg. Co.
Wirt Electric Co.

DIRECT MOTOR DRIVE FOR PLANERS
The Electric Controller & Supply Co.

DRYING MACHINERY
Aiton Machine Co.
Devine Co., J. P.

DYNAMOS AND MOTORS
Allis-Chalmers Co.
Bullock Electric Mfg. Co.
American Engine Co.
Burke Electric Co.
C. & C. Electric Co.
Central Electric Co.
Century Electric Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Doubleday-Hill Electric Co.
Eck Dynamo & Motor Works
Electro Dynamic Co.
Elwell-Parker Electric Co.
Emerson Electric Manufacturing Co
Fort Wayne Electric Works
General Electric Co.
Jeffrey Mfg. Co.
National Brake & Electric Co.
New England Motor Co.
Novelty Electric Co.
Robbins & Myers Co.
Sprague Electric Co.
Stanley-G. I. Electric Mfg. Co.
Stow Mfg. Co.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

ELECTRIC ARC WELDERS
The Electric Controller & Supply Co.

ELECTRIC COOKING APPARATUS
Doubleday-Hill Electric Co.
Simplex Electric Heating Co.

ELECTRICAL DECORATIONS
Doubleday-Hill Electric Co.
Electric Motor & Equipment Co.

ELECTRIC DRILLS.
Chicago Pneumatic Tool Co.

ELECTRIC LIGHTERS
Stanley & Patterson

ELECTRIC LOCOMOTIVES
General Electric Co.
Jeffrey Mfg. Co., The
Westinghouse Electric & Mfg. Co.

ELECTRIC SOLDERING IRONS
American Electrical Heater Co.
Simplex Electrical Co.

ELECTRICAL SUPPLIES
Albert & J. M. Anderson Mfg. Co.
Barron & Co., Jas. S.
Bates, Putnam A.
Central Electric Co.
Chase-Shawmut Co.
Doubleday-Hill Electric Co.
Electric Service Supplies Co.
Electric Motor & Equipment Co.
General Electric Co.
Lawrence Electric Co., F. D.
Manhattan Electrical Supply Co.
Novelty Electric Co.
Paiste Co., H. T.
Partrick, Carter & Wilkins.
Sarco Co.
Stanley & Patterson
Wesco Supply Co.
Western Electric Co.
Weston Electrical Instrument Co.

ELECTROMAGNETS
Devine Co., J. P.
Splitdorf Laboratories
Western Electric Co.
Westinghouse Electric & Mfg. Co.

ELEVATING AND CONVEYING MACHINERY
Jeffrey Mfg. Co.

ENGINES, GAS AND OIL
Allis-Chalmers Co.
American Diesel Engine Co.
Olds Gas Power Co.
Otto Gas Engine Works
Shepherd Engineering Co.
Watertown Engine Co.
Westinghouse Machine Co

ENGINES, STEAM
Allis-Chalmers Co.
American Engine Co.
Ball Engine Co.
Buckeye Engine Co.
Rochester Machine Tool Works
Westinghouse Machine Co.

ENGINEERS AND CONTRACTORS
Ahlm, C. E. F.
Arnold Co., The
Barstow, W. S.
Bates, Putnam A.
Bradley & Sons, Chas. S.
Byllesby & Co., H. M.
Carichoff, E. R.
Clement, Edward E.
Corson, Wm. R. C.
Darlington, F. W.
Dodge & Day
Fergus & Co., W. L.
Foster, Horatio A.
Hallberg, J. H.
Hanchett, George T.
Humphrey, Henry H.
Iron City Engineering Co.
Kelly Engineering Co., John F.
Kitfield, Edward H.
Knowles & Broadnax
Lyndon, Lamar
Mershon, Ralph D.
New England Engineering Co
Reed, Warren B.
Schott, W. H.
Stanton, Le Roy W.
Townsend, Fitzhugh
White & Co., J. G.

FANS AND FAN MOTORS
Central Electric Co.
Century Electric Co.
Dayton Fan & Motor Co.
Diehl Mfg. Co.
Doubleday-Hill Electric Co.
Electric Motor & Equipment Co.
Emerson Electric Manufacturing Co.
Fort Wayne Electric Works
General Electric Co.
Green Fuel Economizer Co.
Hunter Fan & Motor Co.
Robbins & Myers Co.
Sprague Electric Co.
Stanley & Patterson
Wesco Supply Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co

(*Continued on page 29*)

Digitized by Google

General Electric Company

Direct Current Dial Controllers

FOR PRINTING PRESS and
MACHINE TOOL SERVICE

All resistances are moisture-proof, dust-proof and fire-proof.

DIAL TYPE CONTROLLER
Type PP, Form E

The new Type PP Dial Controllers respond to the most exacting demands, withstand the most severe service, fulfill every mechanical requirement and combine all desirable features indicated by years of practical design and hundreds of operating installations.

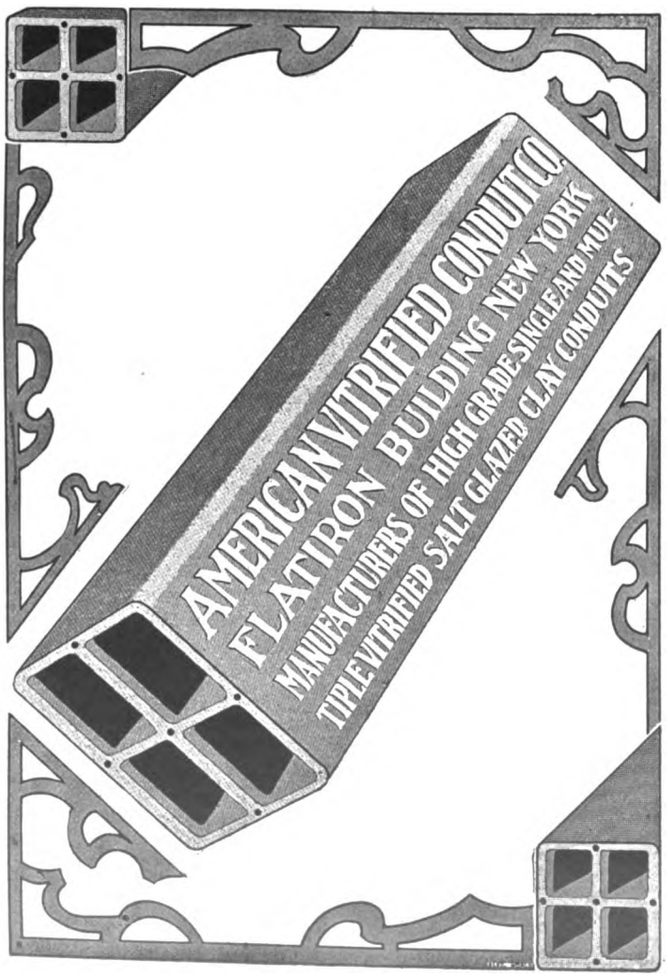
The Type PP Controller is enclosed in iron casing, including all resistance except armature starting resistance, which is in separate iron casing. There are no openings in front, top or bottom of the casing and all external connections are made at the sides near the bottom. All starting segments are renewable.

1159

New York Office:
44 Broad Street

Principal Office:
Schenectady, N. Y.

Sales Offices in
all Large Cities


AMERICAN VITRIFIED CONDUIT CO.
FLATIRON BUILDING NEW YORK
MANUFACTURERS OF HIGH GRADE SINGLE AND MULTIPLE VITRIFIED SALT GLAZED CLAY CONDUITS

"Elk New" "Novelty Renewed"

ELK
Factory
EMPORIUM, PENN.

NOVELTY
Factory
ST. MARYS, PENN.

INDEPENDENT
INCANDESCENT LAMP

MANUFACTURED BY
Novelty Incandescent Lamp Co.
MAIN OFFICE: EMPORIUM, PENN.
ALVIN & JACKSON, Western Sales Agents
502 Monadnock Block, Chicago, Ill.

A STORAGE BATTERY
WILL PAY DIVIDENDS

MANAGERS AND ENGINEERS OF ELECTRIC RAILROADS SHOULD WRITE FOR PARTICULARS AND INFORMATION TO THE

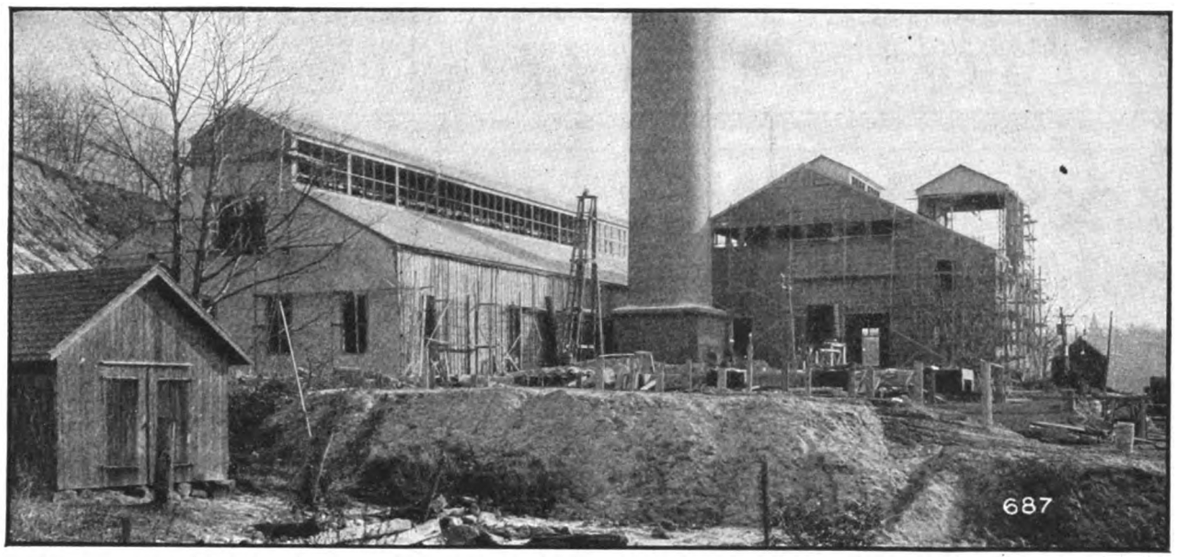
National Battery Company
ELECTRIC STORAGE BATTERIES
BUFFALO, N. Y.

NEW YORK OFFICE
1606 BROADWAY

CHICAGO OFFICE
450 OLD COLONY B'LD'G

PACIFIC COAST 623 SANSOME STREET, SAN FRANCISCO

Digitized by Google



POWER-HOUSE AT GLEN HEAD, L. I., FOR THE NASSAU LIGHT & POWER COMPANY

AMERICAN BRIDGE COMPANY OF NEW YORK

STRUCTURAL STEEL FOR EVERY PURPOSE ANNUAL CAPACITY, 700,000 TONS

General Offices: 42 Broadway, NEW YORK

CLASSIFIED INDEX—(*Continued from page 27*)

Feed-Water Heaters and Purifiers
Platt Iron Works Co.

Field Coil Cushions
Massachusetts Chemical Co.

Flexible Couplings for Shafts
The Electric Controller & Supply Co.

Fixtures (Electric)
Morse, Frank W.
Wells Light Mfg. Co.

Flashers
Electric Motor & Equipment Co.
Phelps Co.
Schneider & Co., C. O.

Flexible Shafting
Stow Mfg. Co.

Floor Outlets
Steel City Electric Co.

Friction Tape
M. W. Dunton & Co.
Massachusetts Chemical Co.

Fuel Economizers
Green Fuel Economizer Co.

Fuses
Chase-Shawmut Co.
Chicago Fuse Wire & Mfg. Co.
D & W Fuse Co.
General Electric Co.
Lawrence Electric Co., F. D.

Gears
New Process Raw Hide Co.

Generators
Allis-Chalmers Co. } Bullock Electric Mfg. Co. }
Crocker-Wheeler Co.
Western Electric Co.

Globes, Shades, Etc.
Frink, I. P.
Gillinder & Sons, Inc.
Holophane Glass Co.
Phœnix Glass Co.
Wheeler Reflector Co.

Graphite
Dixon Crucible Co., Jos.

Heating Apparatus
American Electric Heater Co.
Barr Electric Mfg. Co., W. J.

Heating Apparatus
Prometheus Electric Co.
Simplex Electric Heater Co.

Hoisting Machinery
Allis-Chalmers Co.
Brown Hoisting Machinery Co.
Jeffrey Mfg. Co.

Hydraulic Machinery
Aiton Machine Co.
Allis-Chalmers Co.

Impregnating Apparatus
Devine Co., J. P.

Instruments
American Instrument Co.
Atwater-Kent Mfg. Co.
Biddle, Jas. G.
Bristol Co.
Bullock Electric Mfg. Co.
Cutter Electrical Mfg. Co.
Dongan Instrument Co.
Doubleday-Hill Electric Co.
Duncan Electric Mfg. Co.
Eldredge Electric Mfg. Co.
Fort Wayne Electric Works
General Electric Co.
Keystone Electrical Instrument Co.
Leeds & Northrup Co.
Machado & Roller
Pignolet, Louis M.
Queen & Co., Inc.
Sangamo Electric Co.
Stanley-G. I. Electric Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Weston Electrical Instrument Co.

Insulating Cements
Massachusetts Chemical Co.

Insulating Cloths
Massachusetts Chemical Co.

Insulating Compounds
Massachusetts Chemical Co.

Insulating Machinery
Aiton Machine Co.
American Insulating Machinery Co.
New England Butt Co.

Insulating Paints
Massachusetts Chemical Co.

Insulators and Insulating Material
American Vulcanized Fibre Co.
Doubleday-Hill Electric Co.
Elm City Engineering Co.
Dunton & Co., M. W.
General Electric Co.
Hemingray Glass Co.
Locke Insulator Mfg. Co.
Massachusetts Chemical Co.
Okonite Co.
Standard Paint Co.
Standard Underground Cable Co.
Standard Varnish Co.
Sterling Varnish Co.

Insulator Supports
Steel City Electric Co.

Iridio Platinum, Wire and Sheet
Baker & Co., Inc.

Iron Castings
Aiton Machine Co.

Junction Boxes
Bossert Electric Construction Co.
D & W Fuse Co.
Steel City Electric Co.

Lamp Guards
Hubbell, Harvey
Morse, Frank W.

Lamp-Making Machinery
Dwyer Machine Co.

Lamps, Arc
Adams-Bagnall Electric Co.
Doubleday-Hill Electric Co.
Fort Wayne Electric Works
General Electric Co.
Marquette Electric Mfg. Co.
Stanley-G. I. Electric Mfg. Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Lamps, Decorative
Central Electric Co.
Edison Deco. & Miniature Lamp Dept.

Lamps, Incandescent
Banner Electric Co.
Bay State Lamp Co.
Brilliant Electric Co.
Buckeye Electric Co.

Lamps, Incandescent
Central Electric Co.
Columbia Incandescent Lamp Co.
Doubleday-Hill Electric Co.
Downward Light Electric Co.
Dwyer Machine Co.
Fort Wayne Electric Works
Fostoria Incandescent Lamp Co.
General Electric Co.
Germania Electric Lamp Co.
New York & Ohio Co.
Novelty Incandescent Lamp Co.
Phelps Co.
St. Marys Incandescent Lamp Co.
Sawyer-Man Electric Co.
Shelby Electric Co.
Standard Electric Mfg. Co.
Sterling Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Lifting Magnets
The Electric Controller & Supply Co.

Lightning Arresters
D & W Fuse Co.
Electric Service Supplies Co.
General Electric Co.
Stanley-G. I. Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Lighting Plants
Allis-Chalmers Co.
Crocker-Wheeler Co.
Doubleday-Hill Electric Co
Fort Wayne Electric Works
General Electric Co.
National Brake & Electric Co.
Stanley & Patterson
Western Electric Co.
Westinghouse Electric & Mfg. Co

Locknuts
Steel City Electric Co.

Lubricating Components
Atlantic Mfg. Co.

Machine Tools and Machinery
Allis-Chalmers Co.
Jeffrey Mfg. Co.
New England Butt Co.

(*Continued on page 51*)

Digitized by Google

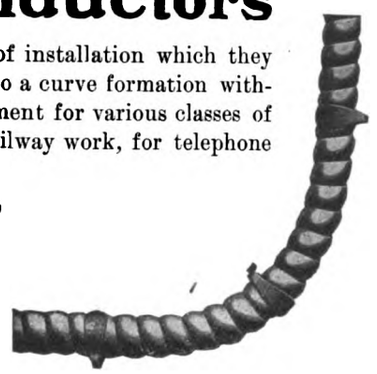
Platinum resistance wires to specifications: protective fuses for small currents: ignition fuses for torpedo and mining operations: special forms for wireless telegraphy: all forms of electrical contacts

GRAND PRIZE
Universal Exposition
St. Louis, 1904
GOLD MEDAL—Lewis & Clark Centennial Exposition, Portland, Ore.—1905

BAKER & COMPANY, INC.
C. O. BAKER, Pres. C. W. BAKER, Vice-Pres.
408-414 N. J. R. R. Ave., Newark, N. J.
NEW YORK OFFICE, 120 LIBERTY STREET

FLEXIBLE STEEL CONDUIT AND Flexible Steel-Armored Conductors

Are unequaled for electric wiring and represent the highest development of the art of installation which they have reduced to absolute simplicity. No elbows are required as they readily bend to a curve formation without flattening. These products are used extensively by the United States Government for various classes of work. They are in great demand for wiring in modern buildings, in steamship and railway work, for telephone connections, etc., etc.



Write for a copy of descriptive bulletin No. 4216

Sprague Electric Company

General Offices: 527 W. Thirty-fourth Street, New York

Branch Offices in Principal Cities

QUEEN INSTRUMENTS

The Queen Acme Portable Testing Set is an instrument widely used by Telephone, Electric Manufacturing and Electric Light and Power Companies for making the various tests they find necessary. It might help you. Circular 366, with colored diagrams, gives all the details. This or any other of our numerous catalogues sent free.

Cable Testing Apparatus, Tachometers, Photometers Electrical and Scientific Instruments

QUEEN & CO., Inc., Corner Eighth & Arch Streets PHILADELPHIA, PA.

"THE STANDARD"

MOTORS-DYNAMOS-FANS
ARE WELL MADE AND YOU'LL LIKE THEM
FOR ALL DIRECT CURRENT CIRCUITS
THE ROBBINS & MYERS CO.
SPRINGFIELD, OHIO.

Complete plants for the
Manufacture and Renewal of Incandescent Lamps
(EXPERTS TO THE LARGEST COMPANIES SINCE 1891)
Central Station lamp testing made practicable by our Photometric System. Send for catalogues.
DWYER MACHINE CO., Lynn, Mass.

Cat. No. 401

Paiste 401 Pushin Attachment Plug

fastens to socket by being simply pushed into same. The proper solution of that troublesome cord-twisting. Brass cap has double bushing for use with either Standard or Re-inforced lamp cord. Write now for free sample and prices

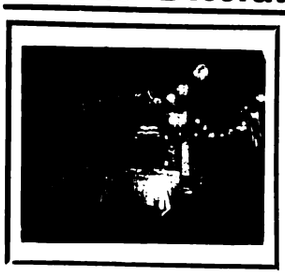
H. T. PAISTE CO., Philadelphia, Pa.
NEW YORK BOSTON CHICAGO
"The Leading Specialty Manufacturers."

WP INSULATING BLACK

Approved by Underwriters' Laboratories.
The latest and best For Wiring Contractors. Good Insulator. Dries quickly.
Never becomes brittle. No disagreeableodor. Ask your dealer. If he doesn't handle it, send to us.

STANDARD VARNISH WORKS
Chicago New York London
Canadian Branch: International Varnish Company, Limited, Toronto, Canada

Edison Ready-to-Use
Electric Decorative Lighting Outfits



Useful all the year around for adornment of table or house. The only safe means of illuminating Christmas Trees or other inflammable decorations. Get the Edison outfit—the most attractive holiday specialty. Always ready—always complete. The Edison outfit is approved for Christmas Trees by the National Board of Fire Underwriters.

For fuller details write our nearest office or
GENERAL ELECTRIC COMPANY
Miniature Lamp Department: HARRISON, N. J.
New York Office: 44 Broad Street. 743

WESTON

Standard, Portable, Direct-Reading

Millivoltmeters, Voltameters
Voltmeters, Ammeters
Milammeters, Ohmmeters
Portable Galvanometers
Ground Detectors and Circuit Testers

Our Portable Instruments are recognized as THE STANDARD the world over. Our STATION VOLTMETERS AND AMMETERS are unsurpassed in point of extreme accuracy and lowest consumption of energy.

WESTON ELECTRICAL INSTRUMENT CO.
Main Office and Works: Waverly Park, NEWARK, N. J.
LONDON BRANCH—Audrey House, Ely Place, Holborn.
PARIS, FRANCE—E. H. Cadiot, 12 Rue St. Georges.
BERLIN—European Weston Electrical Instrument Co., Ritterstrasse No. 88.
New York Office, 74 Cortlandt Street.

Digitized by Google

BIDS for lighting the City of Natchez, Mississippi, for a term of ten years from March 7th, 1908, will be received up to 4 P. M., March 7th, 1907.

Specifications on file at City Clerk's Office.

For further particulars address George T. Eisele, City Clerk, or S. B. Stewart, Chairman, Lights and Water Committee, Natchez, Mississippi.

INCANDESCENT LAMP SALESMEN WANTED. Experienced men who can command trade. Address stating experience, salary and territory wanted; to right men will pay salary, commission or both.

St. Marys Incandescent Lamp Co.
St. Marys, Elk County, Penn.

PATENTS PROTECT YOUR IDEAS

Send for *INVENTOR'S PRIMER*

No patent, no fee — Established 1864

Milo B. Stevens & Co. 910 14th St. Washington, D.C.

Branches at Chicago, Cleveland, Detroit

PATENTS—TRADE-MARKS

James Hamilton, M.E., LL.B.

MEM. AM. SOC. M. E.; ASSOC. AM. INST. E. E.; M. E. (Cornell); LL.B. (B. U. Law School); LATE LECTURER ON PATENTS (B. U. L. S.)

NEW YORK CITY - - - 31 Nassau Street
WASHINGTON, D. C. - - Loan and Trust Building

Write to or call at either office

GEORGE K. WOODWORTH

(Formerly Examiner, Electrical Division, U. S. Patent Office)

COUNSELLOR AT LAW

PATENTS AND PATENT CAUSES

ELECTRICAL PATENT MATTERS

31 State Street — BOSTON

SUBSCRIBE FOR THE

Inventive Age

ONE DOLLAR A YEAR

Contains index of all patents issued each week, and other useful information. Address INVENTIVE AGE PUBLISHING CO., National Union Bldg., Washington, D. C.

ELECTRICAL AND OTHER INDUSTRIES ARE OFFERED LOCATIONS

WITH

Satisfactory Inducements
Favorable Freight Rates
Good Labor Conditions
Healthful Communities

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.

AND THE

YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet, address

J. C. CLAIR
Industrial Commissioner
1 Park Row, CHICAGO, ILL.

PATENTS

TRADEMARKS AND COPYRIGHTS

Send your business direct to Washington
Saves time and insures better service

PERSONAL ATTENTION GUARANTEED

25 YEARS' ACTIVE PRACTICE SPECIALTY

"Working on the Failures of Others"

Siggers & Siggers

PATENT LAWYERS

Suite 20-25 National Union Bldg. — WASHINGTON D. C.

PATENTS PATENTS

Save money and time by sending your :: matters to me ::

TRADE-MARKS
DESIGNS
COPYRIGHTS

E. S. DUVALL
Washington, D. C.
LOAN & TRUST BUILDING

KENT POCKET METERS

Are standard and most reliable. "Dead Beat"

Accuracy Guaranteed

Volt-Ammeters: 0-6 volts, 0-30 amperes, $6.00. 0-10 volts, 0-30 amperes, $7.00. Ampere-Meters: 0-30 amperes, $4.00. Volt-Meters, 0-9 volts, $4.00. 0-15 or 20 volts, $5.00.

Atwater Kent Mfg. Works
116 North Sixth Street
PHILADELPHIA, PA.

MANUFACTURERS

Contemplating establishing plant in the West should take advantage of a location on

THE NORTH-WESTERN LINE

Chicago & North-Western Ry.

which reaches the famous

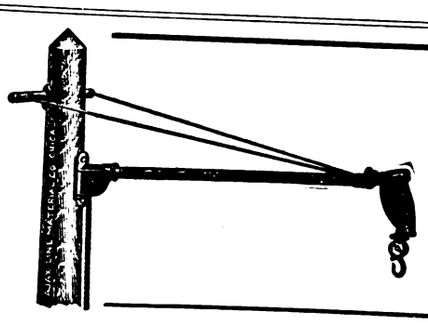
WATER POWERS,
COAL FIELDS,
IRON ORE RANGES,
HARD AND SOFT LUMBER DISTRICTS,
MINING DISTRICTS

of the West and Northwest, and affords the best means of transportation to the markets of the world.

FOR FURTHER PARTICULARS APPLY TO

MARVIN HUGHITT, Jr., Freight Traffic Manager. E. D. EBERHAM, Gen'l Freight Agent.
GEO. BONNELL, Industrial Agent.

NW513 CHICAGO.



AJAX "Academy" Mast-Arm

Ajax Line Material Co.
12 & 14 S. Jefferson St.
CHICAGO

B-S Insulating Paints

For General Electrical Purposes—on the market for twenty-five years

W. E. G. MITCHELL 86 MAIDEN LANE, N. Y. CITY

We also manufacture Various Grades of Insulating Compounds for Special Purposes

Stops Slipping; Preserves the Belt

That's what results from the use of Dixon's Solid Belt Dressing—get a sample

Joseph Dixon Crucible Co., Jersey City, N. J.

ATLANTIC INSULATED WIRE AND CABLE CO.

WIRES AND CABLES

FOR SUBMARINE, AERIAL, UNDERGROUND AND INTERIOR USE

FACTORY STAMFORD, CONN. — 120 LIBERTY STREET NEW YORK CITY

"Southern Mills"

A Southern Monthly Industrial and Electrical Journal

Published at **GREENSBORO, NORTH CAROLINA**

The only journal of its kind published in the South, and as an advertising medium for those wishing to reach all the industries, this journal is unexcelled

SUBSCRIPTION PRICE, $1.50 PER YEAR

The Engineering Press Index Review

Publishes the résumés of all articles appearing in the electrical and other engineering papers the world over.

If you want articles on any subject, you should consult it.

PUBLISHED MONTHLY

Single copy, 1/–; yearly subscription, 10/6.

Technical Press Ass'n
20, rue de la Chancellerie
Brussels

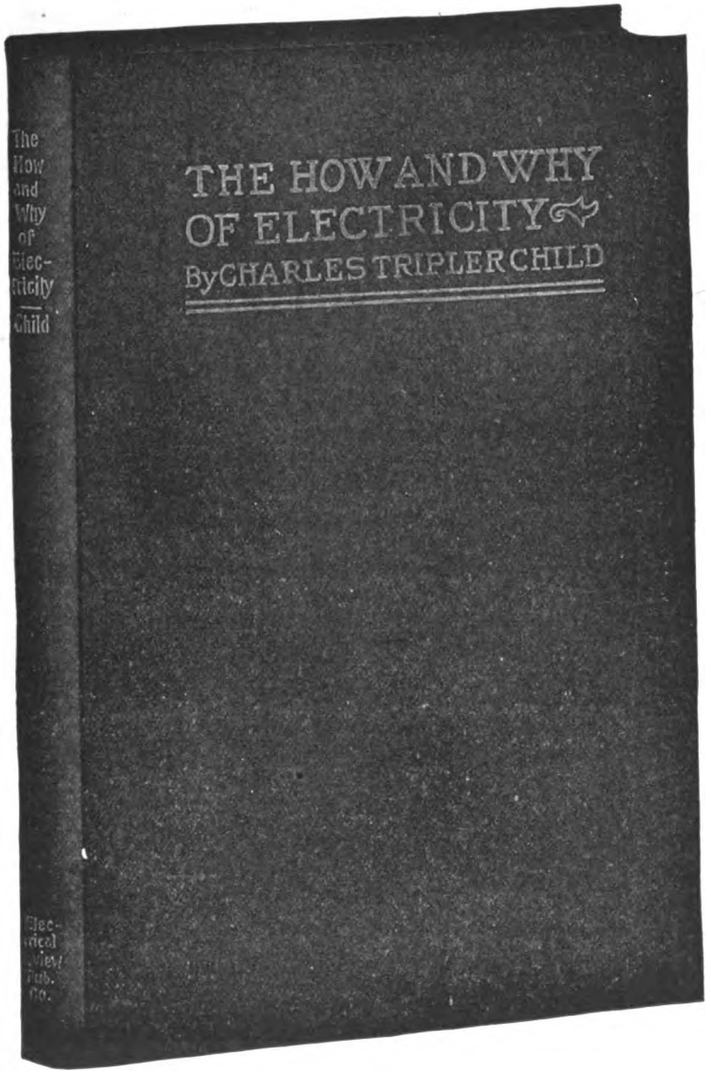
Digitized by Google

Second Edition, Revised and Enlarged Price $1.00, Postage Prepaid

"The How and Why of Electricity"

By Charles Tripler Child

Late Technical Editor of the ELECTRICAL REVIEW



WHILE the added matter has brought the volume up to date in every phase of this study, the original text, as prepared by its brilliant author, remains to entrance the reader. New illustrations have been made where it was deemed possible to further illuminate the explanatory matter. The book contains no mathematics. The phenomena of electricity are treated in splendidly arranged word pictures, and the engineer, the student and the non-technical reader, alike, may be benefited and entertained by this book.

CONTENTS

CHAPTER	
	Preface
I	The Electric Current
II	The Electric Battery
III	The Effects of Electric Flow in the Circuit—Heat and Chemical Action
IV	The Effects of Electric Flow Outside the Circuit—Magnetism and Induction—The Electrical Units
V	Electromagnets—The Telegraph
VI	Electric Signaling Apparatus
VII	The Relations Between Magnets and Electric Currents
VIII	Induction and Reactive Coils
IX	The Telephone
X	Telephone Accessories
XI	The Mechanical Generation of Electricity
XII	The Dynamo Machine
XIII	Various Types of Dynamo Machines
XIV	Alternators—Polyphase Currents
XV	The Electric Motor
XVI	The Electric Railway
XVII	Polyphase Currents and Motors
XVIII	Electrical Power Transmission
XIX	The Incandescent Light
XX	The Arc Light
XXI	Electrochemistry—Storage Batteries
XXII	Wireless Telegraphy
XXIII	Radiation—X-Rays
XXIV	Recent Theories

"The descriptions are helped out with cuts and diagrams that really explain. We know nothing that gives so much help on a difficult and complex matter in so short a space."—*New York Sun.*

"We can unhesitatingly recommend this book to all non-technical readers, who desire a simple and yet correct account of the different features of modern electrical development."—*Street Railway Journal, New York.*

"An excellent manual of the uses of electricity, and while not intended in any way as a text-book, the work is of much value to readers, both professional and lay."—*National Electrical Contractor.*

"The book is a handy one; just what nine men in ten demand in order to seize rapidly the practical side of electricity."—*San Francisco Chronicle.*

"Is admirably adapted to instruct the non-technical reader who is interested in that subject. * * * Mr. Child enjoyed a high reputation for the clearness and intelligibility of his writing, and the volume in question exhibits these qualities."—*New York Tribune.*

"Mr. Child has left a good book; one that we can heartily commend to the non-technical readers for whom it was written; they will not be led astray by platitudinous nonsense, but will receive solid, exact information, if simply expressed."—*Western Electrician, Chicago.*

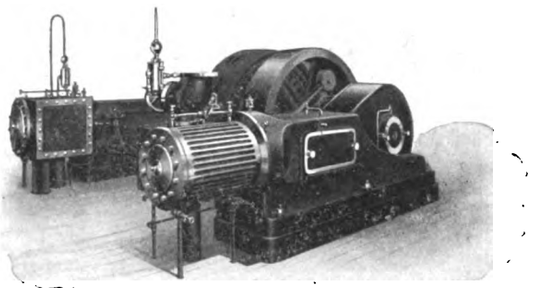
"In spite of the great mass of electrical literature already existing it is one of the first good books of its kind. * * * It will find a large circle of readers on its evident merits."—*Engineering News, New York.*

ELECTRICAL REVIEW PUBLISHING CO.

Book Department 13 PARK ROW, NEW YORK

Digitized by Google

1881 AUTOMATIC and CORLISS FOR 1906 ELECTRIC and POWER SERVICE



Our reputation for building a high-grade engine in the past is fully sustained by our product to-day, which is superior in workmanship, material and design to anything we have ever put on the market.

THE BALL ENGINE CO.
ERIE, PA.

Secor Kerosene Oil Engines

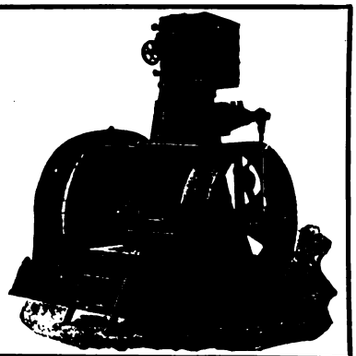
Guaranteed to govern within 2 per cent.
In operation at our show room, 126 Liberty Street

HIGH DUTY
Groshon Pumping Engines
Write for particulars

Marine Engine & Machine Co.
Works: Harrison, N. J. Office: 126 Liberty St., New York

Do You Want An Engine
with every part easy of access and extremely simple in detail?

SHEPHERD ENGINES
will fill the bill. Their simplicity, ease of operation, economy and reliability make them particularly adaptable for electric light and power station work.

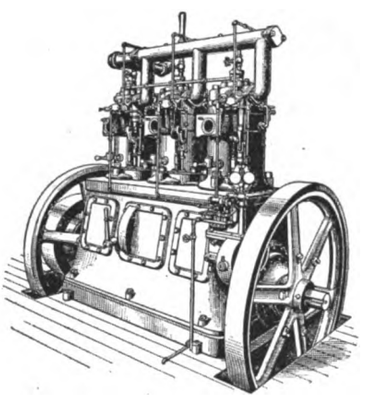


SHEPHERD ENGINEERING CO.
FRANKLIN, PA. 3

WIRT RHEOSTATS
THE RECOGNIZED STANDARD
THE WIRT ELECTRIC CO., INC.
PHILADELPHIA
NEW YORK CHICAGO

The Platt Iron Works Co.
Dayton, Ohio, U.S.A.

Pumping Machinery — *Water Wheels*
Air Compressors — *Condensers*
Oil Mill Machinery — *Feed Water Heaters*
Agencies in Principal Cities.



THE DIESEL OIL ENGINE
does away with all

Firemen	Feed Water Pumps	Coal Bins
Boilers	Smoke Stacks	Boiler House
Steam Piping	Stand-by Losses	Etc.

The Diesel is an oil engine that burns the cheapest kind of crude and fuel oils and distillates. It is simple to run, absolutely reliable and the speed regulation equal to that of the best types of steam engine.

With oil at 3½ cents per gallon we guarantee under bond the cost of fuel for 100 Brake Horse Power Hours not to exceed 28 cents at full load, and 33¼ cents at half load.

VALUABLE LITERATURE UPON REQUEST

The American Diesel Engine Co.
11 BROADWAY, NEW YORK CITY
Western Office: Traction Bldg., Indianapolis, Ind.

OTTO ENGINES

Unsolicited Praise

OTTO OTTO

Farrand Bros., proprietors of the Lakeside Stock Farm, Colon, Michigan, write: "Our engine has run nine years without trouble, but all machinery is bound to wear out." They then ask for platinum with which to tip the electrodes,—a trifling and inexpensive repair. *Nine years* and just beginning to need attention. The average life of the *cheaper* makes is about *five* years. There is a moral in this for the prospective buyer,—Get the "Otto" for long life, and no trouble.

OTTO GAS ENGINE WORKS, Phila, Pa.
STANDARD OF THE WORLD

WHY THROW AWAY GREATER PART OF YOUR COAL

YOU CAN SELL IT FOR THREE TIMES ITS COST BY INSTALLING OUR SYSTEM OF EXHAUST STEAM HEATING

The following points should be worthy of your consideration

Saving in Cost of Labor

Saving in Cost of Fuel

Reduced Cost of Fire Insurance

Reduced Cost of Boiler Insurance

INCREASED PROFITS

Let Us Tell You About Them

AMERICAN DISTRICT STEAM CO.

Main Offices: LOCKPORT, N. Y.

Western Offices: MONADNOCK BLDG., CHICAGO

CHICAGO EDISON COMPANY REPAIR SHOPS

76 MARKET STREET, CHICAGO. TELEPHONE, MAIN 1280

FIRST-CLASS EQUIPMENT THROUGHOUT

DYNAMOS, ARMATURES, MOTORS, ARC LAMPS, INSTRUMENTS

High-Grade Machine Work of all kinds. Correspondence Solicited

---

THE BABCOCK & WILCOX CO.

85 LIBERTY ST. NEW YORK

CABLE ADDRESS "BABCOCK" NEW YORK "GLOVEBOXES" ALL FOREIGN OFFICES

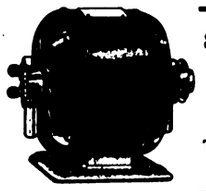
STEAM

WATER TUBE BOILERS

SEND FOR OUR BOOK "STEAM"

BOSTON 53 FEDERAL ST. PHILADELPHIA NORTH AMERICAN BLDG. SAN FRANCISCO 03 FIRST ST. CHICAGO NEW ORLEANS DENVER. COL. 1421 FIFTEENTH ST. ATLANTA, GA. 1027 EMPIRE BLDG. MEXICO CITY HAVANA, CUBA

How did you learn the addresses on this page? Tell the advertiser WHEN YOU WRITE to him.



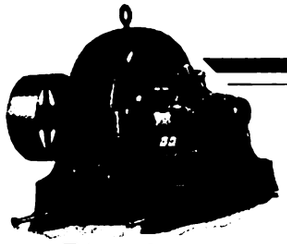
SMALL MOTORS

For Alternating Current 1/40 to 1/2 H.-P.
Direct Current 1/20 to 2 H.-P.

WRITE FOR BULLETINS

THE EMERSON ELECTRIC MFG. CO., ST. LOUIS, MO.

EASTERN OFFICE AND WAREHOUSE, 136 LIBERTY ST., NEW YORK CITY



We do not build very large dynamos and motors and we do not build alternating current machines.

But we do build a limited line of (from hp. to hp.) D. C. generators and motors that haven't a superior for reliability and overload capacity.

If you're a user, present or prospective, of Direct Current dynamos and motors it will pay you to investigate ours.

Catalogues upon request.

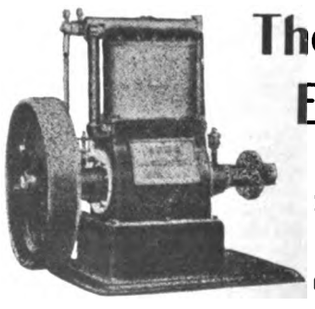
American Engine Co.,

48 RARITAN AVE., BOUND BROOK, N. J.

(1)

SIZES ½, 1, 2, 3, 4, 5 and 8 H. P. on one hundred pounds steam pressure Bed Plates furnished to meet the requirements of any build of dynamo. Will run smooth and steady at any speed from 100 to 800 revolutions per minute. Governor regulates to within 2% from no load to full load.

Send for Catalogue.



The Acme Engine

Rochester Machine Tool Works Limited

Rochester, N.Y., U. S. A.

(2)

Digitized by Google

THE BUCKEYE GAS ENGINE

SIMPLE – ECONOMICAL – DURABLE

ESPECIALLY ADAPTED TO DRIVING ELECTRIC GENERATORS

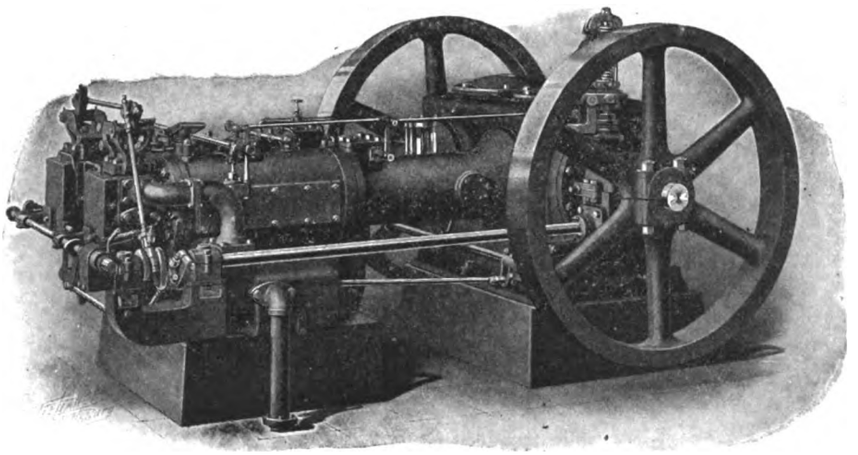
BUILT BY BUCKEYE ENGINE CO., SALEM, OHIO

TYPES

SINGLE-ACTING TWO-STROKE CYCLE

DOUBLE-ACTING TWO-STROKE CYCLE

DOUBLE-ACTING FOUR-STROKE CYCLE



POWERS

25 HORSE-POWER TO 500 HORSE-POWER

500 HORSE-POWER TO 6000 HORSE-POWER

500 HORSE-POWER TO 6000 HORSE-POWER

WE STILL MAINTAIN OUR REPUTATION FOR INDEPENDENT THOUGHT AND ACTION, AND FOR KEEPING ABREAST OF THE TIMES; AND IN PRESENTING THE BUCKEYE GAS ENGINE, ENGINEERS AND PURCHASERS WILL NOTE THAT WE ARE ORIGINATORS AND LEADERS IN THIS NEW LINE, AS WE ALWAYS HAVE BEEN IN OUR STEAM ENGINE PRACTICE.

WE CUT FROM NEW CLOTH

WRITE US WHEN WANTING EITHER GAS OR STEAM ENGINES

CLASSIFIED INDEX—(*Continued from page 29*)

MAGNETIC CLUTCHES
The Electric Controller & Supply Co.

MAGNETIC FRICTION BRAKES
The Electric Controller & Supply Co.

MAGNETIC SOLENOIDS
The Electric Controller & Supply Co.
Cutler-Hammer Mfg. Co.

MAGNETIC SWITCH CONTROLLERS FOR LARGE MOTORS
The Electric Controller & Supply Co.
Cutler-Hammer Mfg. Co.

MAST-ARMS
T. H. Brady

MECHANICAL DRAFT
Green Fuel Economizer Co.

METAL POLISH
L. B. Allen & Co., Inc.

METERS
Doubleday-Hill Electric Co.
Duncan Electric Mfg. Co.
Fort Wayne Electric Works
General Electric Co.
Queen & Co., Inc.
Westinghouse Electric & Mfg. Co.
Weston Electrical Instrument Co.

MINING MACHINERY
Allis-Chalmers Co.
Jeffrey Mfg. Co.

MOULDING BOXES
John L. Gleason

NAME-PLATES
Schwerdtle Stamp Co., The

OUTLET BOXES
Bossert Electric Construction Co.
Chicago Fuse Wire & Mfg. Co.
Crouse-Hinds Co.
Sarco Co.
Steel City Electric Co.

PAINT
Massachusetts Chemical Co.
Standard Paint Co.

PANEL-BOARDS
Waterbury & Co.
Wesco Supply Co.

PATENT SOLICITORS
Clement, Edward E.
Duval, Edw. S
Hamilton, James
Siggers & Siggers
Stevens & Co., Milo B
Woodworth, George K.

PHOTOMETERS
Dwyer Machine Co.
Electric Motor & Equipment Co.
Queen & Co., Inc.

PHOTOMETER STANDARDS
Electrical Testing Laboratories

PINIONS
New Process Raw Hide Co.

PLATINUM PRODUCTS
Baker & Co., Inc.

PLATINUM WIRE AND SHEET, PLATINUM CRUCIBLES AND DISHES, PLATINUM RIVETS
Baker & Co., Inc.

POLES, BRACKETS, PINS, TIES, CROSS-ARMS, CLIMBERS, ETC.
Brady, T. H.
Doubleday-Hill Electric Co.
Klein & Sons, Mathias
Northern Electric & Machine Co.

PUMPS
Platt Iron Works Co.

PUMPING MACHINERY
Allis-Chalmers Co.
Platt Iron Works Co.

PUSH-BUTTONS
Marshall Electric Mfg. Co.
Partrick, Carter & Wilkins Co.
Sarco Co.

RAIL-BONDS
Chase-Shawmut Co.
General Electric Co.
Roebling's Sons Co., John A.

RAILROADS, STEAM
Chicago & Alton R. R.
Chicago & Northwestern R. R.
Illinois Central R. R.
N. Y. Central & Hudson River R. R.

RAILWAY SPECIALTIES, ELECTRIC
Anderson, Albert & J. M.
Bunnell & Co., J. H.
Central Electric Co.

RAILWAY SPECIALTIES, ELECTRIC
Continuous Rail Joint Co. of America
Doubleday-Hill Electric Co.
General Electric Co.
Steel City Electric Co.
Stuart-Howland Co.
Wesco Supply Co.
Westinghouse Electric & Mfg. Co.

REFLECTORS
Frink, I. P.
Holophane Glass Co
Northern Electric & Machine Co.
Phœnix Glass Co.
Sarco Co.
Wheeler Reflector Co.
Wirt Electric Co.

REPAIRS
Chicago Edison Co.
Waterbury & Co.

REPLACERS, INCANDESCENT LAMP
Morse, Frank W.

RESISTANCE BANKS AND UNITS
The Electric Controller & Supply Co.
Cutler-Hammer Mfg. Co.

RESISTANCES
Cutler-Hammer Mfg. Co.
Simplex Electric Heating Co.

REVERSING CONTROLLERS FOR CRANES AND SIMILAR SERVICE
The Electric Controller & Supply Co.
Cutler-Hammer Mfg. Co.

RHEOSTATS
Cutler-Hammer Mfg. Co.
Cutter Electrical & Mfg. Co.
General Electric Co.
Simplex Electric Heating Co.
Westinghouse Electric & Mfg. Co.
Wirt Electric Co.

RINGS, WIRE DISTRIBUTING
Star Expansion Bolt Co.

RUBBER SPECIALTIES
Dickinson Hard Rubber Co.

RUBBER MILL MACHINERY
Aiton Machine Co.

SCHOOLS
Polytechnic Institute of Brooklyn
Rose Polytechnic Institute

SEALS
Schwerdtle Stamp Co., The

SHADES
Frink, I. P.
Hubbell, Harvey
Northern Electric & Machine Co
Wheeler Reflector Co.

SHADEHOLDERS
Hubbell, Harvey

SIGNS, ELECTRIC
Electric Motor & Equipment Co.

SOCKETS
Freeman Electric Co., E. H.
Hubbell, Harvey
Marshall Electric Mfg. Co.
Northern Electric & Machine Co.
Paiste Co., H. T.
Pass & Seymour Co.
Sears, Henry D.
Stewart Electric Co., Frank H.
Trumbull Electric Mfg. Co.
Yost Electric Mfg. Co.

SOLDERING STICKS AND PASTE
Allen & Co., L. B.
Atlantic Mfg. Co.
Burnley Battery & Mfg. Co.
Dunton & Co., M. W.
Standard Chemical Co.

SPARK COILS
Queen & Co., Inc.

SPARKING POINTS
Baker & Co., Inc.

SPECIAL OVERLOAD NO-VOLTAGE AND RESET CIRCUIT-BREAKERS
The Electric Controller & Supply Co.
Cutler-Hammer Mfg. Co.

SPECIALTIES
Barron & Co., Jas. S.
Doubleday-Hill Electric Co.
Marshall Electric Mfg. Co.
Morse, Frank W.
Novelty Electric Co.
Pass & Seymour Co.
Phelps Co.

(*Continued on page 53*)

Digitized by Google

DIRECTORY OF ENGINEERS

ELECTRICAL MECHANICAL CONSULTING

CONTRACTORS SPECIAL INTERESTS

C. E. F. AHLM
Consulting, Electrical and Mechanical Engineer
Designs and Specifications
Expert in the Design of Lifting Magnets
614-615 Caxton Bldg., Cleveland, O.

E. R. Carichoff, M. A.
M. AM. INST. E. E.
SPECIALTIES
Electric Elevators and Motor Control
Inventions and Patent Cases
20 BROAD STREET, NEW YORK

DODGE & DAY
ENGINEERS
Mechanical, Electrical, Architectural
Philadelphia, Penn.
Layout, construction and equipment of industrial establishments.
Send for Our New Bulletin 175
"A MODERN INDUSTRIAL PLANT"

GEO. T. HANCHETT,
CONSULTING AND ELECTRICAL ENGINEER.
114 LIBERTY STREET, NEW YORK.

THE ARNOLD COMPANY
ENGINEERS
CONSTRUCTORS
ELECTRICAL—CIVIL—MECHANICAL
181 La Salle Street
CHICAGO

EDWARD E. CLEMENT
CONSULTING ENGINEER
PATENT ATTORNEY
Expert Opinions, Testimony in Court Cases, Reports on Validity and Infringement, Perfecting and Developing of Inventions. Patents and Patent Causes.
OFFICE
McGILL BUILDING, WASHINGTON, D. C.

W. L. Fergus & Co.
CONSULTING MECHANICAL AND ELECTRICAL ENGINEERS
1509 Fisher Building, CHICAGO

HENRY H. HUMPHREY
CONSULTING ENGINEER
Central Lighting Stations
Electric Power Transmission
SUITE 1305, CHEMICAL BLDG., ST. LOUIS

W. S. Barstow & Company
ENGINEERS
56 Pine Street New York
Failing Building, Portland, Oregon

WM. R. C. CORSON
CONSULTING ENGINEER
Plans, specifications, superintendence of factory, power and lighting installations.
Investigations of electrolysis of underground structures.
Electric machine design.
Reports, Laboratory tests and experiments.
36 PEARL ST., HARTFORD, CT.

HORATIO A. FOSTER
Electrical Engineer
Consultation and reports upon new projects. Investigation of lighting, railway and power properties.
650 BULLITT BUILDING
PHILADELPHIA, PA.

Iron City Engineering Company
CONTRACTING ELECTRICAL ENGINEERS
Power and Light Installations
Bell L. D. Tel. 1599 Court
Frick Bldg. Pittsburg, Pa.

PUTNAM A. BATES
CONSULTING
ELECTRICAL ENGINEER
42 BROADWAY, NEW YORK CITY

F. W. Darlington
MEM. A. I. E. E.
CONSULTING ELECTRICAL AND MECHANICAL ENGINEER
1120 Real Estate Trust Bldg. Philadelphia, Pa.
Expert Testimony, Estimates, Plans, Specifications, and Superintendence. Electric Railways, Electric Power, Electric Light, Steam Plants.

J. H. HALLBERG
CONSULTING ENGINEER
Electric Light, Power and Railway Plants—Suggestions to Secure Economy, Specifications, Examinations and Reports.
45 BROADWAY NEW YORK
Long-Distance Telephone 4578 Broad

THE JOHN F. KELLY ENGINEERING CO.
Consulting and Contracting Engineers
149 BROADWAY, NEW YORK
'Phone-7359 Cortlandt

H. M. BYLLESBY & CO.
(Incorporated)
ENGINEERS
AMERICAN TRUST BLDG.
CHICAGO, ILL.

Electrical Review Publishing Co.
13 Park Row, New York
We will mail, postage prepaid, any scientific book published on receipt of price

EDWARD H. KITFIELD
MECHANICAL ENGINEER
53 STATE ST., BOSTON
Electric Lighting and Street Railway Power Stations and Buildings

VULCANIZED FIBRE
Highest grade for electrical insulation and mechanical purposes. In sheets, tubes rods and special shapes
CATALOGUE AND SAMPLES ON APPLICATION
AMERICAN VULCANIZED FIBRE CO.
WILMINGTON, DEL.

THE PHOSPHOR BRONZE SMELTING CO. LIMITED.
2200 WASHINGTON AVE. PHILADELPHIA
ELEPHANT BRAND PHOSPHOR-BRONZE
INGOTS, CASTINGS, WIRE, RODS, SHEETS, ETC.
—DELTA METAL—
CASTINGS, STAMPINGS AND FORGINGS.
ORIGINAL AND SOLE MAKERS IN THE U.S.

WATER-TUBE BOILERS
STIRLING, A. & T. HORIZONTAL AND CAHALL VERTICAL
STOKERS AND SUPERHEATERS
The Stirling Consolidated Boiler Company
GENERAL OFFICES
Trinity Building, New York
Works
BARBERTON, OHIO
Works
MANSFIELD, OHIO

Digitized by Google

ELECTRICAL MECHANICAL CONSULTING

DIRECTORY OF ENGINEERS

CONTRACTORS SPECIAL INTERESTS

EDWARD R. KNOWLES
ELECTRICAL, CIVIL AND MECHANICAL ENGINEER
Consulting Expert
Industrial Engineering in all its branches. Remodeling Power, Light and Heat Installations Gas Engine and Producer Power Systems.

SAMUEL G. McMEEN KEMPSTER B. MILLER
McMEEN & MILLER
TELEPHONE ENGINEERS
Complete Plans, Special Reports
Laboratory Certificates, Telephone Patents Solicited
1454 to 1457 Monadnock Block - - - CHICAGO, ILLINOIS

LE ROY W. STANTON
CONSULTING TELEPHONE ENGINEER
Plans, Specifications and Supervision of Installation of Complete Telephone Plants. Special Reports on Telephone Properties and Apparatus.
611 Electrical Building, Cleveland, Ohio.

VAN RENSSELAER LANSINGH,
Illuminating Engineer
Telephone 6925-6926 Cortlandt
227 Fulton St. NEW YORK CITY

RALPH D. MERSHON
CONSULTING ELECTRICAL AND MECHANICAL ENGINEER
Estimates, Reports, Plans, Specifications and Supervision of Electric Lighting, Railway and Power Plants.
Long Distance Power Transmission.
NEW YORK: 60 Wall Street
MONTREAL: Street Railway Chambers

Warren B. Reed
Consulting Engineer
Lighting Plants, Power Plants, Street Railroads
Wiring Plans and Specifications
Estimates, Inspection, Supervision
1013 Hibernia Bank Building
Long Distance 'Phone Main 878
NEW ORLEANS, U. S. A.

FITZHUGH TOWNSEND
ELECTRICAL ENGINEER
Electrical Designs and Calculations, Investigation and Development of Inventions, Electrical Enterprises, Tests and Measurements.
45 BROADWAY and 117TH ST. & AMSTERDAM AVE. } N. Y. CITY

LAMAR LYNDON,
CONSULTING ELECTRICAL ENGINEER.
Long Distance Power Transmission and Alternating Current Problems a Specialty.
60 WILLIAM STREET, NEW YORK.

New England Engineering Co.
100 BROADWAY, NEW YORK — WATERBURY, CONN.
Electric Railways, Electric Light and Power Plants, Gas and Waterworks, or any other engineering installations built or remodeled.

W. H. SCHOTT
ENGINEER
1100 to 1128 American Trust Bldg.
CHICAGO
DESIGNER AND BUILDER—Central Station Heating, Gas, Electric Light, Water Works and Power Plants.

J. G. WHITE & COMPANY
INCORPORATED
ENGINEERS CONTRACTORS
43-49 Exchange Place, 41-43 Wall Street
New York, N. Y.
LONDON CORRESP'D'TS: J. G. WHITE & CO., Ltd. 9 Cloak Lane, Cannon Street
CANADIAN CORRESP'D'TS: CANADIAN WHITE COMPANY, Montreal
Principal Philippine Office: Manila, P. I.

ENGINEERS appearing in this department may be sure that their addresses are in the most conspicuous location for the electrical industry

CLASSIFIED INDEX—(*Continued from page 51*)

SPECIALTIES
Sarco Co.
Wesco Supply Co.
Yost Electric Mfg. Co.
SPLICING COMPOUNDS
Massachusetts Chemical Co.
SPRINGS
Cary Spring Works
STANDARD CELLS
Weston Electrical Instrument Co.
STAPLES
Blake Signal & Mfg. Co.
STEAM SPECIALTIES
American District Steam Co.
New Process Raw Hide Co.
Robertson & Sons, Jas. L.
STEEL
American Bridge Co.
STEEL STAMPS
Schwerdtle Stamp Co., The
STENCILS
Schwerdtle Stamp Co., The
STOKERS
Westinghouse Machine Co.
STORAGE BATTERIES
American Battery Co.
Electric Storage Battery Co.
General Storage Battery Co.
Gould Storage Battery Co.
National Battery Co.
Tray Plate Battery Co.
Willard Storage Battery Co.
SWITCHBOARDS
{ Allis-Chalmers Co. / Bullock Electric Mfg. Co. }
Bossert Electric Construction Co.
Doubleday-Hill Electric Co.
Fort Wayne Electric Works
General Electric Co.
Trumbull Electric Mfg. Co.
Wagner Electric Mfg. Co.
Waterbury & Co.
Western Electric Co.
Wesco Supply Co.
Westinghouse Electric & Mfg. Co.
SWITCHBOARD MATS
Massachusetts Chemical Co.
SWITCHES, ETC.
Central Electric Co.
Chase-Shawmut Co.
Cutler-Hammer Mfg. Co.
Cutter Electrical Mfg. Co.

SWITCHES, ETC.
Doubleday-Hill Electric Co.
Electric Controller & Supply Co.
Electric Motor & Equipment Co.
General Electric Co.
Hart & Hegeman Mfg. Co.
Hart Mfg. Co.
Lawrence Electric Co., F. D.
Marshall Electric Mfg. Co.
Partrick, Carter & Wilkins Co.
Sarco Co.
Trumbull Electric Mfg. Co.
Western Electric Co.
Wesco Supply Co.
Westinghouse Electric & Mfg. Co.
TABLET BOARDS
Doubleday-Hill Electric Co.
TAPE AND SPLICING COMPOUND
Doubleday-Hill Electric Co.
Massachusetts Chemical Co.
Okonite Co.
TELEGRAPH SUPPLIES
Bunnell & Co., J. H.
Stuart-Howland Co.
Wesco Supply Co.
TELEPHONES
American Electric Telephone Co.
Atwater-Kent Mfg. Co.
Automatic Electric Co.
Central Electric Co.
Connecticut Tel. & Elec. Co.
Couch Co., S. H.
Doubleday-Hill Electric Co.
Kellogg Switchboard & Supply Co.
Manhattan Electrical Supply Co.
Novelty Electric Co.
Stanley & Patterson
Stromberg-Carlson Tel. Mfg. Co.
Wesco Supply Co.
Western Electric Co.
TELEPHONE SERVICE
American Bell Telephone Co.
New York Telephone Co.
THEATRE DIMMERS
Cutler-Hammer Mfg. Co.
Simplex Electric Heating Co.
Wirt Electric Co.
TESTING
Electrical Testing Laboratories
TIME CHECKS
American Railway Supply Co.

TIES, CROSS-ARMS, BRACKETS, PINS, CLIMBERS, ETC.
Central Electric Co.
Klein & Son, Mathias
Morris Co., Elmer P.
TIME SWITCHES
Anderson, Albert & J. M.
Electric Motor & Equipment Co.
TOOLS
Jessops & Sons, Wm.
Klein & Sons, Mathias
TRANSFORMERS
{ Allis-Chalmers Co. / Bullock Electric Mfg. Co. }
Crocker-Wheeler Co.
Doubleday-Hill Electric Co.
Fort Wayne Electric Works
General Electric Co.
Lafayette Electrical Mfg. Co.
National Brake & Electric Co.
New York & Ohio Co.
Stanley-G. I. Electric Mfg. Co.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.
TROLLEY WHEELS
Doubleday-Hill Electric Co
TURBINE GOVERNORS
Allis-Chalmers Co.
Lombard Water-Wheel Gov. Co.
TURBINES, STEAM
Allis-Chalmers Co.
General Electric Co.
Westinghouse Machine Co.
TURBINES, WATER
Allis-Chalmers Co.
Platt Iron Works Co.
UNCOATED ARMATURE TAPES AND SLEEVINGS
Dunton & Co., M. W.
VACUUM DRYING APPARATUS
Devine Co., J. P.
VARNISH, INSULATING
Massachusetts Chemical Co.
Roessler Hasslacher Chemical Co.
Standard Varnish Co.
Sterling Varnish Co.
WATER-POWER PLANTS AND EQUIPMENT
Platt Iron Works Co.

WATER-WHEELS
Allis-Chalmers Co.
Leffel & Co., Jas.
Platt Iron Works Co.
WATER-WHEEL GOVERNORS
Allis-Chalmers Co.
Lombard Water-Wheel Co.
National Water-Wheel Governor Co.
Woodward Governor Co.
WINDING MACHINERY
Aiton Machine Co.
American Insulating Machinery Co.
New England Butt Co.
WIRE CONNECTORS
Doubleday-Hill Electric Co.
WIRES AND CABLES
American Electrical Works
Atlantic Insulated Wire & Cable Co.
Bishop Gutta Percha Co.
Bridgeport Brass Co.
Central Electric Co.
Chicago Fuse Wire Mfg. Co.
Chicago Insulated Wire & Mfg. Co.
Collyer Insulated Wire and Cable Co.
Crescent Insulated Wire & Cable Co.
Dielectric Co. of America
Doubleday-Hill Electric Co.
General Electric Co.
India Rubber & Gutta Percha Insulating Co.
Indiana Rubber & Insulated Wire Co.
Lawrence Electric Co., F. D.
Marion Insulated Wire & Rubber Co.
Moore, Alfred F.
National Conduit & Cable Co.
National India Rubber Co.
New York Insulated Wire Co.
Northern Electric & Machine Co.
Okonite Co., The
Partrick, Carter & Wilkins Co.
Phillips Insulated Wire Co.
Phosphor-Bronze Smelting Co., Ltd.
Roebling's Sons Co., John A.
Safety Insulated Wire & Cable Co.
Simplex Electrical Co.
Standard Underground Cable Co.
Waterbury Co.
Wesco Supply Co.
Western Electric Co.
WIRE ROPE MACHINERY
Aiton Machine Co.

Digitized by Google

The

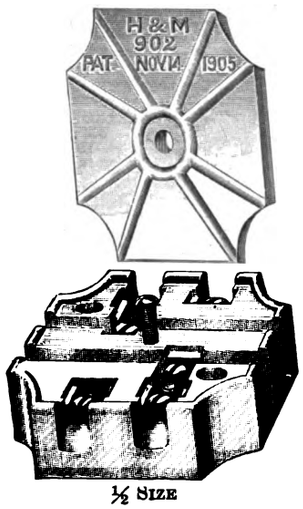
American Bell Telephone Company,

125 Milk Street, Boston, Mass.

H & M Moulding Branch Blocks

Are Approved by the Underwriters' National Electric Association for both Moulding and Cleat Work

WHEN A PLUMBER OR STEAM-FITTER HAS OCCASION TO RUN A BRANCH LINE FROM THE MAIN HE GENERALLY USES A FITTING KNOWN AS A TEE—YOU PROBABLY ARE "WISE" TO THIS. WELL, H & M BRANCH BLOCKS ARE "ELECTRICIANS' TEES." THEY ARE THE FITTINGS WE WANT YOU TO GET "WISE" ON.



½ SIZE

Doesn't it appeal to you as a pretty good method of making branches? Why not have suitable fittings for your wiremen to work with? All you need is an assortment of the six different styles. We make a block for every form of branch. The cut herewith illustrates our No. 902 two-wire main to double two-wire branch. They do away with *all* of the objectionable features of the old method, and make a safer, cheaper, and more up-to-date method of making branches.

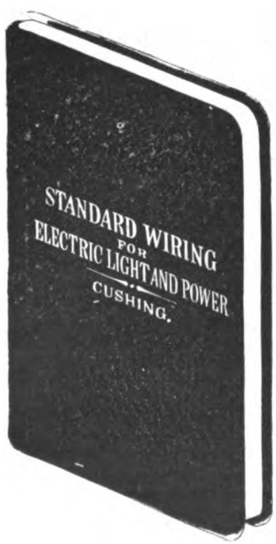
YOUR JOBBER OUGHT TO KNOW
If he doesn't, we do—get "wise" at once

THE ELM CITY ENGINEERING COMPANY
61-65 Orange Street, NEW HAVEN, CONN.

THE 1906 EDITION

Standard Wiring

For Electric Light and Power



By H. C. CUSHING, Jr., A. I. E. E., Electrical Engineer and Inspector.

ADOPTED
By the Fire Underwriters of the United States
By Cornell University, Stanford University and other Technical Colleges and Schools
By over 109,500 Electrical Engineers, Central Station Managers and Wiremen

BECAUSE
It is the only book on Wiring and Construction kept strictly up to date
It contains all the necessary Tables, Rules, Formulas and Illustrations
It settles disputes, and if referred to before wiring will prevent disputes

FLEXIBLE LEATHER COVER (Pocket Size) $1. Sent post paid upon receipt of price, by

ELECTRICAL REVIEW PUBLISHING CO., 13-21 Park Row, NEW YORK

Digitized by Google

You Wouldn't Start a Horse Car Line

in this age of electric cars? Not if you wanted to make money out of the business of transportation.

Then why should you start a manual telephone exchange in this age of automatics if you want to make money out of the telephone business?

The automatic system of telephony bears the same relation to the manual system that the electric car does to the horse car. It is the apotheosis of telephone development, as the electric car is of transportation development.

The automatic telephone system produces the best service more economically than indifferent service can be produced with manual equipment.

There is no more question as to the relative popularity of the automatic and manual telephone service where the two kinds are in competition than there is as to the relative popularity of the trolley car and the horse car.

And, as for the securities—the same comparison may be applied with the same results.

Our Automatic system has been adopted in the following cities:

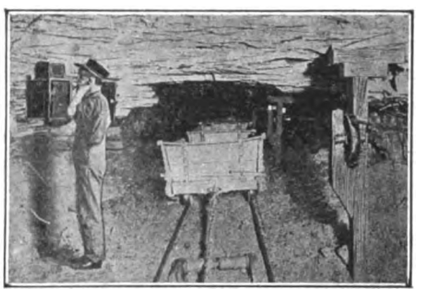
Aberdeen, So. Dak.	Dayton, Ohio	Marion, Ind.	Sioux City, Ia.
Akron, Ohio	El Paso, Texas	Medford, Wis.	South Bend, Ind.
Albuquerque, N. M.	Fall River, Mass.	Miamisburg, Ohio	Spokane, Wash.
Allentown, Pa.	Ferguson, Mo.	Mount Olive, Ill.	Springfield, Mo.
Auburn, Me.	Grand Rapids, Mich.	New Bedford, Mass.	St. Marys, Ohio
Auburn, N. Y.	Hastings, Neb.	Oakland, Cal.	Tacoma, Wash.
Battle Creek, Mich.	Havana, Cuba	Ocean Park, Cal.	Toronto Jct., Can.
Bellingham, Wash.	Hazleton, Pa.	Pentwater, Mich.	Traverse City, Mich.
Berlin, Germany	Hopkinsville, Ky.	Portland, Me.	Urbana, Ill.
Buxton, Iowa	Jonesboro, Ark.	Portland, Ore.	Van Wert, Ohio
Cadillac, Mich.	Lake Benton, Minn.	Princeton, N. J.	Walla Walla, Wash.
Champaign, Ill.	Lewiston, Me.	Richmond, Ind.	Watch Hill, R. I.
Chicago, Ill.	Lincoln, Neb.	Riverside, Cal.	Wausau, Wis.
Clayton, Mo.	Los Angeles, Cal.	San Diego, Cal.	Westerly, R. I.
Cleburne, Texas	Manchester, Ia.	San Francisco, Cal.	Wilmington, Del.
Columbus, Ga.	Marianao, Cuba	Santa Monica, Cal.	Woodstock, N.B., Can.
Columbus, Ohio			

Automatic Electric Company

Van Buren and Morgan Sts., Chicago, U. S. A. 8

The illustration shown below will appeal to the modern and up-to-date Mine Operator. It shows a Stromberg-Carlson Mine-Telephone in daily service.

Estimates promptly submitted on specially designed apparatus for



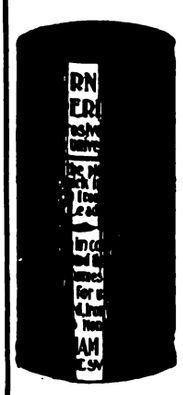
Mining Systems, Steam, Electric and Interurban Railways, Hotels, Manufacturing Plants and Institutions of all kinds.

Down in the Mine.

This instrument has been specially built for this work after a careful study of existing conditions. It is durable, efficient and of great value in the operation of the Mine, and in time of accident its reliability is there at the time you need it most. Ask for Booklet 94-F. Our services are at your command.

STROMBERG-CARLSON TELEPHONE MFG. CO.

ROCHESTER, N. Y. CHICAGO, ILL.



QUICK AND GOOD WORK is the kind that

BURNLEY SOLDERING PASTE (Patented)

will help you to do. Put up in 2 oz., 4 oz., ½ lb., 1 lb., 5 lb., 10 lb. and 50 lb. packages.

Stick and Paste

The Burnley Battery and M'f'g Co.

Painesville, Ohio

DRY BATTERIES

JEFFREY

Elevating—Conveying—Power Transmission Screening—Crushing—Coal Mining—Coal and Rock Drilling—Coal Washing Machinery and Electric Locomotives. Catalogues are yours for the asking. Address

THE JEFFREY MFG. CO.

COLUMBUS, OHIO, U. S. A.

Is Your Time Worth Saving? Then put a Tolophone in your Rosidenco

—

NEW YORK TELEPHONE CO.

15 DEY STREET

How did you learn the addresses on this page? Tell the advertiser WHEN YOU WRITE to him.

60-DAY CLOCKS

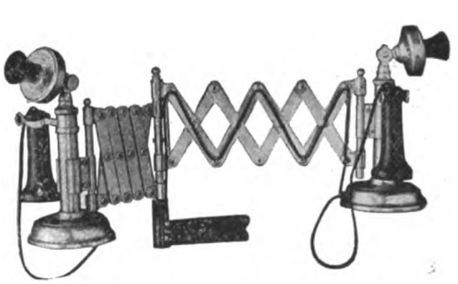
The Prentiss Clock is the only 60-day clock manufactured in the world and keeps perfect time throughout its long run. By its use you are always assured of the correct time and date with a minimum amount of attention on your part.

Also Frying-Pan, Tile, Program, Electric, Synchronized and "Approved" Watchman's Clocks.

Send for Catalogue No. 206.

The Prentiss Clock Improvement Co.

Dept. 20, 49 Dey Street, New York City



Burns' Adjustable Desk Telephone Bracket

IS IN A CLASS BY ITSELF

No. 833 Double Bracket for Roll-top Desk
No. 855 Double Bracket for Flat-top Desk
No. 866 Double Bracket for Table

No. 86

TELEPHONES SWITCHBOARDS

COMPLETE EXCHANGES

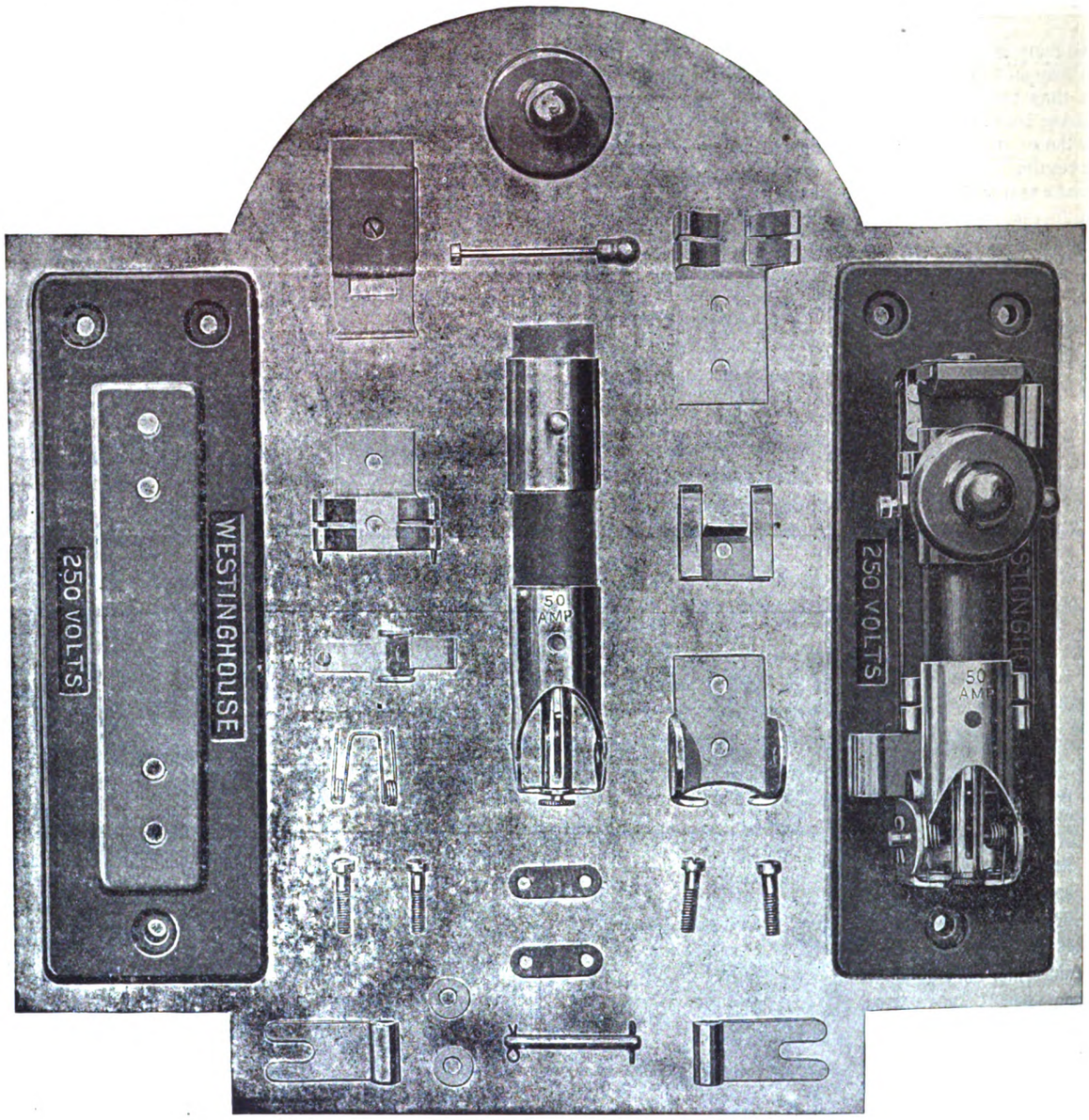
American Electric Telephone Co.

State and 64th Streets, Chicago, Ill.

Digitized by Google

Westinghouse

Type F Circuit Breaker



We illustrate complete, and in detail, a carbon-break circuit breaker which, within its range, is equal to any other breaker of five times its cost.

The Westinghouse Electric & Mfg. Co.

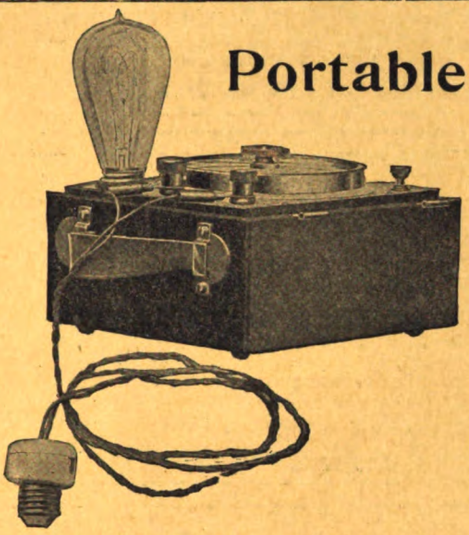
ADDRESS NEAREST DISTRICT OFFICE

Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Los Angeles, Minneapolis, New Orleans, New York, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Seattle, Syracuse

Canada: Canadian Westinghouse Co., Ltd., Hamilton, Ontario Mexico: G. & O. Braniff & Co., City of Mexico

Digitized by Google

Westinghouse



Portable Lamp Testing Volt-Wattmeter

Every Central Station Should Have One

Can be used without change of calibration on either alternating or direct current circuits. Reverse readings not necessary on direct currents. A socket is provided for the lamps to be tested.

There are two concentric scales, one indicating watts, the other volts. The wattage of the lamp or the voltage of the current can be read by using the switch to cut the series windings in or out.

The Westinghouse Electric & Mfg. Co.

Address nearest District Office

Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Los Angeles, Minneapolis, New Orleans, New York, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Seattle, Syracuse

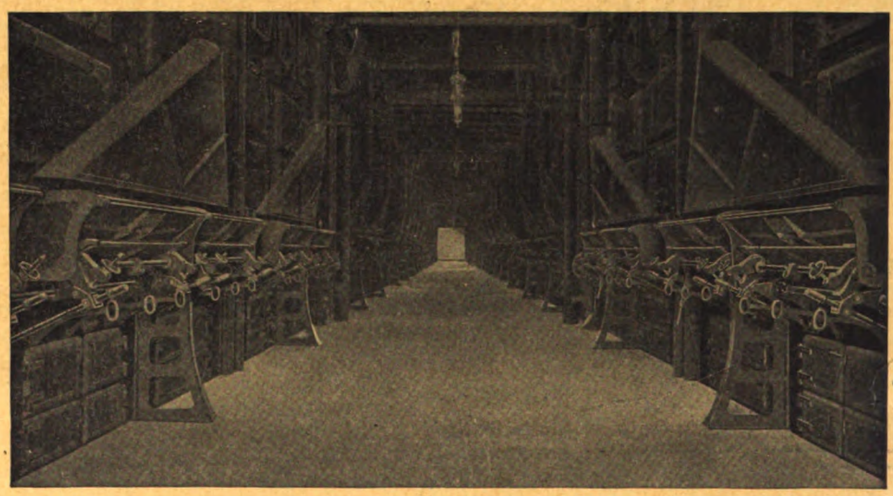
Canada: Canadian Westinghouse Co., Ltd., Hamilton, Ontario

Mexico: G. & O. Braniff & Co., City of Mexico

The Roney Stoker

Simplicity of Operation

is a marked characteristic: two simple adjustments, both within the comprehension of the ordinary fireman, control the whole action of the stoker, forcing, checking or banking the fire at will.



19,000 H. P. of Roney Stokers on second floor of boiler room, 74th St. Power Station Interborough Rapid Transit Co., New York

The Westinghouse Machine Co.

Designers and Builders of Steam Turbines, Steam Engines, Gas Engines and The Roney Mechanical Stoker

Address nearest sales office for information

New York, 10 Bridge St.
Boston, 131 State St.
Baltimore, Continental Building
Cleveland, New England Building
Chicago, 171 La Salle St.
Cincinnati, Traction Building
Atlanta, Candler Building
St. Louis, Chemical Building
Pittsburg, Westinghouse Building
Philadelphia, N. American Building
Denver, McPhee Building
San Francisco, Hunt, Mirk & Co.

Digitized by Google

Crescent Rubber Insulated WIRES and CABLES

TRADE MARK
CRESCENT INSULATED WIRE & CABLE CO. TRENTON, N.J.

National Code Standard
Crescent Insulated Wire and Cable Co.
New York Office, 53 Barclay St.
Main Office and Factory
Trenton, N. J.

Store Lighting

CLUSTER REFLECTORS
The most satisfactory fixtures for store lighting. Give strong, even light at minimum expense.

SHOW CASE REFLECTORS
for lighting all styles of show cases. Used in many of the finest stores in the country.

FRINK'S SPECIAL PATENT WINDOW REFLECTOR
The only perfect light for show windows. Installed in hundreds of the best stores
CATALOGUE AND ESTIMATES FREE
I. P. Frink, 551 Pearl St., New York

SEAMLESS RUBBER INSULATED
PAPER INSULATED, LEAD ENCASED } WIRE & CABLE

BRANCHES
Chicago, Ill. New Orleans, La.
Pittsburg, Pa. San Francisco, Cal
WATERBURY COMPANY
69 SOUTH STREET NEW YORK

NOTED FOR ITS GREAT DURABILITY
(The spot is our registered trade mark)
SAMSON SPOT CORD
's made of Extra Quality Stock, Hard, Smooth Braid, thoroughly water-proofed, giving minimum abrasion, maximum wear. It stands all sorts of weather.
Send for Samples and Prices.

SAMSON CORDAGE WORKS, - BOSTON, MASS.

BARE and INSULATED COPPER WIRE

Lead Incased Cables

Galvanized Telegraph Wire

John A. Roebling's Son's Co., Trenton, N. J.

AGENCIES AND BRANCHES: NEW YORK CHICAGO CLEVELAND ATLANTA
OAKLAND, Cal. LOS ANGELES PORTLAND, Ore. SEATTLE

NATIONAL ELECTRICAL CODE STANDARDS

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." WEATHER-PROOF SLOW-BURNING WEATHER-PROOF, AND IDEAL WIRE

PRICES AND SAMPLES ON APPLICATION

PHILLIPS INSULATED WIRE COMPANY
Office and Factory, PAWTUCKET, R. I.

FLEXDUCT

THE SUPERIOR CONDUIT FOR INTERIOR WIRING
NATIONAL METAL MOLDING COMPANY
FULTON BUILDING PITTSBURG, PA.

Highest Grade Quality

ELECTRICALLY AND MECHANICALLY BETTER THAN ANY OTHER WIRE MADE

I.X.L. Weather-Proof Slow Burning Weather-Proof Slow-Burning Wire

National Electrical Code Standard

Collyer Insulated Wire & Cable Company, PAWTUCKET RHODE ISLAND

(2)

READ THIS

We CANNOT ADVERTISE all our goods here, but will send Catalogues and circulars FREE FOR THE ASKING.

J. H. BUNNELL & CO., Inc.
20 Park Place, New York

MANUFACTURERS OF

TELEGRAPH INSTRUMENTS, ELECTRICAL APPARATUS AND SUPPLIES.

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

UNIVERSITY OF MICHIGAN
3 9015 08006 9175

Digitized by Google

Digitized by Google